A Natural Resources Inventory for the City of Poughkeepsie

2019

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Executive Summary

Jennifer Rubbo

The City of Poughkeepsie is a small urban area of about 30,000 people located approximately 75 miles north of New York City. It is located mid-way between New York City and Albany and is one of two cities in Dutchess County. The Hudson River borders the City on the west, and the Town of Poughkeepsie borders its remaining sides. In recent years the availability and proximity to natural resources has contributed to the revitalization of Poughkeepsie. Most notably, the scenic beauty of the Hudson River, including the opening of the Walkway Over the Hudson State Park, has increased the visibility of Poughkeepsie as a tourist destination.

Urban and suburban areas worldwide have gained recognition as important contributors to landscape-level conservation efforts. While often regarded as lacking in ecological value, research has shown that small patches of habitat in backyards, tree-lined streets, and in open spaces found in parks are important for many species and perform significant ecosystem services (Bolund & Hunhammar, 1999; Aronson, et al., 2014; Langellotto, et al., 2018). Ecosystem services are the benefits that nature provides for people, and are often divided into categories based on type of service provided (Table 1) (Bolund & Hunhammar, 1999; WWF, 2016; Costanza, et al., 1997). A Natural Resources Inventory (NRI) for the City of Poughkeepsie is a first step at documenting the areas in the City of Poughkeepsie that provide these important ecosystem services and will help us to understand how to become better stewards of our land, air, and water.

Table 1 Ecosystem Services (WWF, 2016)

Ecosystem Services	Examples
Cultural	Recreation and ecotourism, mental and physical health, aesthetic values, spiritual and religious values
Supporting	Nutrient cycling, photosynthesis, soil formation
Regulating	Air quality regulation, climate regulation, water purification and waste treatment, disease and pest regulation
Provisioning	Food, raw materials, medicinal resources, fresh water

What is in the NRI

The Environmental Cooperative at the Vassar Barns completed the Poughkeepsie Natural Resources Inventory over three years, between 2016 and 2019. We worked closely with Vassar College students, faculty, and staff to create maps and write the narrative contained in this report. Throughout the process, the Environmental Cooperative engaged local stakeholders through community meetings and presentations to the City of Poughkeepsie Common Council, Shade Tree Commission, Historic District and Landmark Preservation Commission, and the Waterfront Advisory Council. Hudsonia a local environmental education and research non-profit, completed the habitat map and report titled *Significant Habitats in the City of Poughkeepsie* in 2018, which we have summarized in Chapter 4 of this report, Biological Communities and Habitats. Funding for the NRI and the Significant Habitat Assessment and report was provided in part by a grant from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation.

Natural Resources Inventory Web Map

To facilitate a holistic understanding of natural resources in the City, Vassar student Rebecca O'Dell created a web-map version of the NRI available at https://arcg.is/KWXOG (O'Dell & Cunningham, 2019).

This web-based tool allows a user to find a specific parcel within the City and see all the layers of the NRI for that specific site.

There are seven broad categories in the final Natural Resources Inventory: Geology, Water Resources, Biological Communities and Habitats, Land Use, Recreational Resources, Historical Resources, and Climate Change. In reality, however, these resources are strongly linked, influence one another, and are hard to separate. We have organized this document so the reader can investigate them within stand-alone chapters; however, the reader can gain a more complete assessment of the City by reading the entire document and understanding that each chapter is part of a whole. In total, there are 26 maps in the NRI each highlighting the natural, historic and cultural resources of the City of Poughkeepsie.

Over the years various local organizations have conducted studies about the Natural Resources of Poughkeepsie. We have included some of the past reports in the Appendix of this document, as well as new reports that were created in tandem with this project. We have attempted to reference and provide links to prior work within relevant chapters; however, this is not a complete compilation of all existing information about natural resources in the City of Poughkeepsie. New reports produced for this inventory, and included in full in the Appendix, are:

Appendix A: *Significant Habitats in the City of Poughkeepsie* (Heffernan & Stevens, 2018)

Appendix B: Emerald Ash Borer Management Recommendations for the City of Poughkeepsie (Futterman & Rubbo, 2017)

Appendix C: College Hill Park Invasive Species Survey (Manring, Blass, Curri, & Rubbo, 2018)

Appendix D: Poughkeepsie Scenic Resources Inventory (Land Use, Environmental Planning and Urban Design Workshop, Cornell University, 2018)

Using the NRI

An NRI facilitates a proactive approach to land-use planning. It helps to identify areas that are ecologically important in order to inform development and revitalization in the City. It provides the basis for making decisions in a larger context and assists with issues and goals such as climate resilience, walkable communities, park management, and the equitable distribution of resources across the municipality (Haeckel & Heady, 2014). City officials can use the NRI to revise and update the natural resources section of the City's comprehensive plan, which is the blueprint for future growth and land use in the City. Comprehensive planning offers an important opportunity to recognize, conserve and protect a municipality's natural areas. Planners may use the NRI as a starting point for site development review. Its broad landscape view of natural resources is helpful when paired with site-specific information provided in parcel development (Haeckel & Heady, 2014). NRIs also provide the basis for open space inventories and planning, which prioritize areas for conservation or recreation based on many factors including scenic beauty, historical significance, habitat value, and ecosystem services (Haeckel & Heady, 2014). The NRI can help to encourage intermunicipal coordination of natural resource management with neighboring municipalities. For example, as interest grows in the Fall Kill as a community resource, the NRI will assist Poughkeepsie and adjacent communities in updating the Fall Kill watershed management plan.

To be effective an NRI should be actively used. The City Common Council can formally adopt the NRI by local law to assure its use. Adoption of the NRI would formally integrate it into municipal decision-making (see Appendix G of Haeckel and Heady, 2014 for an example of a Model Local Law to Adopt the NRI). For more information about the uses of an NRI in municipal government and public outreach please see Chapter 6 of "Creating a Natural Resource Inventory: A Guide for Communities in the Hudson River Estuary Watershed" (Haeckel and Heady, 2014).

Perhaps the most impactful action the City of Poughkeepsie can take in regard to natural resources is the development of a Conservation Advisory Council (CAC). A CAC could oversee future environmental, conservation and sustainability initiatives and help to engage residents in the community. A CAC would be responsible for updating of the NRI as well as facilitating future conservation projects.

Natural Areas in Poughkeepsie

As we compiled the maps and narrative for this report, certain areas of the City emerged as "hot spots" of natural and cultural resources. We have briefly described these areas below along with the ecosystem services they provide. Further descriptions of their importance are found in the later chapters of this report. The Poughkeepsie community should not assume that areas left out of this summary are less important. All natural, historic, and cultural areas, regardless of size, have intrinsic value and serve to maintain connections between residents, local history, and the natural environment

Hudson River

The Hudson River is the largest contiguous habitat in the City of Poughkeepsie as well as an important generator of tourism and economic development. With a history of industrial pollution, efforts continue in the cleanup of this important natural resource. The Hudson is home to several threatened and endangered species and is the drinking water source for the City. As an estuary the hydrology of the Hudson is greatly affected by tides. In light of projections for sea level rise and increased flooding, planners should carefully consider development and use of the Hudson River shoreline.

View of the Mid-Hudson Bridge from Waryas Park, Poughkeepsie.
Photo credit: Sarah Salem

Ecosystem Services- Hudson River

Beautification, Habitat, Water Source, History, Recreation, Climate Resilience.

Fall Kill

The last 2.5 miles of this 38-mile creek flows through the City of Poughkeepsie before entering the Hudson River just under the Walkway Over the Hudson. Due to Poughkeepsie's location at the mouth of the Fall Kill, the City's section of the creek receives inputs from the entire 19.5 square mile watershed, influencing the amount of water entering the stream and the water quality. In the City, impervious surfaces, littering, and combined sewer overflows contribute negatively to this stream's water quality and aesthetic value. Local organizations and officials are realizing the potential of this important natural resource to the revitalization of the City. Local non-profits, residents, and City officials are recognizing that stewardship of the stream for habitat, water quality, flood mitigation and a connection to nature in the highly developed Northside neighborhood is increasingly important.

The Fall Kill at Malcolm X Park during a spring creek clean up.
Photo credit: Karl Rabe

Ecosystem Services – Fall Kill

Beautification, Habitat, Flood Control, History, Recreation, Climate resilience

Vassar Farm and Ecological Preserve

Bridging the Town and the City of Poughkeepsie, nearly half of the Vassar Farm and Ecological Preserve is located in the City of Poughkeepsie and is the second largest contiguous natural area within city limits. In addition to providing a variety of habitat types, the Preserve also offers community gardens and hiking trails for public use.

Farm road at the Vassar Farm and Ecological Preserve.
Photo credit: Jen Rubbo

Ecosystem Services – Vassar Farm and Ecological Preserve

Habitat, Flood Control, Water Quality, History, Recreation, Climate Resilience.

Springside (and adjacent privately owned parcels to the south)

Springside is a National Historic Landmark and offers carriage roads and interpretive trails free of charge allowing visitors to experience nature and history together. Alone, Springside offers open space and recreational opportunities. If we combine the adjacent parcels further south that are privately owned and currently undeveloped with the Springside property, the ecosystem services and value of these open spaces increases dramatically.

The Porter's Cottage/Gatehouse at Springside in the City of Poughkeepsie.
© *Sean Hemmerle 2017*

Ecosystem Services - Springside

Beautification, Habitat, History, Recreation, Climate Resilience

College Hill Park

College Hill Park is the largest City-owned park as well as the highest point in the City of Poughkeepsie. The park is one of the largest natural areas in the City. It offers residents impressive views of the surrounding landscape, walking trails, a playground, and a basketball court. Additionally, it is a local historic landmark; home to the Guilford Dudley Memorial Shelter and the Clarence Lown Memorial Rock Garden. It is also the site of the City's water storage.

The pollinator garden at the Clarence Lown Memorial Garden at College Hill Park.
Photo credit: Camelia Manring

Ecosystem Services – College Hill Park

Beautification, Habitat, History, Recreation, and Climate Resilience

Urban Trees

As a Tree City USA for over 40 years, the City of Poughkeepsie has a proud history of tree-lined streets. In recent years, invasive species and pests such as the Emerald Ash Borer have affected trees in the City. In 2018, the City of Poughkeepsie received a grant for a tree inventory, which will facilitate planting and maintenance in the future. Trees can be one of the most cost-effective ways to improve communities: they cool the air, slow runoff, reduce flooding, and beautify neighborhoods. In addition to street trees, trees in backyards, church properties, school yards, and other private areas are equally important and both City officials and residents should consider public education about the maintenance and management of trees

Little Market Street, one of the many tree-lined streets in the City of Poughkeepsie.
Photo credit: Camelia Manring

Ecosystem Services – Urban Trees

Beautification, Habitat, Flood Control, Water Quality, History, Recreation, Climate Resilience

City Department of Public Works and Parcel south

The City Department of Public Works (DPW) is home to one of the only segments of the Fall Kill within City boundaries that is not channelized by stone walls. Located on the DPW site is a portion of an important riparian wetland area that continues north (outside of the City boundary). Just south of the DPW site is a parcel that is undeveloped and contains stream-side forests and wetlands within the floodplain. Due to the lack of channelization, this area floods readily without harming buildings or roads. It is an important flood mitigation area as it is the only segment of the creek in the City of Poughkeepsie where flooding can naturally occur.

Volunteers sampling the Fall Kill near the City of Poughkeepsie DPW during the 2018 AquaBlitz.
Photo credit: Jen Rubbo

Ecosystem Services – City Department of Public Works

Flood control, Water Quality, Habitat, Climate Resilience

Opportunities and Future Projects

Several opportunities for future research and gaps in data were identified in the process of developing this inventory.

Addressing sustainability, climate resilience and adaptation, and environmental stewardship as part of the planning and revitalization of Poughkeepsie will help to increase the quality of life of residents. Residents and City officials should use the information in this NRI alongside site-level assessments, on-the-ground reconnaissance, and local information and knowledge to support responsible decision-making. As with most mapping projects, the data used to create the maps in this report changes quickly. These maps and supporting materials provide a baseline to facilitate future inventories and assessments and identify subjects that merit closer study. To be most effective in the long term, the NRI should be actively used and routinely updated. It is our hope that this document can be guidance for sustainable and conservation-minded development and revitalization of the City of Poughkeepsie.

Additional projects and initiatives that the City might want to pursue include, but are not limited to:

1. Mapping the sewersheds of the MS4 stormdrains in the City of Poughkeepsie.
2. More consistent and frequent water quality monitoring of the Fall Kill and Morgan Lake.
3. Updating the Fall Kill Management Plan.
4. Creating an inventory of and mapping flood occurrences based on records from the City Fire Department on basement pump-outs after large storm events.
5. Inventorying Green Infrastructure sites and identifying and prioritizing future potential sites
6. Surveying invasive plants in parks and along the Fall Kill and creating management plans for the control of these species.
7. Inventorying and managing empty lots that could serve as habitat (even temporarily through the planting of pollinator friendly plants).
8. Using tools such as iTree to determine the value and importance of the City's Urban Forest.

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Chapter 1. Introduction

Camelia Manring, Julia Blass, and Jennifer Rubbo

Poughkeepsie train station.
Photo credit: Camelia Manring

What is an NRI

The City of Poughkeepsie is a small urban area located on the banks of the Hudson River midway between New York City and Albany. The City has been shaped by its natural resources. Native Americans utilized the abundant waterways, rich soils, and productive forests and early settlers took advantage of these resources to drive settlement of the region.

Natural resources in urban areas are often overlooked. As our knowledge of the importance of small habitats and urban ecosystems increases, inventories like this one will become more important as a baseline for further studies about the urban ecology of cities. As revitalization efforts move forward, it is important that we understand the ways our natural resources are providing important services, such as flood protection and climate resiliency. The first step in this effort is to know the location and types of natural resources within a community. Natural resources can include air, land, fresh and saltwater, and habitats such as meadows, forests, and farmland. In an urban area, natural resources are rarely large tracts of land, but instead manifest as smaller entities, such as street trees, community gardens, parks, empty lots, and backyards. The interface between humans and urban natural areas is also important to consider. Wastewater and stormwater infrastructure and park amenities and maintenance are just two examples of how we need to consider our impact on the resources available to us. Additionally, historic and cultural resources are closely linked to the natural environment and can help to document land use patterns and past use of natural resources. Humans consume natural resources for energy, personal fulfillment, health, food, ecosystem services, economic and cultural capital, and more (World Wildlife Fund, 2019). The broad range of human uses for natural resources means that conservation and environmentally sound management of these resources is crucial to the health of both the environment and humanity.

By compiling and interpreting the physical, ecological, biological, historical and cultural assets of a municipality, a natural resource inventory (NRI) is a useful tool for informed land use education and management (Vail, Curri, Chatrchyan, & Carroll, 2010). The Environmental Cooperative at the Vassar Barns has prepared this NRI for the City of Poughkeepsie to help City officials, planners, developers, and residents make informed and environmentally-conscious choices regarding land use in their City. The variety of natural resource data provided in this NRI may enable more sustainable development and help ensure the wellbeing of the City's residents. Consulting the NRI can inform a range of decisions about how to safely and effectively use the land in the City—from habitat preservation to the property zoning. Beyond land use planning, the NRI is also a tool for public education. The NRI can foster a deeper familiarity among Poughkeepsie residents to better understand the richness, accessibility, and distribution of resources in our City.

This NRI is a living document and should be updated to reflect changes in Poughkeepsie's resource base and land use over time. Regular NRI revisions help the City's government and residents make choices about land use based on the most up to date information. It is important to note that the NRI is intended for general planning, education and information purposes and should not be used as a substitute for on-site surveying and data collection.

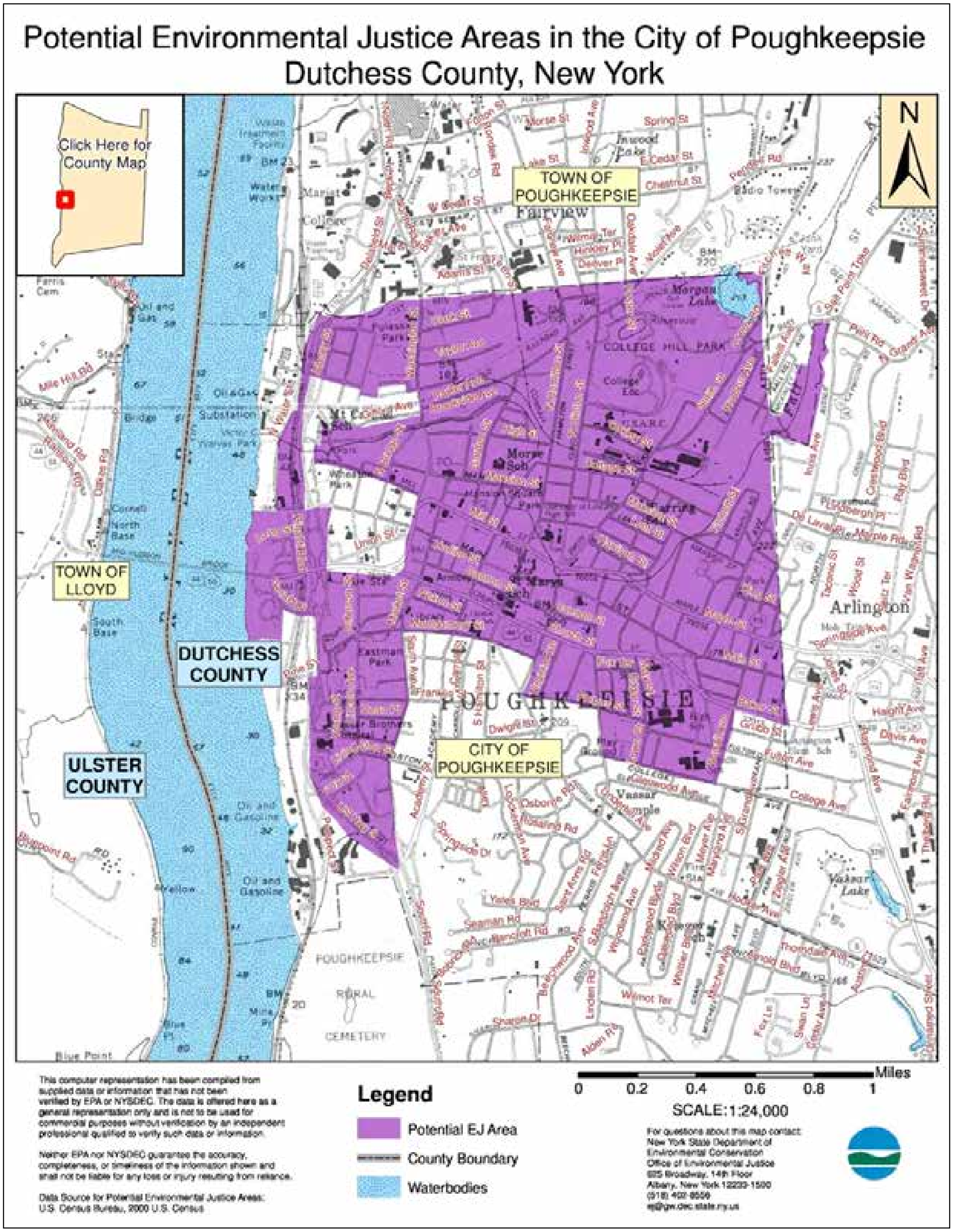
City Profile

The City is bordered by the Town of Poughkeepsie to the North, East, and South, and with the Town of Lloyd in Ulster County, to the west across the Hudson River connected by the Walkway Over the Hudson and the Mid-Hudson Bridge. The following base map and aerial map of the City of Poughkeepsie were created using data from Dutchess County (2015 & 2017), Ulster County (2017), and NYS GIS Clearinghouse (2018) (Map 1.1). These maps provide a basic understanding of the geography of Poughkeepsie and context for the historical, cultural, and natural resources presented throughout the NRI. The City of Poughkeepsie Base Map was used as the basis for the other maps in the NRI. The aerial photo (Map 1.2) was taken in the summer of 2013 and highlights some of the dense greenspaces and impervious surfaces throughout the City. The third introductory map shows the City's topography, showing landforms and hills throughout the city (Map 1.3).

Of the City's total population of 30,267 (US Census Bureau, 2016), 37% are white, 36.5% are black, and 20.2% are Hispanic (US Census Bureau, 2018). The median income is $39,067. Importantly, the highest and lowest income ranges are not evenly distributed across the City (US Census Bureau, 2016). One of the driving factors of socioeconomic class distribution in the City was and continues to be, the East-West Arterial. Since the completion of the Arterial in 1979 (Poughkeepsie-Dutchess County Transportation Council, 1997) as part of Lyndon B. Johnson's "War on Poverty," the City has undergone a social division between residents on the north side of the Arterial, who are generally lower-income, and residents on the south side, who are generally of higher-income (Nasso, 2017). Understanding some of the geographic aspects of demographic distribution and change can inform the ways in which land use decisions impact the lives of residents.

Environmental justice aims to target the disproportionate effects of environmental issues, such as air and water pollution, waste disposal, and climate change on disadvantaged populations most often defined by race and/or socioeconomic status (Peterson & Rynasko, 2008). The New York State Department of Environmental Conservation (NYS DEC) has identified and mapped communities in the State as potential Environmental Justice areas and includes the North side of Poughkeepsie in this designation (Figure 1.1) (NYS Department of Environmental Conservation, 2000). This NRI can aid environmental justice efforts in the City of Poughkeepsie by identifying the spatial distribution of valuable and vulnerable natural resources such as the Fall Kill. The status and health of the Fall Kill is an environmental justice issue, as the stream runs almost exclusively through a low-income area of Poughkeepsie whose residents are more vulnerable to the effects of flooding and water pollution than higher-income residents. (The DEC's map of potential environmental justice areas can be found at their website: https://www.dec.ny.gov/docs/permits_ej_operations_pdf/dutchessej.pdf)

Figure 1.1 Map of Environmental Justice areas in the City of Poughkeepsie



Data and Methods

The Environmental Cooperative at the Vassar Barns was the lead in the preparation of the Poughkeepsie Natural Resource Inventory project; taking place between October of 2016 and May of 2019. Major funding and support came from a grant from the NYS DEC Hudson River Estuary Program. Local stakeholders were given the opportunity to provide input through a series of community meetings. The majority of the work done for the NRI was completed by Vassar College students, staff, and faculty working closely with City of Poughkeepsie administrators, council members, and residents. A broad range of data sources, ranging from local to national, were used to create the NRI. All maps were created using GIS ArcMap software and original sources of data are documented in Appendix E. Maps are projected using the NAD 1983 coordinate system, UTM zone 18N, and are displayed at a 1:19,500 scale. All are based on the following base map (Map 1.1) and have been adjusted to best illustrate the resource(s) depicted.

Natural Resources Inventory Web Map

To facilitate a holistic understanding of natural resources in the City, Vassar student Rebecca O'Dell created a web-map version of the NRI available at https://arcg.is/KWXOG (O'Dell & Cunningham, 2019).

This web-based tool allows a user to find a specific parcel within the City and see all the layers of the NRI for that specific site.

How to Use the NRI

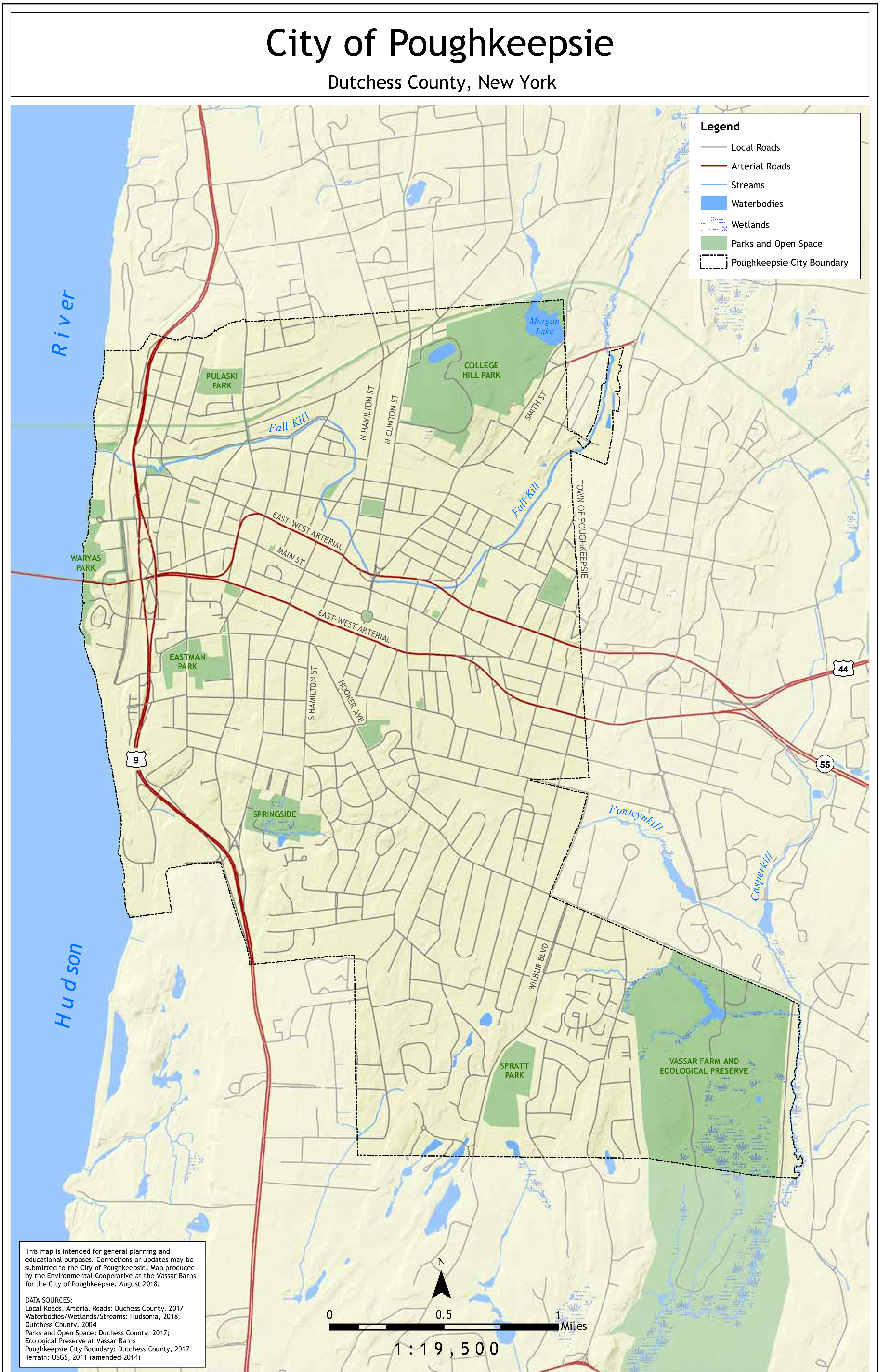
This document was created for use by the City of Poughkeepsie as it moves forward with planning, development, and revitalization. While the maps included in the NRI are useful for the initial and broader stages of planning projects, they are not a substitute for on-site surveys. The NRI is a resource that is especially useful during the conception of new environmentally-sound planning and land use regulations and choices. The City planning department and planning board, City council, and citizen commissions will find the information and maps included in this report useful. Some uses of the NRI include:

- Updating the City comprehensive plan with natural resource and sustainability elements
- Developing plans and goals for natural resource management
- Informing zoning and land use regulations
- Reviewing new development proposals
- Establishing a baseline of environmental conditions in order to monitor and assess the impacts of future planning and development on the environment; and
- Identifying and mitigating potential sources of harm to natural resources.

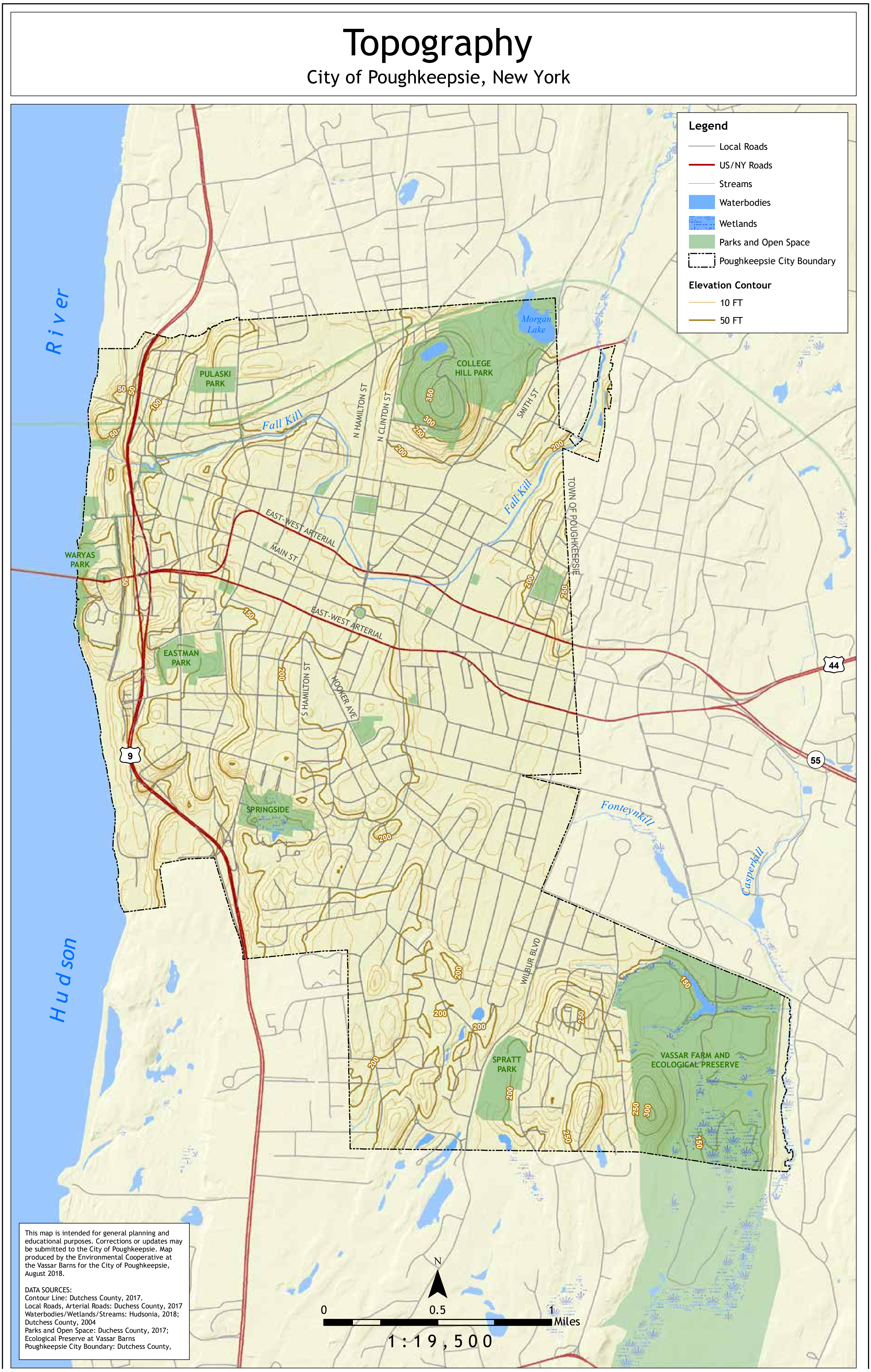
The NRI is an important educational resource. We encourage teachers, students, residents and community groups to use the information in the report and the maps to learn more about the community where they live. It is important to note that many of the maps and information are related and although the report is broken up by chapters by similar resources, connections between chapters can be easily created. For example, Biological Communities and Habitats connects with Recreational Resources since many of the significant habitats in the City are located on City parkland. The maps in this report are an important aid to the visualization of connections between natural and man-made environments.

This NRI can be supplemented by the NYS DEC Hudson Valley Natural Resource Mapper, an interactive online tool for viewing maps of various natural resources in the Hudson River Estuary Watershed (NYS Department of Environmental Conservation, 2018). The Natural Resources Mapper is intended to be used as a companion to the NRI, and should not be used as a substitute for the NRI or for specific, on-site surveys.

Map 1.1 City of Poughkeepsie Base Map



Map 1.2 City of Poughkeepsie Aerial Map


Topography
City of Poughkeepsie, New York
Legend
Local Roads
US/NY Roads
Streams
Waterbodies
Wetlands
Parks and Open Space
Poughkeepsie City Boundary
Elevation Contour
10 FT
50 FT
Hudson River
Morgan Lake
COLLEGE HILL PARK
PULASKI PARK
Fall Kill
N HAMILTON ST
N CLINTON ST
SMITH ST
EAST-WEST ARTERIAL
MAIN ST
TOWN OF POUGHKEEPSIE
WARYAS PARK
EASTMAN PARK
S HAMILTON ST
HOOKER AVE
SPRINGSIDE
Fonteynkill
Casperkill
WILBUR BLVD
SPRATT PARK
VASSAR FARM AND ECOLOGICAL PRESERVE
This map is intended for general planning and educational purposes. Corrections or updates may be submitted to the City of Poughkeepsie. Map produced by the Environmental Cooperative at the Vassar Barns for the City of Poughkeepsie, August 2018.
DATA SOURCES:
Contour Line: Dutchess County, 2017.
Local Roads, Arterial Roads: Duchess County, 2017
Waterbodies/Wetlands/Streams: Hudsonia, 2018;
Dutchess County, 2004
Parks and Open Space: Duchess County, 2017;
Ecological Preserve at Vassar Barns
Poughkeepsie City Boundary: Dutchess County,
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0 0.5 1 Miles
1:19,500

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Chapter 2. Geology and Soils

Julia Blass and Jennifer Rubbo

Exposed bedrock near the Fall Kill.
Photo credit: Camelia Manring

Geology shapes the landscape in visible and invisible ways - influencing landforms and topography, soil depth and chemistry, resulting in plant communities, as well as the above- and below-ground movement of water and contaminants. These factors influence the establishment of ecosystems and can be important considerations for land development. Geology and soils also contribute important natural and economic resources for human populations, including groundwater recharge and storage, minerals, and construction materials, as well as agricultural resources.

The maps presented in this chapter are only intended to give a general sense of the geologic features and soils of the city, as the data presented were collected at broad scales. The information can be enhanced through local knowledge and site-specific surveys.

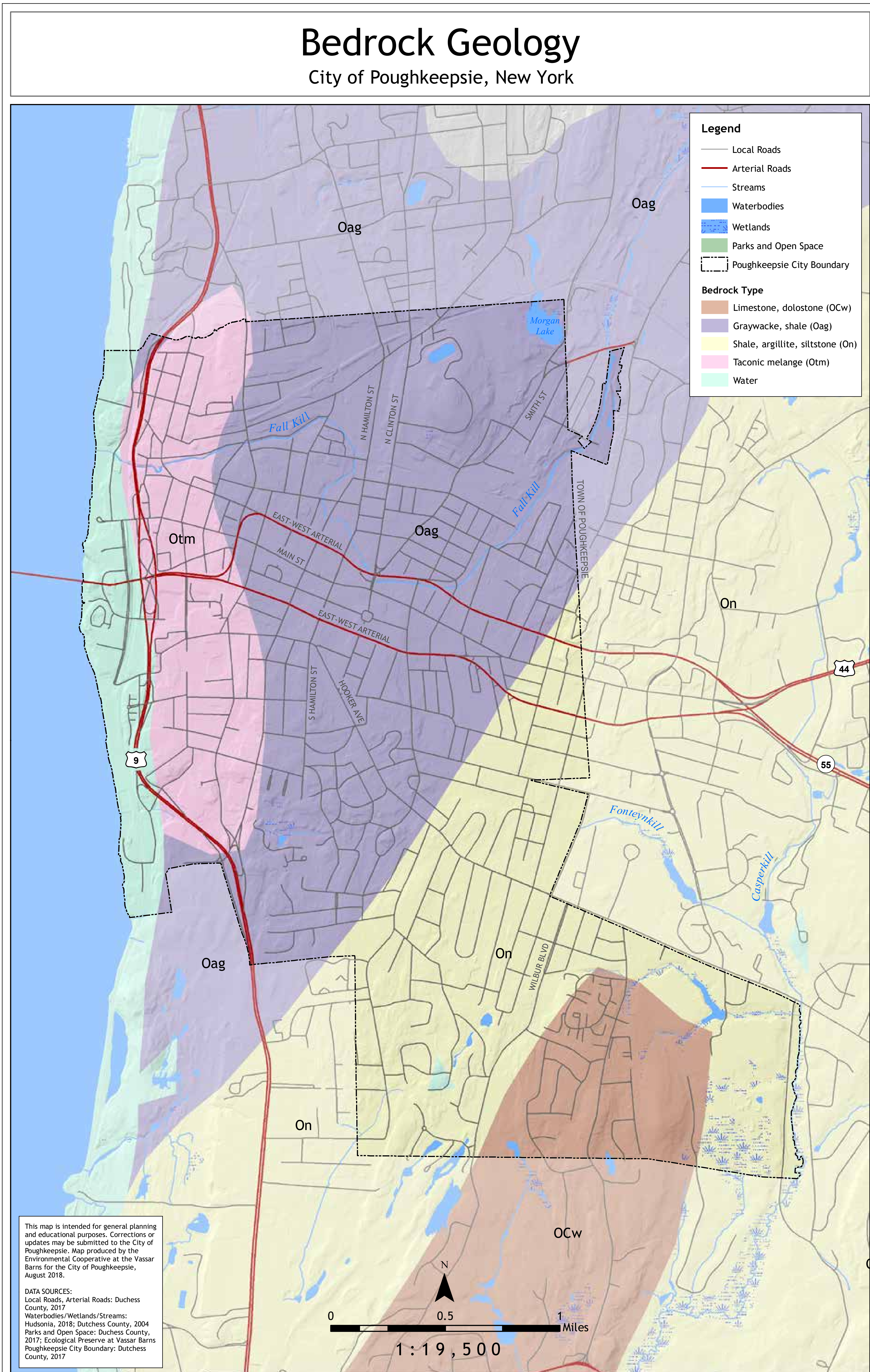
Bedrock Geology

Bedrock geology underpins the City of Poughkeepsie's landforms and topography and has shaped patterns of soil development, habitats, and water movement that define the ecological landscape. Characteristics of the bedrock geology strongly influences above and below ground water movement and can determine groundwater storage capacity and the movement of contaminants in water supplies. According to general bedrock geology maps from the New York State Museum (Map 2.1), bedrock in the City of Poughkeepsie is composed primarily of shale and greywacke which is less permeable (Lower Hudson Bedrock Sheet). The City's southeastern corner is partially underlain by limestone and dolostone, which are typically more permeable and therefore more susceptible to groundwater contamination from surface water runoff. These calcium-rich carbonate bedrock materials are also more likely to support alkaline or calcareous habitats and plant communities. Table 2.1 describes the various bedrock formations in the City of Poughkeepsie

Table 2.1: Bedrock geology descriptions of the City of Poughkeepsie

Map Symbol	Bedrock Type	Description
OCw	Limestone, dolostone	Wappinger Formation; water-soluble rocks "formed primarily from the precipitation of calcium and magnesium carbonate in seawater, commonly through the action of algae and other organisms like corals and mollusks." (Budnik, Walker, & Menking, 2010) Calcareous (Kiviat & Stevens, 2001)
Otm	Taconic Melange	"Relatively unaltered to moderately metamorphosed autochthonous clastic sedimentary rocks...a jumbled mix of sandstone blocks in a matrix of mud." (Budnik, Walker, & Menking, 2010)
Oag	Graywacke, shale	Austin Glen Formation; Coarse-grained sandstone containing >15% clay. Potentially calcareous (Haeckel & Heady, 2014)
On	Shale argillites, siltstone	Normanskill Formation; gray to black shales and argillites with silty laminations. (Fisher, Isachsen, & Rickard, 1970)
N/A	Water	Unknown; adjacent to Hudson River. (Budnik, Walker, & Menking, 2010)

Map 2.1 Bedrock Geology of the City of Poughkeepsie



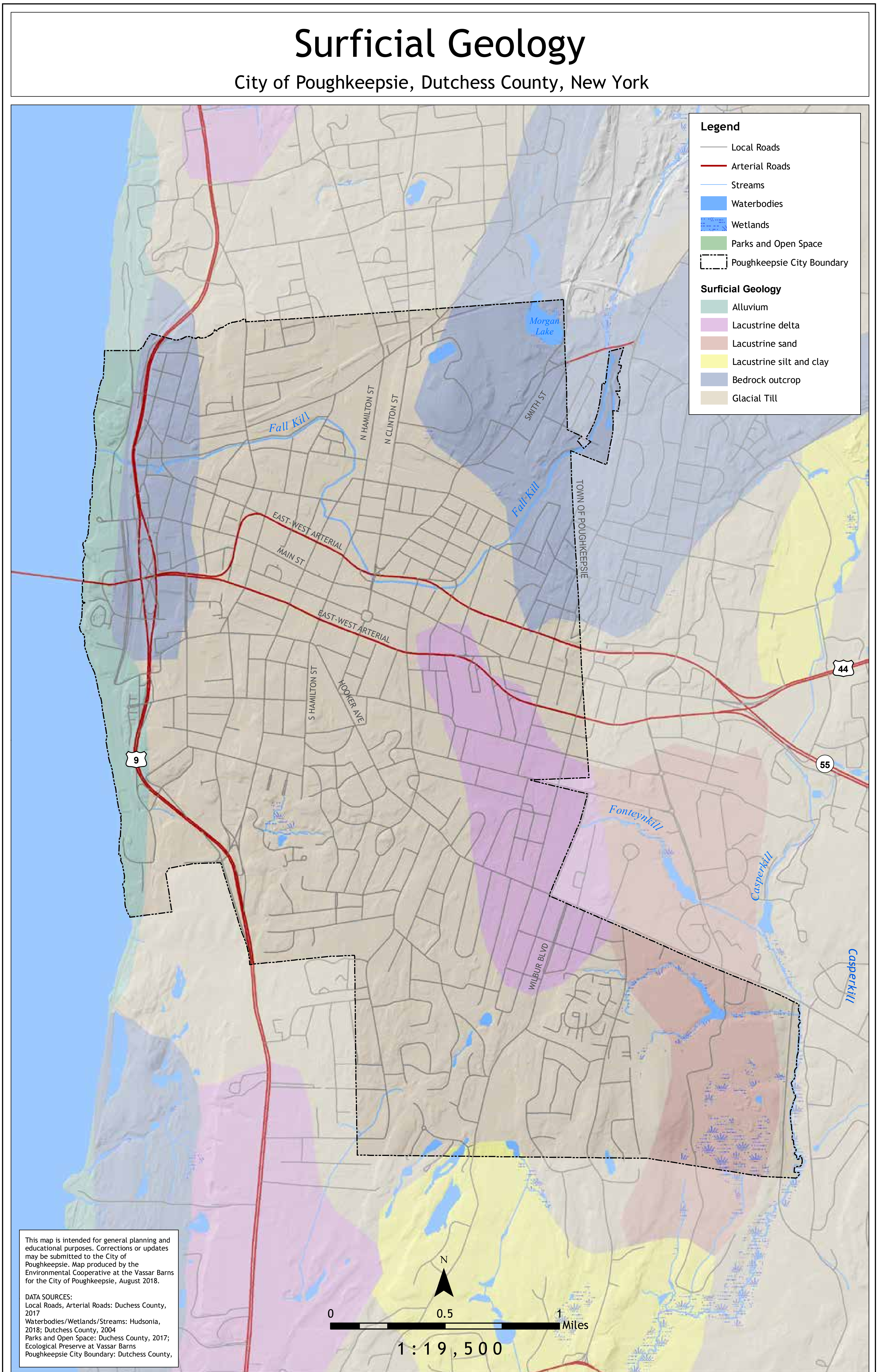
Surficial Geology

Surficial geology refers to the layer of unconsolidated sediment that sits above bedrock. Surficial geology materials mapped in the City of Poughkeepsie include sand and gravel, clay and silts, and glacial tills, presented in Table 2.2. These materials influence soil development and can affect suitability for development projects such as the construction of new roads, and buildings, or septic systems. They are therefore important to consider in urban planning. Surficial materials also affect surface and groundwater flow and storage; for example, alluvium, which are formed by riverine deposits, are often associated with high-yield unconsolidated aquifers (Gilchrist, et al., 2010). Certain surficial deposits also have important economic value; for example, sand deposits may be mined for road maintenance and construction uses.

Table 2.2: Surficial geology descriptions in the City of Poughkeepsie (NYS Museum, 2018)

Surficial Material	**Description (Lower Hudson Surficial Shape)**
Alluvium	Formed by riverine deposits. Oxidized fine sand to gravel, permeable, generally confined to flood plains within a valley, in larger valleys may be overlain by silt, subject to flooding, thickness 1-10 meters
Lacustrine delta	Formed by ancient lakes. Coarse to fine gravel and sand, stratified, generally well sorted, deposited at a lake shoreline, thickness variable (3-15 meters).
Lacustrine sand	Formed by ancient lakes. Generally, quartz sand, well sorted, stratified, usually deposited in proglacial lakes, but may have been deposited on remnant ice, generally a near-shore deposit or near a sand source, permeable, thickness variable (2-20 meters).
Lacustrine silt and clay	Formed by ancient lakes. Generally laminated silt and clay, deposited in proglacial lakes, generally calcareous, low permeability, potential land instability, thickness variable (up to 50 meters).
Bedrock outcrop	Exposed bedrock, generally within 1 meter of surface.
Glacial Till	Variable texture (boulders to silt), usually poorly sorted sand-rich diamict, deposition beneath glacier ice, permeability varies with compaction, thickness variable (1-50 meters).

Map 2.2 Surface Geology of the City of Poughkeepsie



Soils

Soil is the foundation for ecosystems and many natural processes and strongly influences feasibility for land use and development. Soil controls the decomposition of organic matter and biogeochemical cycles; regulates water flow; and influences the vegetation, habitat type, and agricultural potential of particular locations (Haeckel & Heady, 2014). Some important soil characteristics include pH, soil texture, reaction (acidity), permeability, drainage, organic content, depth to bedrock, and slope. These soil characteristics determine the establishment of habitats and distinct plant communities. From a land use perspective, consideration of soil properties is important. It will impact such things as planning and design of drainage systems, the siting of structures, septic system evaluation, properly engineering foundations, basements, and roads, and determining the feasibility of excavation.

There are many soil types in the City of Poughkeepsie, and each soil type is further classified by variation of slope and topography. The reaction (pH), depth to bedrock, and drainage classifications for each soil survey unit are displayed in Table 2.3. Full descriptions of each listed soil type can be found with the Dutchess County Soil Survey or using the USDA Web Soil Survey.

Table 2.3: Soil types of the City of Poughkeepsie. (Web Soil Survey, 2018, Soil Survey of Dutchess County, New York, 2001)

Name on Map	Full Name	Soil Reaction	Depth to bedrock (inches)	Drainage
BeC	Bernandon Silt Loam, 8-15% slopes	Very strongly acid to moderately acid	>60	Well-drained
BeD	Bernandon Silt Loam, 15-25% slopes	Very strongly acid to moderately acid	>60	Well-drained
BgB	Bernandon Silt Loam, 3-8% slopes	Very strongly acid to moderately acid	>60	Well-drained
Ca	Canandaigua Silt Lam	Moderately acid to neutral in the surface and upper subsoil, neutral in the lower subsoil and substratum	>60	Very poorly drained
DwB	Dutchess Cardigan Complex, undulating/rocky	Very strongly acid to moderately acid in solum, strongly acid to slightly acid in the substratum	>60	Well-drained

Table 2.3: Soil types of the City of Poughkeepsie. (Web Soil Survey, 2018, Soil Survey of Dutchess County, New York, 2001) (Continued)

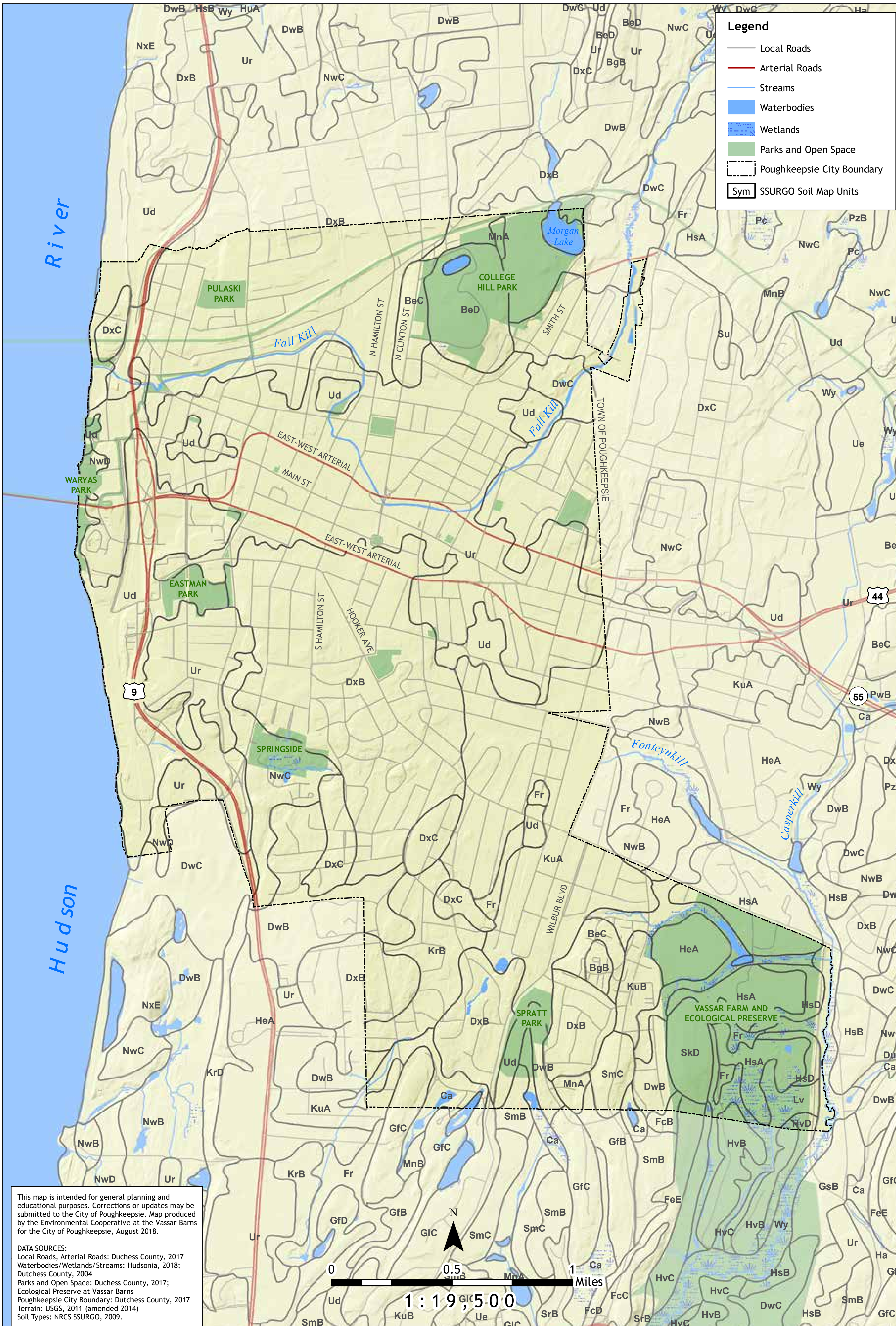
DwC	Dutchess Cardigan Complex, rolling/ rocky	Very strongly acid to moderately acid in solum, strongly acid to slightly acid in the substratum	>60	Well-drained
DxB	Dutchess Cardi-gan Urban Land Complex, undulat-ing/rocky	Very strongly acid to moderately acid in the solum, and strongly acid to slightly acid in the substratum	20-40	Well-drained
DxC	Dutchess Cardi-gan Urban Land Complex, rolling/ rocky	Very strongly acid to moderately acid in the solum, and strongly acid to slightly acid in the substratum	>60	Well-drained
Fr	Fredon Silt Loam	Moderately acid to neutral in the surface and subsoil, and slightly acid to moderately alkaline in the substratum	>60	Somewhat poorly drained
HeA	Haven Loam, nearly level	Very strongly acid to moderately acid	>60	Well-drained
HsA	Hoosic Gravelly Loam, nearly level	Very strongly acid or strongly acid above 30 inches, very strongly acid to slightly acid below 30 inches	>60	Somewhat exces-sively drained
HsD	Hoosic Gravelly Loam, hilly	Very strongly acid or strongly acid above 30 inches, very strongly acid to slightly acid below 30 inches	>60	Somewhat exces-sively drained
KrB	Knickerbocker Fine Sandy Loam, undulating	Very strongly acid to moderately acid	>60	Somewhat exces-sively drained

Table 2.3: Soil types of the City of Poughkeepsie. (Web Soil Survey, 2018, Soil Survey of Dutchess County, New York, 2001) (Continued)

KuA	Knickerbocker Urban Land Complex, nearly level	Very strongly acid to moderately acid	>60	Somewhat excessively drained
KuB	Knickerbocker Urban Land Complex, undulating	Very strongly acid to moderately acid	>60	Somewhat excessively drained
Lv	Livingston Silt Clay Loam	Strongly acid to neutral in the surface and upper subsoil, neutral to moderately alkaline in the lower subsoil and substratum	>60	Very poorly drained
NwC	Nassau-Cardigan Complex, rolling/ very rocky	Very strongly acid to moderately acid	20-40	Somewhat excessively drained
NwD	Nassau-Cardigan Complex, rolling/ rocky	Very strongly acid and strongly acid	20-Oct	Somewhat excessively drained
SkD	Stockbridge Silt Loam, 15-25% slopes	Strongly acid to neutral in the surface, moderately acid to neutral in the subsoil, moderately acid to moderately alkaline in the substratum	>60	Well-drained
SmC	Stockbridge-Farmington Complex, rolling/ rocky	Strongly acid to neutral in the surface, moderately acid to neutral in the subsoil, moderately acid to moderately alkaline in the substratum	>60	Well-drained
Ud	Udorthents, smoothed	N/A	>80	Well-drained
Ur	Urban Land	N/A	Variable	Covered by impervious materials

Soil Types

City of Poughkeepsie, New York



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Chapter 3. Water Resources

Jen Rubbo, Neil Curri, Elise Chessman, Julia Blass

The Fall Kill near Dongan Park.
Photo credit: Jennifer Rubbo

Introduction

The City of Poughkeepsie is located where the mouth of the Fall Kill drains into the Hudson River, and the City's founding was based predominantly around its access to water. Though the exact translation is debated, the name Poughkeepsie is derived from a Wappinger phrase meaning "reed-covered lodge by the little water place" (Britannica, n.d.). The Fall Kill and the Hudson River were the major factors that drew settlers to this area. Water was a source of power to early industrial activity, and the Fall Kill powered the processing of corn, lumber, and cloth through dammed millponds. (The Fall Kill Plan, 2012).

The City of Poughkeepsie is on the east bank of the Hudson River, at the midpoint of a 153-mile estuary from the City of Troy to New York Harbor – nearly half the entire river's length (Hudson River Watershed Alliance, 2013). An estuary is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it and with a free connection to the open sea (Pritchard, 1967). Salty seawater pushes up the Hudson River during flood tide, diluted by freshwater runoff as it moves northward; during ebb tide, the salt front recedes southward. The alternating tides raise and lower the surface of the Hudson River approximately 3 feet at Poughkeepsie, and causes the river to change its direction of flow four times a day. The combination of tidal flows, saltwater, and freshwater inputs creates diverse habitats throughout the Hudson River estuary, which support important commercial and recreational species like striped bass, bluefish, and blue crab (NYS Department of Environmental Conservation, 2019a).

Not only does the Hudson River provide important habitat, but it also supplies the City of Poughkeepsie residents with potable drinking water. The salt front in the Hudson River estuary is typically well south of Poughkeepsie, but in times of drought it moves north, potentially impacting the City's drinking water intake and treatment plant.

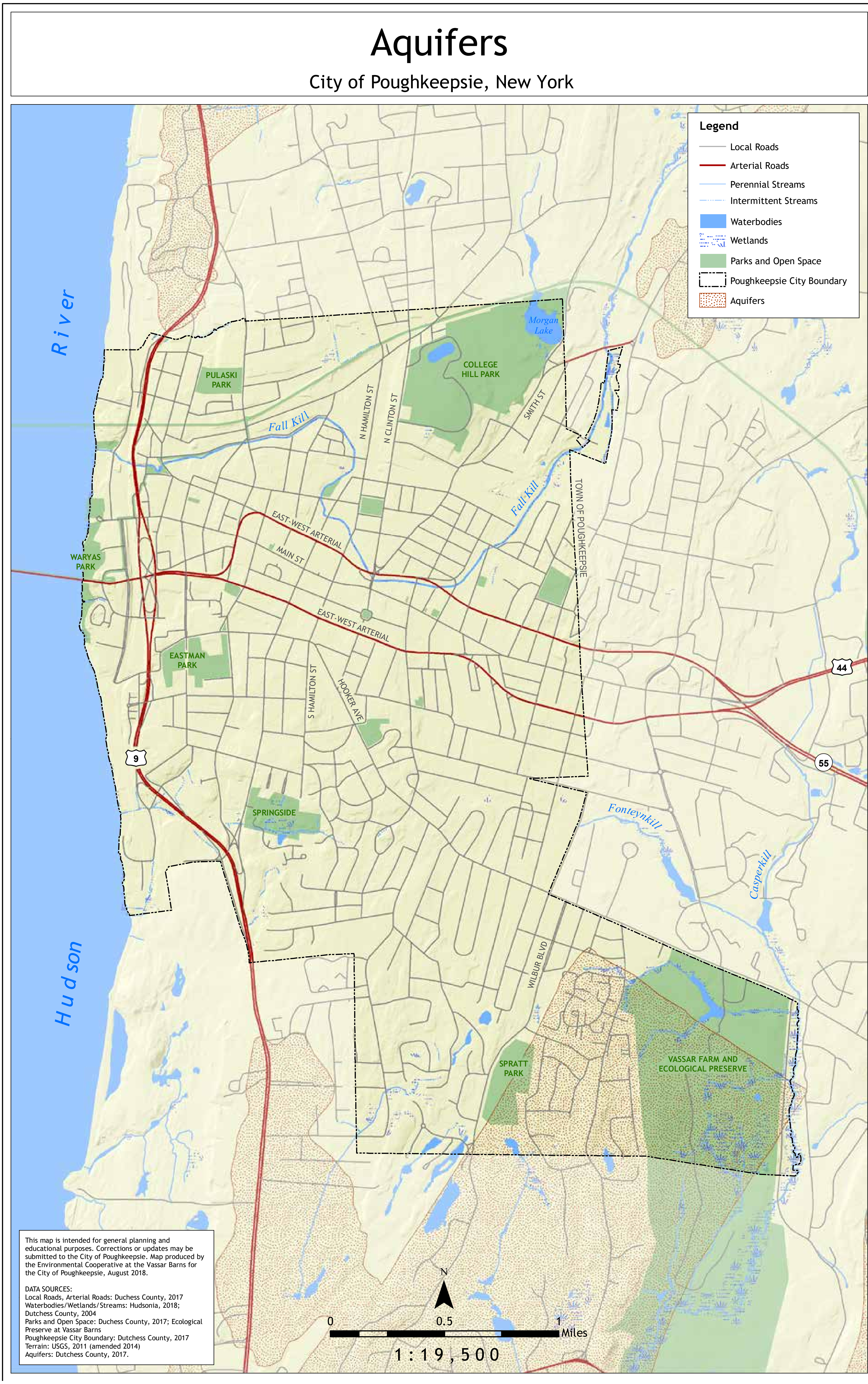
Threats to water quality in the Hudson River, Fall Kill, and other small streams include point-source pollution from current and former industrial sites, stormwater runoff, and releases of untreated sewage during storms (i.e., combined sewer overflows). In addition, contaminants in the watershed, such as fertilizers and septic systems, also impact the quality of water in the Fall Kill and the Hudson River. Healthy water resources not only ensure a clean drinking water source but also provide important habitat for many organisms.

Groundwater and Aquifers

Groundwater feeds our rivers and streams and is the primary source of water for aquatic habitats during times of drought. Aquifers are areas with significant amounts of groundwater saturation. This groundwater is used to supply wells and other water sources. Groundwater recharge occurs primarily through infiltration of precipitation. The amount of impervious surface in a watershed can impact groundwater recharge, by both reducing the rate at which water infiltrates into the ground and the quality of the water infiltrating into the ground. Polluted runoff practices such as salting roads and the use of chemicals on yards can impact the groundwater quality and subsequently the water quality in the City's aquifers, streams, and rivers.

The City of Poughkeepsie does not utilize groundwater as a drinking water resource. However, aquifers within and surrounding the City should be identified, as these areas are important to the biological health of many natural areas (Map 3.1). For example, both the Fall Kill and Casperkill receive water from groundwater sources, maintaining flow during dry times of the year. While several aquifers exist just outside of the City boundary, only one major aquifer exists within the City limits in the Southeast corner. About half of this one aquifer in the City exists within the Vassar Farm and Ecological Preserve. The conservation of natural areas in the Vassar Preserve is very important to the aquifer's health, supporting both groundwater recharge and filtration.

Map 3.1 Aquifers of the City of Poughkeepsie



Watersheds and Surface Water

Watersheds in Poughkeepsie

A watershed or drainage basin is the area of land from which all water drains into a particular stream, river, lake, or other waterbody. Surface topographic features (such as ridges, mountains, and hills) constitute watershed or basin boundaries. Watersheds are nested, with smaller subwatersheds existing within larger watersheds. For example, the Fall Kill watershed is a subwatershed of the Hudson River watershed. A healthy watershed has adequate pervious areas for water to infiltrate, which reduces direct inputs of polluted runoff to the waterway. This helps to recharge groundwater, mitigate flood and erosion impacts, and minimize the cost of water treatment and public infrastructure. Land use influences the quantity and quality of water supplies, and therefore understanding watersheds is critical to making informed natural resource management and land use decisions. The City of Poughkeepsie is part of the Hudson River basin and has four watersheds (Map 3.2). The majority of the City is within the Fall Kill and Casperkill watersheds, with the remaining area within the Hudson River Direct Drainage E and F basins.

The Dutchess County planning office created watershed boundaries for this map from high-resolution elevation surveys. As part of this dataset, there have been 5,272 subwatersheds delineated for every small stream and drainage within Dutchess County - 57 of which are located within or partially within the City of Poughkeepsie. The average size of these subwatersheds is approximately 100 acres. This level of watershed detail was provided to allow finely detailed analysis of water resources, a framework for organizing research, and as a potential basis for public outreach and education of stormwater issues on a neighborhood level. Watershed boundaries can encourage residents to think about how water naturally flows through their neighborhood as well as the geography of the built environment in which they live (Wills, 2010).

In an urbanized area like Poughkeepsie, the storm sewer and wastewater systems likely subvert many of the topographic subwatershed boundaries depicted in the map by collecting stormwater in catch basins and conducting it through underground pipes to other subwatersheds. Likewise, wastewater entering the combined sewer system may be entering these pipes in one subwatershed and pumped directly to the sewage treatment plant or Hudson River (during times of high precipitation), located in another subwatershed. (see Potential and Known Sources of Pollution Map for locations of CSO drainage areas; Map 3.6). In contrast to a watershed, a *sewershed* is the area of land where all the *sewers* flow to a single end point. Precipitation that falls on impervious surfaces in Poughkeepsie, for the most part, would follow these sewershed delineations rather than topographic watershed delineations. Topographic watershed delineations are still a helpful guide to understanding water flows in a specific area.

Surface Water in Poughkeepsie

The City of Poughkeepsie's major waterbodies are the Hudson River and the Fall Kill, and the Casperkill borders it at the Southeast corner. Additionally, there are small lakes, ponds, and reservoirs that are important surface water resources in the City. Most notably, Morgan Lake, which is located in the northeastern corner of the City, and the Victorian reservoir at College Hill Park.

The Hudson River is a defining natural feature in the City of Poughkeepsie. In addition to its historical, economic and cultural significance, the river provides an important connection to nature for residents and fosters local identity. The entire western border of the City of Poughkeepsie is located on the shores of the Hudson River. Hudson River habitats including the main channel, tidal shallows, intertidal shallows and the tidal tributary mouth of the Fall Kill, make up the largest contiguous habitat type in the City (Heffernan & Stevens, 2018). The Hudson River watershed drains 13,390 square miles (Hudson River Watershed Alliance, 2013) and all of the land in the City of Poughkeepsie eventually drains into the Hudson River. Land use in the City of Poughkeepsie has significant impacts on both water quality of the tributaries that feed into the Hudson River and the river itself.

The primary tributary that flows through the City of Poughkeepsie is the Fall Kill, which originates in the towns of Clinton and Pleasant Valley, flows through Hyde Park, the Town of Poughkeepsie, and finally the City of Poughkeepsie where it enters the Hudson (Bean, Lynch, & Burns, 2006). Its watershed covers an area of 19.5 square miles and is approximately 38 miles long. The northern reaches of the creek are largely undisturbed, with many woodlands, wetlands, and marshes present in these sections of the watershed. As the stream enters the City of Poughkeepsie, the buffer of natural area that borders the creek decreases and developed surfaces get closer to the stream. The Fall Kill is channelized by New Deal Era stone walls for 2.5 miles through the City of Poughkeepsie. There is little to no buffer, and the stream channel rapidly conveys water through the City to the Hudson River. Channelization and the highly developed impervious surroundings make certain areas of Poughkeepsie especially susceptible to flooding, as was witnessed during Hurricane Irene in August 2011. There is, however, a small portion of the creek within the City boundary that is not channelized in stone walls. This section is located primarily near a parcel of land owned by the City of Poughkeepsie Department of Public Works and privately owned adjacent parcels to the south. This section of the creek has been identified as a significant habitat area and should be considered an important flood retention area due to the presence of small sections of an undeveloped forested riparian buffer, (Heffernan & Stevens, 2018) (see Appendix A for complete report). The Fall Kill Management Plan, which was completed in 2006, is the most comprehensive study of the biology and water quality of the creek and provides important recommendations for the improvement of water quality that are still relevant today (Bean, Lynch, & Burns, 2006).

The Casperkill is 11 miles long, with the mainstem of the stream located mostly in the Town of Poughkeepsie there is about ¾ of a mile of the creek in the City of Poughkeepsie bordering the easternmost edge of the City. The watershed spans a total of 12 square miles. Twenty percent of the watershed lies within the City boundaries, mostly in the southern and eastern portions of the City (Menking K. , Cunningham, Foley, Freimuth, & Smith, 2009). The creek flows through an area of mixed land use dominated by suburban and urban development including shopping centers, parking lots, and residential homes. The most natural section of the creek is located within the Vassar Farm and Ecological Preserve where a 300-2000 ft. vegetated buffer exists. While not located in the City of Poughkeepsie, this section of the creek is an important area to note. The protection of the forest and open space in this area help to mitigate the inputs of non-point source pollution entering the creek further upstream. The Casperkill finally enters the Hudson River near Tilcon Quarry, just south of the Poughkeepsie Galleria.

Inputs to the Casperkill include surface runoff, and small tributaries, including a small unnamed tributary located in the City at the entrance of the Vassar Farm and Ecological Preserve and the Fonteynkill. The Fonteynkill is located in the Town and is presumed to drain a residential portion of the City of Poughkeepsie via underground sewers and pipes contributing to the water quality of the stream (Cunningham, Livingston, & Cardillo, 2013). The Fonteynkill surfaces about 3,300ft upstream of the confluence with the Casperkill at the boundary of the City and Town of Poughkeepsie (Menking K. , Cunningham, Foley, Freimuth, & Smith, 2009).

Typical urban development practice during industrialization included burying most small streams and/or using them as sewers to transport waste out of cities. Because infrastructure and development has disconnected these small streams from the surrounding watershed, buried streams cannot provide ecosystem services such as nutrient pollution reduction in stormwater runoff (Trice, 2013). In Poughkeepsie, several small streams no longer appear in recent maps and GIS data, or, such as the Fonteynkill appear with significant sections buried underground. The paths of these streams are difficult to ascertain but can be inferred from historic maps.

Based on an 1891 map of portions of Ulster and Dutchess County, the Fonteynkill historically began further west in the City of Poughkeepsie, near the intersection of Hooker Avenue and present-day S. Cherry Street (Figure 3.1) (Beers F. , 1891). Historic maps from 1867 and 1834 depict a stream called Kidney Creek (or Kidney Kill) at the north edge of the City of Poughkeepsie (Figure 3.2 (Beers F. W., 1867) ; (Figure 3.3 (Winfield, 1834). Recent topographic maps do not depict this stream nor does recent GIS data or aerial photographs. However, an outlet to the Hudson River is visible in recent aerial photographs emerging from the approximate location of the former mouth of Kidney Creek, suggesting that the entire creek has been buried underground. The above-referenced 1834 map also shows two streams emptying into the Hudson near Pine Street; no evidence of these creeks can be seen in recent maps, aerial images, or GIS data (Figure 3.4 (Winfield, 1834).

Figure 3.1. 1891 Map of the City of Poughkeepsie showing the Fonteynkill extending into what is now the City of Poughkeepsie.

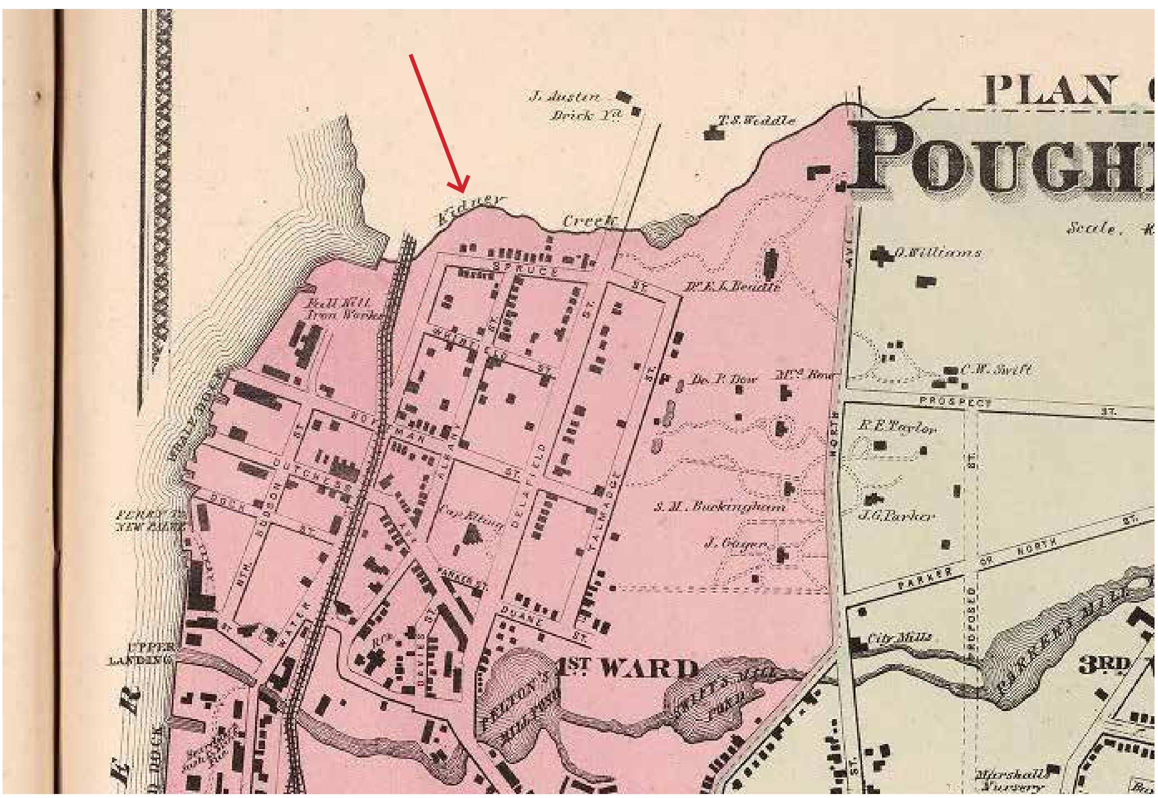


Figure 3.2. 1867 map of the City of Poughkeepsie showing the now buried Kidney Creek and its outfall into the Hudson River.

Figure 3.3. 1834 map the City of Poughkeepsie showing the now buried Kidney Kill (creek).

Figure 3.4. 1834 Map of small streams flowing into the Hudson River near Pine Street in the City of Poughkeepsie.

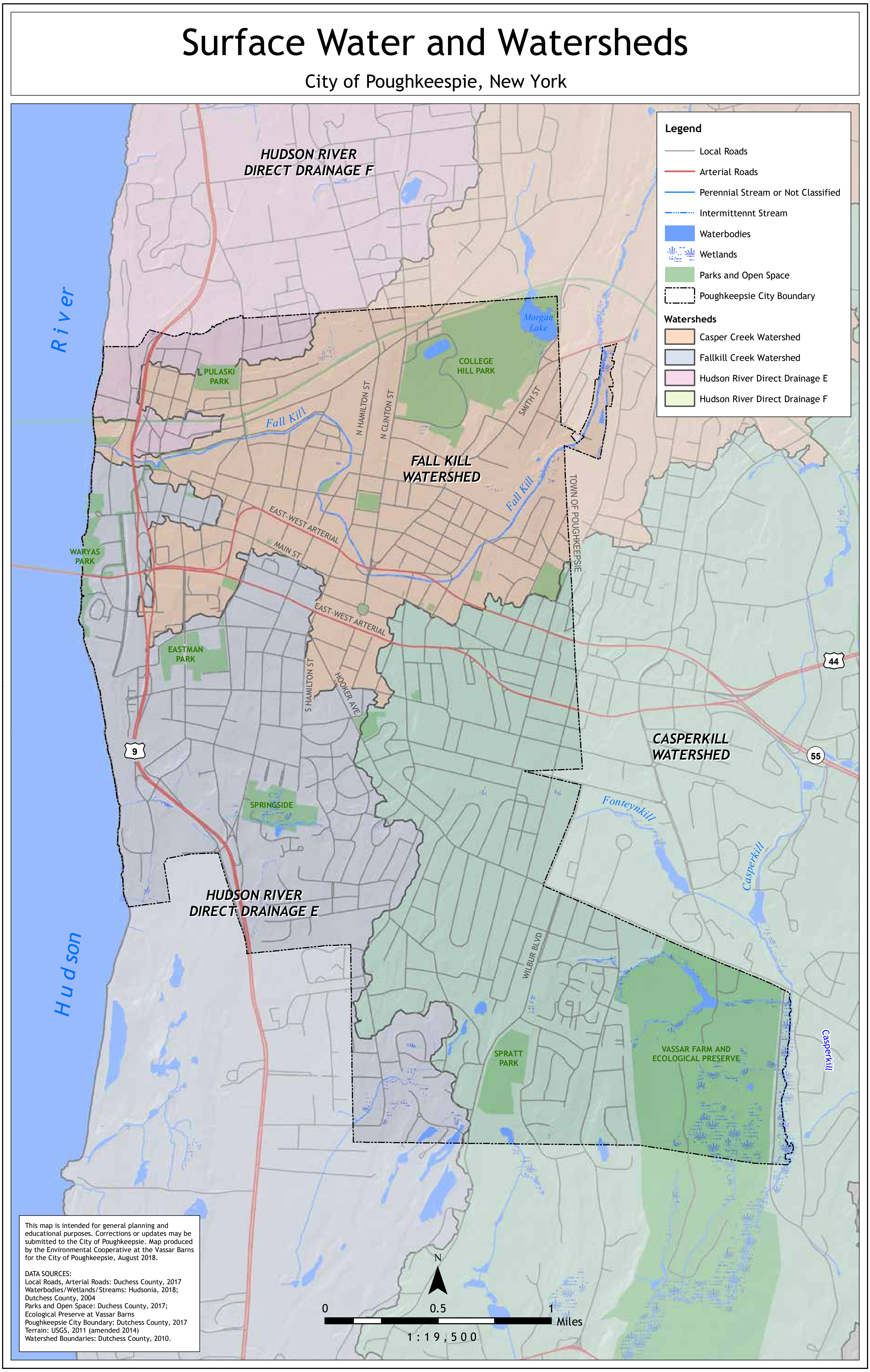
As part of the Significant Habitats Report (Appendix A) Hudsonia delineated the streams and stream fragments illustrated in Map 3.2, as well as waterbodies and wetlands within the City of Poughkeepsie boundary. They describe a network of seemingly disconnected stream fragments located in the southern portion of the City that are presumed to be portions of streams that are now partially piped or buried so their complete paths were not detectable.

There are efforts by many organizations to maintain the health of the Hudson River, its subwatersheds and tributaries. Within Poughkeepsie, the Fall Kill Watershed Committee and the Casperkill Watershed Alliance have done important work to contribute to the health and knowledge of our watersheds. The Fall Kill Watershed Committee and the Casperkill Watershed Alliance have been inactive in recent years however these local groups have assessed the Fall Kill and Casperkill extensively in the past (see Health of the Casperkill, Dutchess County, New York (Menking K. , Cunningham, Foley, Freimuth, & Smith, 2009) and A Watershed Management Plan for the Fall Kill, Dutchess County, New York (Bean, Lynch, & Burns, 2006). Vassar College has continued to monitor water quality in the Fonteynkill until 2017. Since 2017, the local non-profit Scenic Hudson has worked to gain community support for the revitalization of the creek, based on work completed in the 2012 Fall Kill Plan (The Fall Kill Plan, 2012).

Additional resources that discuss the Fall Kill and Casperkill include:

Fall Kill Neighborhood Source Assessment Report (Palmer & Hesse, 2013)
Fall Kill Trash Assessment (Rubbo, 2008a)
Fall Kill Stream Walk (Rubbo, 2008)
The Suburban Stream Syndrome: Evaluating Land Use and Stream Impairments in the Suburbs (Cunningham, et al., 2009)

Map 3.2 Surface Water and Watersheds of the City of Poughkeepsie



Wetlands

A wetland is a distinctive habitat that provides important ecosystem services. Wetlands are defined by saturation of surface water or groundwater for a period of time throughout the year, and the presence of plants that are adapted to saturated soil conditions. In addition to providing habitat for a diversity of plants and animals, they play an important role in stormwater management. Wetlands slow down runoff, increase infiltration into groundwater, and help to filter out sediment and other contaminants. In an urban or suburban area, they are an important part of the natural landscape that helps mitigate the impacts of flooding, and are especially important today as storms become more severe and flooding increases due to global climate change.

Figure 3.5. Section of the Fall Kill with small wetlands that are likely important in flood mitigation.

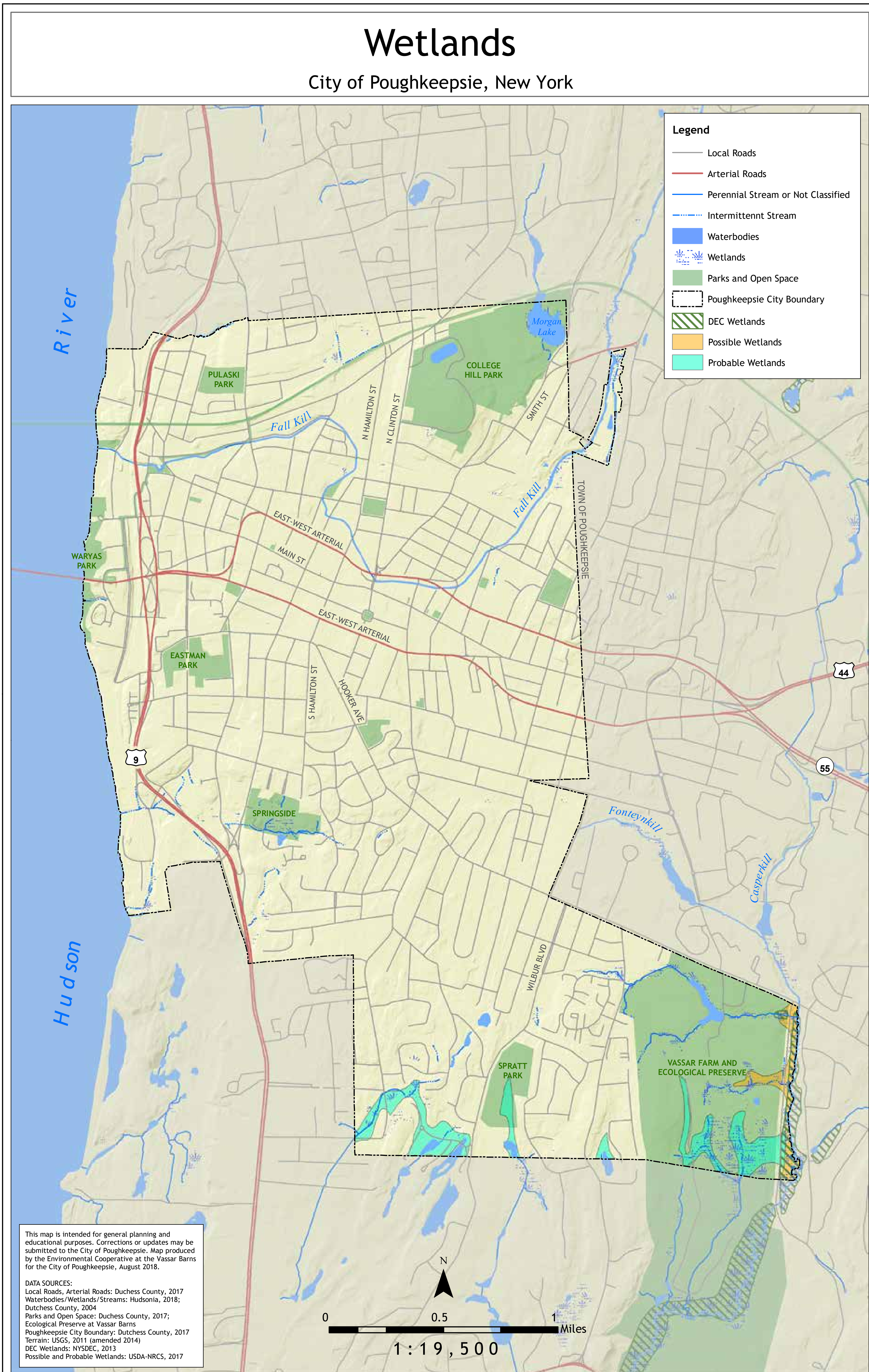
Wetlands are not common in the City of Poughkeepsie. Historically, many wetlands in developing areas were filled, which is likely what occurred in Poughkeepsie. The few remaining wetlands should be preserved as they function as important areas for mitigating the impact of floods by storing flood waters and slowing surface runoff, and help to improve water quality. Wetlands in Map 3.3 were identified using data from Hudsonia's Significant Habitat Report (Heffernan & Stevens, 2018) and NYS DEC freshwater wetland data. Wetlands and their importance as habitat are further addressed in the Significant Habitat Report (Heffernan & Stevens, 2018).

Freshwater wetlands regulated by New York State can be viewed using the DEC Environmental Resource Mapper (NYS Department of Environmental Conservation, 2019b). These maps show approximate extent and location of wetlands subject to State regulation under the Freshwater Wetlands Act and include wetlands above 12.4 acres or of unusual local importance. NYSDEC also regulates the 100 ft adjacent area around these wetlands. NYSDEC wetland maps are incomplete and often contain inaccuracies. There is a 500 ft check zone around NYSDEC identified wetlands, in which the DEC recognizes that additional wetland area may exist. There is only one New York State DEC regulated wetland within City boundaries, and it is on the Vassar Farm and Ecological Preserve.

The wetlands that are located adjacent to the Fall Kill near the Department of Public Works parcel and just south of that on a privately owned parcel are worth noting (Figure 3.5) since the Fall Kill is not channelized by stone walls yet at this point. This means that during flood events the creek may overflow into these wetlands, located within the 100-year flood plain. The wetlands thus may play an important role in retaining floodwaters where the Fall Kill enters the City. There may be other important hydrologic and habitat connections between these wetlands and the Fall Kill given their close proximity.

Also worth considering along with confirmed wetlands are the City's possible and probable wetland areas. These can be categorized based on the drainage class of soil groups. Soils that are somewhat poorly drained can be considered possible wetland areas, while soils that are poorly drained or very poorly drained can be considered probable wetland areas (Kiviat & Stevens, 2001). Researchers often use soil drainage classes to identify potential wetlands that are missing from existing wetland maps. Not only do poorly drained soils indicate that a wetland may be present, but they may also indicate previously drained areas with the potential for wetland creation or restoration.

Map 3.3 Wetlands of the City of Poughkeepsie



Flood Hazard Areas and Riparian Buffer Areas

Floodplains are low-lying areas adjacent to streams or rivers that become inundated during times of high flow. Streams naturally overflow their banks to disperse floodwaters. This flooding helps slow the water, recharge groundwater and increase water quality by letting particulates settle out instead of being carried downstream. Stream channelization is a modification to the banks of the stream that stops overbank flooding and moves water quickly downstream. While channelization might succeed in reducing flooding locally, it generally has negative impacts on the stream ecosystem as a whole. As the volume and velocity of the water increase through channelized areas, bankside erosion increases, suspended sediment increases, stream habitat is destroyed, and the risk of flooding downstream of channelized areas increases.

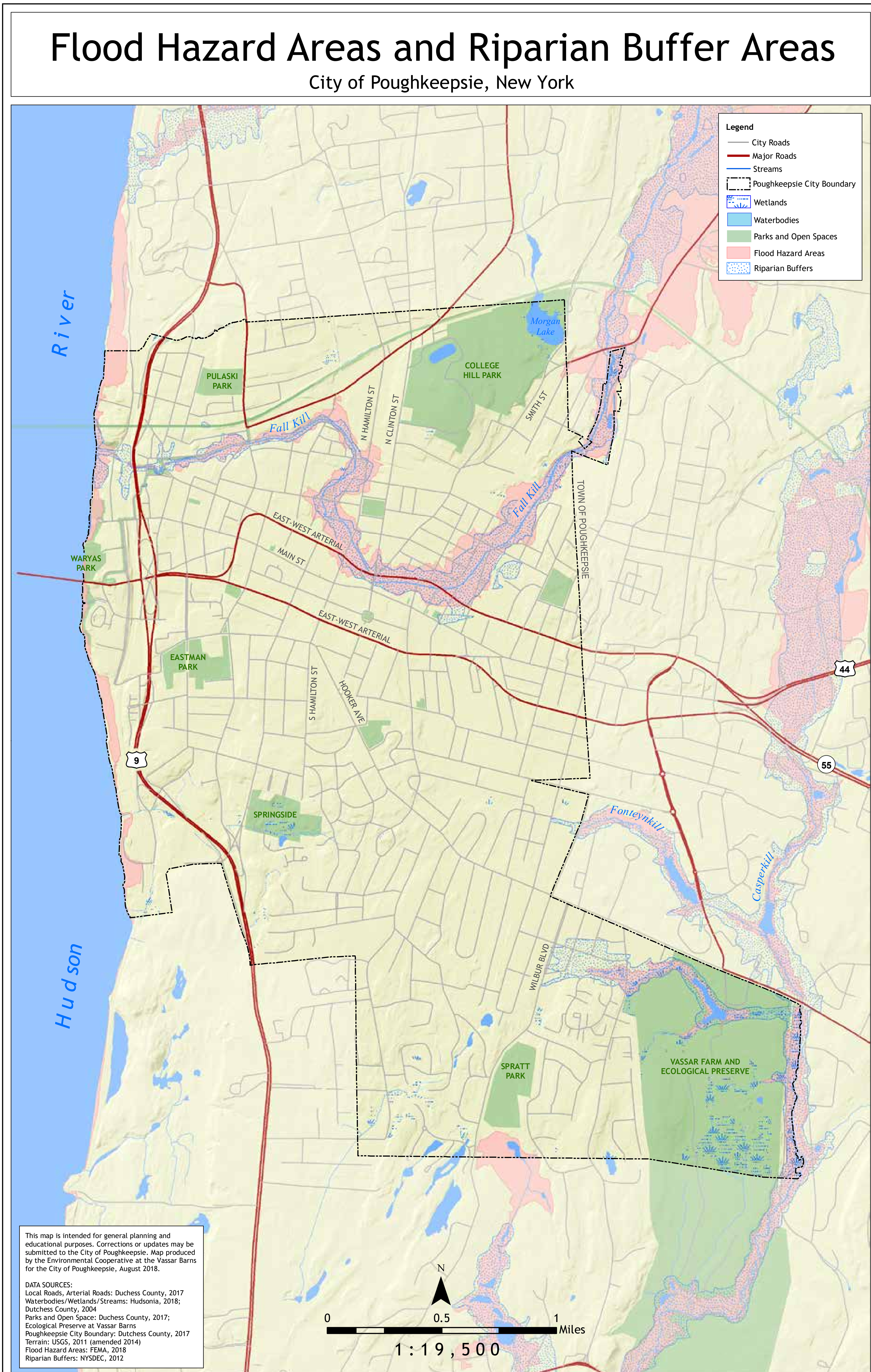
The Flood Hazard Areas and Riparian Buffer Areas map (Map 3.4) shows data from the Federal Emergency Management Agency (FEMA). FEMA maps flood zones with boundaries that represent the 1% chance annual flood (the "100-year" floodplain). The FEMA designation determines low-cost federal flood insurance rates and facilitates local land use controls that comply with FEMA's requirements (FEMA, 2019). The City participates in FEMA's National Flood Insurance Program (NFIP), with 164 policies in place as of 2015, insuring a total of $40,731,800 worth of property. NFIP has paid 39 claims since 1978 (City of Poughkeepsie Hazard Mitigation Plan, 2016). The flood hazard areas map can help to understand which areas of the City are at greatest risk of flooding, and where to focus on flood mitigation like green infrastructure and grey stormwater infrastructure improvements. Some of the major flood hazard areas fall within highly developed parts of the City of Poughkeepsie along the Fall Kill. The Fall Kill is an identified vulnerability in the City in the event of a flood because the channel is in disrepair in places (City of Poughkeepsie Hazard Mitigation Plan, 2016).

Knowing the locations of key water-related infrastructure such as storm drain outfalls and combined sewer overflows (CSOs) and their relationship to flood zones is important for discussions of future development and planning in the City (See Map 3.6. Potential and Known Sources of Pollution Map, and Map 3.7 Stream Barriers Map). Properly sized bridge crossing and culverts, as well as the removal of large debris from the stream, will aid in reducing flooding in the City. Additionally, reducing the amount of water that enters storm drains through the increase of pervious surfaces and other Green Infrastructure practices will help to decrease flooding potential.

Flood zones are not static. Land use, climate change, impervious surfaces, obstructions in floodways, precipitation and runoff changes, technological improvements in measuring topography, and new hydrologic modeling techniques can all alter the boundary of the flood zone (Findlay, Burns, Urban-Mead, & Lynch, 2010). Any map of flood hazard areas is therefore always subject to change. Furthermore, areas outside the mapped flood hazard areas may still flood during intense storms. These boundaries simply delineate areas with a higher risk of flooding (1% annual chance) based on historic rainfall and hydraulic modeling of the stream channel and watershed characteristics.

The Flood Hazard Areas and Riparian Buffer Areas map also illustrates riparian areas subject to the 2% annual chance flood (New York Natural Heritage Program, 2018). These areas may not be included in FEMA's flood zones. In Poughkeepsie one of these areas exists in the southeastern corner of the City near Wilbur Blvd. Riparian buffers are vegetated areas alongside the creek that help to protect the creek by slowing runoff, infiltrating water, providing shade that cools the water, and reducing the amount of sediment and pollutants entering the stream. NYS regulates, up to 50 ft. from the mean high water line, the disturbance of the bed or banks of streams with classifications of AA, A, B, C(T) or C(TS) (NYS Department of Environmental Conservation, 2019c). NYS does not protect the Fall Kill under this regulation because it is designated as a Class C stream (see Table 3.1). However, the City of Poughkeepsie Code does state specific provisions for uses abutting the Fall Kill (https://ecode360.com/27017455). The code requires setbacks of 30 feet from the top of the creek banks for any structure or use of land other than parking, recreation or open space. Parking areas may be located nearer than 20 feet to the top of the banks. Additionally, developers must direct surface drainage for parking and loading areas away from the creek and these areas are required to be landscaped and stabilized to reduce erosion (City of Poughkeepsie, 2017).

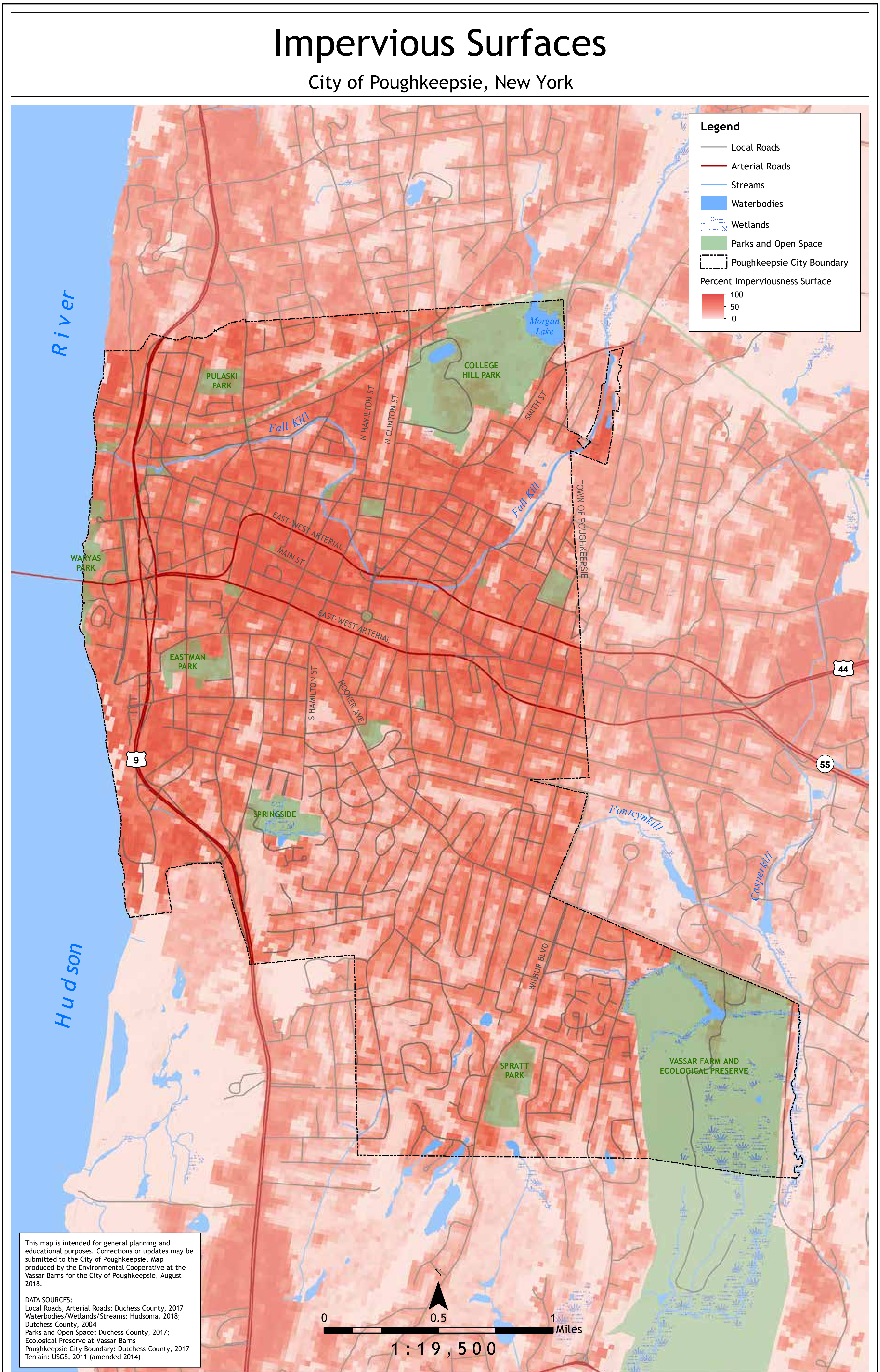
Map 3.4 Flood Hazard Areas and Riparian Buffer Areas



Impervious Surfaces

Poughkeepsie is an urban environment with 14.2% of the land cover in the City classified as "high density developed" implying a high percentage of impervious surfaces (Homer, et al.). An impervious surface is anything that prevents the infiltration of water, such as parking lots, pavement, roads, or buildings. When precipitation falls on impervious surfaces it rapidly flows into storm drains which lead directly to streams and rivers. This runoff carries with it pollutants and trash and impacts the water quality of the waterbodies it flows into. Large volumes of water runoff from impervious areas also increase the potential for flooding. The Impervious Surfaces map (Map 3.5) shows where high percentages of impervious surfaces exist in the City of Poughkeepsie. Areas with high impervious surfaces that are located near the Fall Kill or the Hudson River could be prioritized as areas that should be targeted for stormwater practices that reduce runoff and keep stormwater on site. Green infrastructure practices, specifically, should be considered and would help to reduce runoff by mimicking and preserving natural features and increasing on-site infiltration (New York State Stormwater Management Design Manual, 2015). Additionally, reducing the amount of runoff from impervious surfaces in areas that drain into Combined Sewer Overflows would help to reduce the amount of polluted runoff entering the Hudson River (See Potential and Known Sources of Pollution Map (Map 3.6) and the Combined Sewer Overflows section for more information about CSOs).

Map 3.5 Impervious Surfaces of the City of Poughkeepsie



Water Quality Assessments and Classifications

The Hudson River Estuary Program's [Hudson Valley Natural Resource Mapper] is a convenient way to view waterbodies and their classifications in the Hudson Valley and easily download fact sheets from the Waterbody Inventory/Priority Waterbody List. (www.dec.ny.gov/gis/hre/)

The New York State Department of Environmental Conservation assesses freshwater stream segments and open waterbodies and designates "best uses" for waterbodies across the state.

The classifications and best uses for state waterbodies are:

- Class A, AA, A-S, or AA-S - water supply, primary and secondary contact recreation, and fishing
- Class B - primary and secondary contact recreation, fishing
- Class C - fishing and wildlife propagation
- Class D - fishing

Waterbodies classified as A, B, or C may also have an associated standard of (T), indicating they are trout waters, or (TS), indicating they are trout-spawning waters. For more information about the water body classifications see DEC's webpage Water Quality Standards and Classification and the DEC's Classification - Surface Waters and Groundwaters website. The DEC assesses water bodies using various monitoring techniques, including biomonitoring and water quality assessments. When a water body is not meeting the standards for its designated "best use" it may be listed on the Priority Waterbody List as impaired. Impaired water bodies are considered for inclusion on the state's Clean Water Act Section 303(d) List and reported to Congress (New York State Department oF Environmental Conservation, 2018a).

There are four major waterbodies in the City of Poughkeepsie: The Hudson River, the Fall Kill, the Casperkill and tributaries and Morgan Lake. The Fall Kill is classified as a Class C stream and designated as Impaired due to nutrient pollution from urban stormwater runoff and suspected municipal sources (Lower Hudson River Waterbody Inventory/ Priority Waterbodies List, 2008). The Fall Kill Management Plan, documents how human activity has negatively impacted the overall health of the creek (Bean, Lynch, & Burns, 2006). The creek contains high levels of nitrate and phosphate, high chloride levels, and high levels of toxic heavy metals in stream sediments. Additionally, researchers found high levels of fecal coliform and *E. coli* bacteria at all sample sites on the length of the creek. Studies of the fish in the Fall Kill showed that all the species were tolerant to moderately tolerant of pollution, and studies of the macroinvertebrates indicated that while most of the length of the creek is "slightly impacted" by pollution, the lower end is "moderately impacted" (Bean, Lynch, & Burns, 2006).

The Hudson River is a Class A tidal estuary due to its use as a water source for the City of Poughkeepsie and neighboring communities. NYS has designated the River as impaired with known pollutants including metals (cadmium) and PCBs. Sources of pollutants include toxic and contaminated sediments, combined sewer overflows and urban stormwater runoff (Lower Hudson River Waterbody Inventory/ Priority Waterbodies List, 2008). Presence of these contaminants has led to fish consumption advisories. Several NY DEC and DOH networks monitor water quality and use of the Hudson as a source of drinking water and for recreation purposes. In 2018, an intermunicipal council of the seven communities that source their drinking water from the Hudson created the Hudson River Drinking Water Intermunicipal Council, with the focus of long-term protection of the Hudson as a source of drinking water (Riverkeeper, 2018)

Table 3.1. Summary of Waterbody Classification and Impacted Uses in the City of Poughkeepsie, NY (from the Waterbody Inventory/Priority Waterbody List) (Lower Hudson River Waterbody Inventory/ Priority Waterbodies List, 2008)

Waterbody	ID	Class	Water Quality	Uses Impacted	Pollutants	Pollutant source	303(d) list	Notes
Hudson River	1301-0001	A	Impaired	Known: Impaired - Fish Consumption, Stressed - Recreation Suspected: Stressed - public bathing, habitat/hydrology	Known: Metals (cadmium), priority organics (PCBs) Suspected: pathogens, thermal changes	Known: Toxic contaminated sediment, combined sewer overflow, urban stormwater runoff Suspected: Habitat modification, power generation	Yes 2b (Multiple Segment/Categorical Water, Fish Consumption)	Fish consumption use in this portion of the Lower Hudson is impaired by elevated levels of priority organics (PCBs, dioxin), heavy metals (cadmium) and other toxics primarily the result of past industrial discharges Roseton on west shore and Low Point on east shore in general area of Chelsea, to the mouth of the Rondout River in Kingston
Fall Kill	1301-0087	C	Impaired	Known: Impaired - Aquatic Life, Recreation, Stressed - Aesthetics	Known: Aesthetics (debris/trash), Pathogens Suspected: Nutrients (phosphorus, D.O./ Oxygen Demand, Silt/ Sediment, Unknown Toxicity	Known: Urban/Storm Runoff Suspected: Municipal, Industrial Possible: Other Sanitary Discharge	Yes, 3a (Waterbody Requiring Verification of Impairment)	Aquatic life support and recreational uses in the Fall Kill are impaired by nutrient enrichment, pathogens and various other pollutants attributed to municipal inputs and urban nonpoint sources.
Casper Creek and Tribs	1301-0195	C	Minor impacts	Suspected: Aquatic Life - Stressed	Suspected: nutrients (Phosphorus)	Possible: Agriculture, Urban/Storm runoff	n/a	Aquatic life support thought to experience impacts due to nutrient enrichment from non-point sources.
Morgan Lake	1301-0198	Unassessed						
Unnamed trib	1301-0197	Unassessed						Small stream segment near Beechwood Ave.

Potential and Known Sources of Surface Water Pollution

In the City of Poughkeepsie, known and potential sources of surface water pollution include discharges from regulated facilities, stormwater runoff from industrial facilities, discharges from Municipal Separate Storm Sewer Systems (MS4s), and Combined Sewer Overflows (CSOs). Map 3.6 has these potential sources of pollution compiled together on this one map and described in more detail below. Additional resources that provide information about wastewater and stormwater are included in Table 3.2.

Table 3.2: Summary of Resources about Wastewater and Stormwater Infrastructure

Potential Pollutant Source	**Agency**	**Website**
Combined Sewer Overflows (CSO)	NYS DEC	Sewage Discharge Notifications
Multiple Separate Storm Sewer System (MS4)	EPA	Stormwater Discharges from Municipal Sources
Multiple Separate Storm Sewer System (MS4)	NYS DEC	Stormwater
State Pollutant Discharge Elimination System (SPDES)	EPA	Enforcement and Compliance History Online (ECHO)
State Pollutant Discharge Elimination System (SPDES)	NYS DEC	State Pollutant Discharge Elimination System (SPDES) Permit Program
DECinfo Locator Tool – a mapping tool that provides information about the enviromental quality of specific sites	NYSDEC	DECInfo Locator

State Pollutant Discharge Elimination System (SPDES)

In accordance with the Federal Clean Water Act, New York State regulates wastewater and stormwater discharges through the State Pollutant Discharge Elimination System (SPDES) program. The SPDES program is designed to eliminate the pollution of New York waters and to maintain reasonable standards of purity (NYS Department of Environmental Conservation, 2019d). Several sites in the City of Poughkeepsie are regulated under individual permits as well as the Multi-Sector General Permit (MSGP) for Stormwater Discharges Associated with Industrial Activity. In addition, stormwater discharges from the City of Poughkeepsie's municipal stormwater system are regulated under the SPDES Municipal Separate Storm Sewer System (MS4) general permit.

Individual Permits

A SPDES individual permit is required for constructing or using an outlet or discharge pipe ("point source") that discharges wastewater into the surface waters (or ground waters) of the state. Sewage treatment plants and other disposal systems that discharge into waters of the state also require individual permits (New York State Department of Environmental Conservation, 2019e). There are four sites with individual permits in the City of Poughkeepsie. Information about Individual Discharge Permits (Table 3.3) is available through the EPA's Enforcement and Compliance History Online (ECHO, https://echo.epa.gov) and NYSDEC's SPDES Permit Program page (http://www.dec.ny.gov/permits/6054.html).

Table 3.3 SPDES individual permits - Site locations and permit numbers

Permit ID	Facility Name	Location
NY0005673	Poughkeepsie Terminal	Sunfish Cover Road
NY0036731	Poughkeepsie Water Treatment Plant	Dutchess Avenue
NY0071897	Effron Fuel Oil Corp Terminal	Prospect Street
NY0026255	Poughkeepsie Stp	North Water Street

Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity

Industrial facilities must obtain permit coverage for stormwater discharges through either an individual industrial SPDES permit, the SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity, or provide certification using the No Exposure Exclusion that industrial activities are not exposed to stormwater (New York State Department of Environmental Conservation, 2019f). There are four industrial sites in the City of Poughkeepsie with coverage under the MSGP for Stormwater Discharges Associated with Industrial Activity. Information about MSGP facilities in the City of Poughkeepsie (Table 3.4) can be found at https://www.dec.ny.gov/chemical/9009.html. An index of MSGP sites is available through the NYSDEC's SPDES Permit Program page at http://www.dec.ny.gov/permits/6054.html.

Table 3.4 MSGP Facilities – Site locations and permit numbers

Permit ID	Facility Name	Location
NYR00C508	Eisner Brothers Inc	67 Parker Ave.
NYR00F897	Baroni Scrap Metal	20 Van Kleek Drive
NYR00B032	Clinton Point Quarry	Sheafe Rd.
NYR00D602	Cranesville Block Co Inc	18 Sunfish Cove Rd.

Municipal Separate Storm Sewer System (MS4)

The City of Poughkeepsie has storm drains that are separate from the sewer system and are part of the Municipal Separate Storm Sewer System (MS4). MS4 is a specific type of SPDES permit and requires that the community have a stormwater collection and conveyance system that is owned by the City, is not a combined sewer and is not part of the sewage treatment plant or publicly owned treatment works (US EPA, 2018). As an MS4 community, the City of Poughkeepsie must develop, implement and enforce a Stormwater Management Program (SWMP). The SWMP must include 6 Minimum Control Measures (MCMs): Public Education and Outreach, Public Participation/Involvement, Illicit Discharge Detection and Elimination, Construction Site Runoff Control, Post Construction Run-off Control, and Pollution Prevention/Good Housekeeping (NYS Department of Environmental Conservation, 2019g). For more information about MS4s in the City of Poughkeepsie and their SWMP, contact the City of Poughkeepsie Engineering Department.

In the City of Poughkeepsie, storm drains that are not connected to the wastewater treatment facility (are not CSOs) move water directly from roads and rooftops into the nearest waterbody. Twenty-four storm drains, the majority on the north side of Poughkeepsie, drain directly into the Fall Kill. On the south side of Poughkeespie, most outfalls drain into small wetlands and streams, with eight outfalls located on tributaries of the Casperkill. There are six outfalls that drain directly into the Hudson River.

Combined Sewer Overflows

Combined Sewer Overflows (CSOs) convey sewage from homes and businesses as well as stormwater from roads and rooftops through the same system. They are physically separate from MS4s described above which only convey stormwater. In a CSO, all of the water is transported to a sewage treatment facility (POTW, Publicly Owned Treatment Works). During times of dry weather or light rain, these facilities can handle the water entering the system, but when there are significant rainfall events the system cannot handle the volume of water and it overflows directly to the Hudson River. Therefore, during high flow events, there is a combination of stormwater runoff and sewage from homes and business being piped directly into the nearest waterbody.

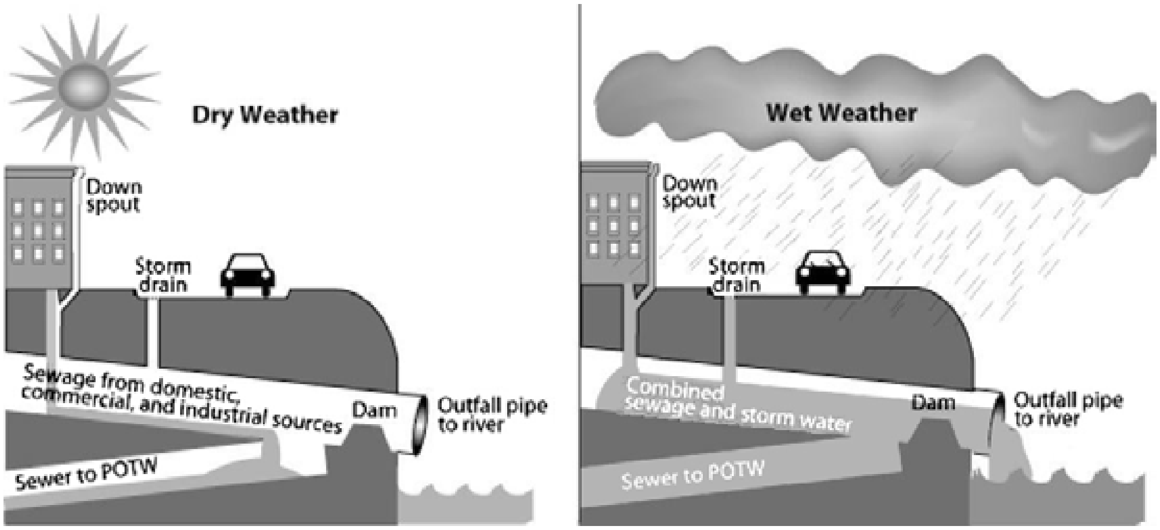
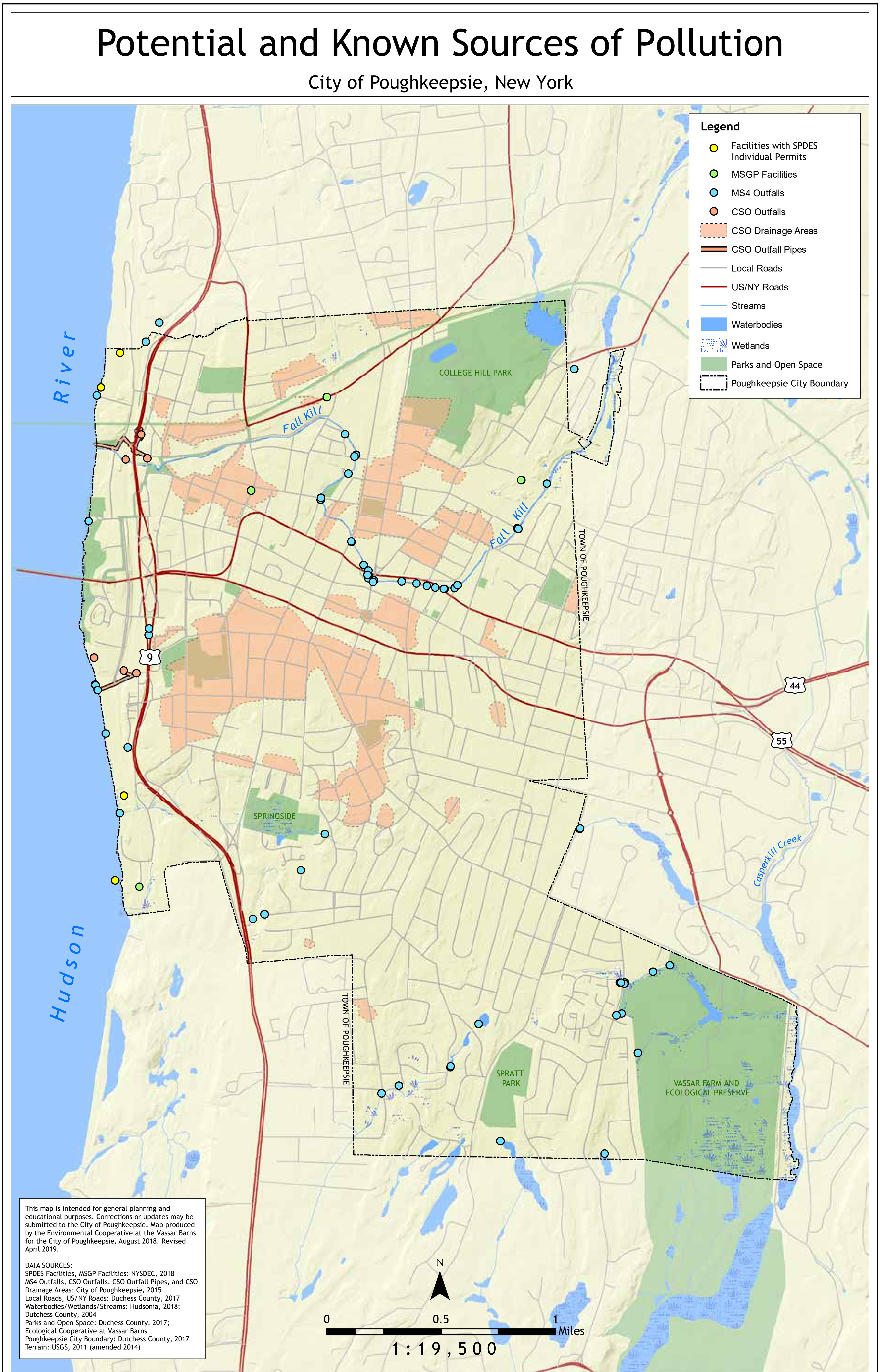


Figure 3.6 Schematic of a typical combined sewer system that discharges directly to surface waters. credit: US EPA

There are about 800 CSOs in New York State, and the City of Poughkeepsie has six CSOs that empty into the Hudson River (NYS Department of Environmental Conservation, 2019h). The Potential and Known Sources of Pollution map (Map 3.6) shows the location of CSO outfalls in the City as well as the drainage areas that contribute to these outfalls. The City is aware of the frequency of the overflows and required to report them to the NYS DEC through a new initiative, the Sewage Pollution Right To Know (SPRTK Act). Under this policy CSO discharges must be reported to the public through NY-Alert within two hours of the incident (DiNapoli, 2018). The City has a long-term plan in the works to separate the sewer system. They have allocated $10 million for future sewer repairs over the next few years that would help reduce, but not eliminate, the CSO discharge (Rolison, 2018). However, the long-term plan for sewer repairs and CSO separation has an estimated cost of over $50 million, and at this time the City can only allocate $2.7 million (Rolison, 2018). Until the sewer system can be separated, sewage will continue to be discharged into the Hudson and the mouth of the Fall Kill through the combined sewer overflows during periods of heavy precipitation. Though the sewage is diluted as it enters the river, it is still a threat to the overall health of the river's ecosystems. Another, perhaps more feasible, strategy for decreasing the impact of CSOs is to prioritize stormwater mitigation in CSO drainage areas, which are identified on Map 3.6. Green infrastructure practices that can be implemented into new development or retrofitted during upgrades is one way to decrease and slow down the amount of stormwater entering the sewer system (New York State Stormwater Management Design Manual, 2015; Palmer & Hesse, 2013).

Map 3.6 Potential and Known Sources of Pollution Map



Culverts and Aquatic Barriers

Grant funding is available through NYS to support the City in its efforts to become better stewards of its water resources. For more information visit the NYS Department of Environmental Conservation Grant Application website. (http://www.dec.ny.gov/pubs/grants.html)

It is important to understand the condition of infrastructure at points where streams and roads intersect. Culverts and bridge crossing can become barriers to the movement of aquatic organisms if they are inappropriately placed or sized, resulting in the stream becoming disconnected as these points. This disconnect results in habitat fragmentation and the decline of animal populations, especially migratory fish such as the American eel, who depend on movement up and down stream for reproduction and life history. These crossings may also become sources of flooding if the culverts and bridge are blocked by woody debris or trash, slowing or blocking the flow of water through the structure. In the City of Poughkeepsie common impacts from stream crossings include an increase in flooding due to clogged culverts and bridge crossings, altered sediment and nutrient processes, increases in erosion of stream banks, and changes in water quality.

In 2016, The Environmental Cooperative at the Vassar Barns conducted a culvert assessment of the Fall Kill and Casperkill Watersheds (Stalzer, Chessman, Schmidt, & Rubbo, 2016) as part of a larger effort by the Hudson River Estuary Program to map and assess aquatic barriers in Hudson Valley streams. This effort is in conjunction with the North Atlantic Aquatic Connectivity Collaborative (NAACC). The NAACC's primary goals are to assess infrastructure to determine how well it maintains the ecological function, hydrology, and passability of the stream for organisms, organic debris, and sediment.

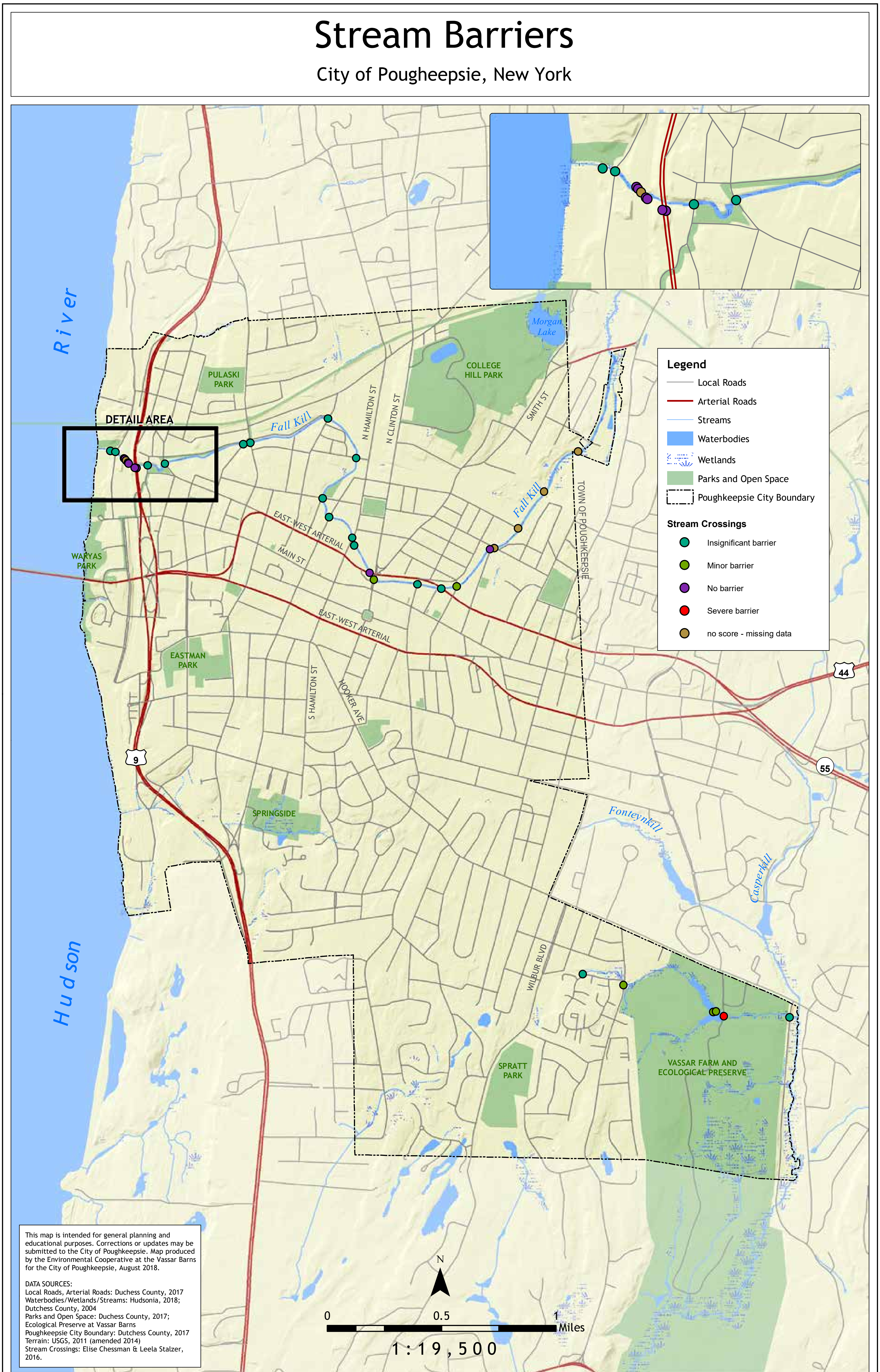
In the City of Poughkeepsie, there were 29 road crossings assessed along the Fall Kill. Researchers assessed each road crossing based the NAAC protocol which includes a suite of 13 variables. These variables are used to create a weighted composite Aquatic Passability score that falls between 0-1, with a score of 1 representing a crossing the meets all passability standards. For mapping purposes, these scores were translated into narrative descriptors (Table 3.5) (Scoring Road-Stream Crossings as Part of the North Atlantic Aquatic Connectivity Collaborative (NAACC), 2015) , which are presented on the Stream Barriers map (Map 3.7). Of the 29 road crossings that were assessed, five could not be scored for various reasons. In-depth results from the Fall Kill and Casperkill study, including assessments of individual culverts and bridge crossing can be accessed at the North Atlantic Aquatic Connective Collaborative Website. While none of the road crossings in the Fall Kill were considered more than a minor barrier, researchers did note that often the amount and composition of trash in the creek could act as a barrier to connectivity as there were several observations of debris piled up to the extent that it was diverting water flow. Blockages of debris at bridge crossing along the Fall Kill contributed, in part, to flooding of neighborhoods during Hurricane Irene in 2011. The City of Poughkeepsie does clean these areas periodically, when reported, however regular clearing of the creek is necessary to maintain connectivity.

A small portion of the Casperkill watershed falls within the City boundaries and in this area, there were six road crossings assessed along the Casperkill. Researchers designated one crossing located on the Vassar Farm and Ecological Preserve as a severe barrier.

Table 3.5. Aquatic passability scores for road crossings within the City of Poughkeepsie.

Descriptor	Aquatic Passability Score	# of Fall Kill Crossings	# of Casperkill Crossings
No Barrier	1.0	8	0
Insignificant Barrier	0.80 - 0.99	14	2
Minor Barrier	0.60 - 0.79	2	3
Moderate Barrier	0.40 - 0.59	0	0
Significant Barrier	0.20 - 0.39	0	0
Severe Barrier	0.00 - 0.19	0	1

Map 3.7 Stream Barriers



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Chapter 4: Biological Communities and Habitats

Significant Habitats in the City of Poughkeepsie, Dutchess County, NY
By Elise Heffernan and Gretchen Stevens, Hudsonia Ltd. May 2018
Summarized by Julia Blass and Jennifer Rubbo

Pollinator garden at College Hill Park.
Photo credit: Camelia Manring

Introduction

In May 2018, Hudsonia Ltd. compiled a Significant Habitats Report for the City of Poughkeepsie as part of the Natural Resources Inventory project funded by the Hudson River Estuary Program (Heffernan & Stevens, 2018). This report assessed the types of habitats present in the City and developed conservation priorities for the protection and restoration of the City's habitats. The report offers important information regarding habitats and the species that live in them in the urban environment. The Hudsonia report outlines the state of the City's habitats, and provides the foundational ecological information necessary for future decisions regarding the intersection of conservation, urban planning and development. The full report is available in Appendix A and it is highly recommended that the report be read in its entirety.

Poughkeepsie is a heavily urbanized area dominated by paved surfaces and the built environment; it is still home, however, to significant areas of habitat that play an important role in the ecological health of the City and the greater Hudson Valley Region. A **habitat** can be defined as "the place where an organism or population lives or where a biological community occurs, and is defined according to both its biological and non-biological components."[1] Habitats include large, **ecologically significant areas** such as the Hudson River, the Fall Kill, and the Vassar Farm and Ecological Preserve. These are areas that include:

- "habitats that are rare or declining in the region, or those that support rare species and other species of other conservation concern;
- common habitats that meet a minimum size criterion for the habitat type;
- complexes of connected habitats that, by virtue of their size, composition, or configuration, appear to have significant biodiversity value."[2]

Other cultivated natural landscapes, such as College Hill Park and Springside, play important roles as habitats that preserve the biodiversity and ecological health of Poughkeepsie's communities. Preservation of the natural areas in the City of Poughkeepsie--from individual trees on the street to the larger tracts of natural land--is important for many reasons. Preserving the City's natural areas provides dual benefits for both Poughkeepsie's human and wildlife populations as these areas function in a variety of ways including: providing habitat, reducing stormwater runoff, mitigating the effects of climate change, providing shade and recreation areas, and beautifying the City.

Moving forward the Significant Habitats Report is a valuable resource to city planners, administration and residents and may be useful as the City:

- reviews a new comprehensive plan,
- approves proposed developments,
- improves its parks,
- and manages land use in the City of Poughkeepsie

Habitats in Poughkeepsie

Almost 20% of the 5.1 mi^2 (3258 ac) of terrestrial area of the City was mapped as ecologically significant habitat. If the Hudson River is included in this calculation, that percentage increases to 29.0% of the City.[3] The Hudsonia report identifies 18 habitat types of potential ecological significance and notes that each of these habitats have been modified by past or present human activities. The ecologically significant habitats located within the City of Poughkeepsie are categorized into three general categories: Upland Habitats, Non-Tidal Wetland Habitats, and Hudson River Habitats and further subdivided into specific habitat types (Map 4.1, Table 4.1). A complete description of the methods Hudsonia used to map habitats can be found in the full report.[4]

1 Hudsonia, 2018 p. 8.
2 Hudsonia, 2018 p. 8.
3 Hudsonia, 2018 p. 23.
4 Hudsonia, 2018 p. 17

Table 4.1 Ecologically significant habitats present in the City of Poughkeepsie, identified by Hudsonia, 2018.[5]

Habitat Category	Specific Habitat Type	Brief Description[6]
Upland Habitats	Upland Hardwood Forest	Non-wetland forest dominated by hardwood trees (conifers make up < 25% of canopy).
	Upland Conifer Forest	Non-wetland forest dominated by conifer trees (>75% of canopy).
	Upland Mixed Forest	Non-wetland forest with a mix of hardwoods and conifers (conifers make up 25-75% of canopy).
	Crest/Ledge	Upland area with shallow soil and partially exposed bedrock.
	Upland shrubland	Open (nonforested) area with shrubs making up > 20% of ground cover
	Cultural	Open area (may have scattered trees) mowed frequently or other-wise managed in an intensive way (lawn, playing field, golf course, garden, park, cemetery).
	Waste Ground	Land that has been severely altered by human activity but lacks pavement or structures. Gravel mines, quarries, dumps, wetland fill, abandoned lots, or construction sites. Places where soil has been removed, and sometimes replaced [like fill].
Non-Tidal Wetland Habitats	Hardwood and shrub swamp	Wetland (identified by predomi-nance of hydrophytic vegetation) dominated by trees and/or shrubs.
	Intermittent woodland pool	Small wetland partially or fully surrounded by forest with no surface water inlet or outlet.
	Marsh	Wetland dominated by hydrophytic herbaceous vegetation that stays saturated/flooded most of the time.
	Wet meadow	Area of seasonally saturated or flooded soils dominated by hydro-phytic herbaceous vegetation.
	Spring/seep	Location where groundwater discharges to ground surface

5 Hudsonia, 2018 p. 24.
6 Hudsonia, 2018, unpublished brief descriptions of habitats

	Constructed pond	Man-made body of water with a mostly managed shoreline (bordered by developed or cultural areas).
	Open water	Body of water (natural or manmade) with a mostly undeveloped shoreline.
	Stream	Intermittent stream – stream that has flow at least part of the year, including man-made ditches. Perennial stream – stream that generally flows year-round.
Hudson River Habitats	Riprap and native rocky shore	Manmade or naturally occurring rocky shore, sparse plant life and unknown faunal diversity
	Tidal tributary mouth	Area where mixing of tidal and non-tidal water occurs, where tributary and river meet.

Detailed descriptions of all habitat types, including their ecological attributes, the species that they could potentially support, and their conservation values can be found beginning on p.24 of Hudsonia's report. A list of species of conservation concern that have been documented in or near the City of Poughkeepsie is provided in Appendix F, (Species of Conservation Concern in the City of Poughkeepsie, NY). The largest habitat types in Poughkeepsie, which include the Hudson River, streams, upland hardwood forests, and cultural areas, are discussed below.

The Hudson River is the largest contiguous habitat in the City of Poughkeepsie and its most significant ecological resource. Poughkeepsie is located within the tidal portion of the Hudson River, known as an estuary. Though connected to the Atlantic Ocean by tides, the Hudson is entirely freshwater in Poughkeepsie, a globally-rare habitat. It is a designated NYSDEC Significant Biodiversity Area that supports many rare species as well as regionally important fisheries (Penhollow, Jensen, & Zucker, 2006). Poughkeepsie also lies within the Kingston-Poughkeepsie Deepwater Significant Coastal Fish and Wildlife Habitat as designated by the New York State Department of State (NYS Department of State). It is a well-known spawning area for the Atlantic sturgeon and overwintering grounds for the shortnose sturgeon, both of which are listed as federally endangered species (NYS Department of State, 2012). It is an important habitat for many other migratory and resident fish species including the American eel, American shad, blueback herring, striped bass, fourspine stickleback, hogchoker, and white perch (NYS Department of State, 2012). In addition to fish it provides habitat and food for many other organisms, such as blue crab, bald eagles, and a variety of waterfowl (NYS Department of State, 2012).

Seventy percent of the shoreline in Poughkeepsie is made up of rock riprap and native rock[7] (Map 4.2). These rocky areas are harsh environments since temperature fluctuates radically, they are temporarily inundated due to tides, ice scours the banks in the winter, and there is wind and wave disturbance. The largest threat to these areas is sea-level rise and more frequent flooding. Development of the shoreline should take into account these potential and predicted changes to the water levels at the shoreline (see Ch.7 for more information about Climate Change in Poughkeepsie). The Hudson River Sustainable Shorelines project is an effort through the Hudson River National Estuarine Research Reserve to disseminate and facilitate best practices for shoreline management in light of potential climate change impacts. More information about this project can be found at https://www.hrnerr.org/hudson-river-sustainable-shorelines

Streams in Poughkeepsie include both perennial streams, which have water year-round, and intermittent streams which only flow seasonally or after heavy rain (see Chapter 3. Water Resources). Streams provide important aquatic habitat for a variety of fish, invertebrates, amphibians and bird species. Equally important is the riparian area adjacent to the stream. Intact riparian areas are typically forested, providing shade to the stream as well as habitat to a host of both aquatic and terrestrial animal species. Two perennial streams located in the City of Poughkeepsie are major tributaries to the Hudson River: the Fall Kill on the north side, and the Casperkill, which flows along the southeastern border of the City. The Fall Kill is highly impacted by channelization and pollution, nonetheless it continues to serve as an important habitat for migratory fish species such as the American eel and river herring. The area along the Fall Kill, adjacent to the City Department of Public Works, is an important site when considering ecosystem services of the creek. The stream is not channelized in this area and there are intact areas of floodplain forest that provide important habitat and floodwater retention and storage (see Ch. 3 Water Resources).

The small portion of the mainstem of the Casperkill within the City is located on the Vassar Farm and Ecological Preserve. The Casperkill is exposed to high levels of non-point source pollution for much of its length; however, as it flows through the Vassar Preserve, water quality improves due to an intact riparian buffer. Biomonitoring studies have shown a change in benthic macroinvertebrate indicators from "poor" upstream of the Preserve to "very good" at sampling points on the Preserve (Menking, Cunningham, Foley, Freimuth, & Smith, 2009). Practices that will increase the quality of habitat within streams include: 1) reducing surface runoff into the stream; 3) decreasing impervious surfaces in the watershed; and 2) maintaining and restoring a vegetated riparian buffer that includes shade providing trees where possible. Historically, there were more streams in the City of Poughkeepsie which are now mapped as small stream fragments throughout the City. It is likely that these are now buried or piped and no longer provide the ecosystem services of a natural stream. (see Ch. 3 Water Resource for more information about buried streams in the City).

Upland Hardwood Forests comprise the most extensive terrestrial habitat type in the City of Poughkeepsie, with the largest habitat patches of forest found on the Vassar Farm and Ecological Preserve. Large mature trees also exist throughout the City in smaller remnants of forest, such as at College Hill Park and Springside. These patches of large mature trees potentially provide habitat for important small mammals such the federally endangered Indiana Bat (Appendix F) which has been observed in Poughkeepsie and its vicinity. Several priority bird species associated with larger forest habitats have been identified in or near

7 Hudsonia 2018 p. 61

Poughkeepsie and might use forest areas in the City, including Kentucky warbler, scarlet tanager, and wood thrush, among others (Appendix F). It is important to note that, while the Hudsonia maps only depict forest areas that are 0.2 acres or greater, street trees and backyard trees also contribute to the urban forest ecosystem. In addition to acting as refuge and food source for many species of birds, butterflies, and other insects, mature trees provide a multitude of services to people as well. These include cooling from shade, carbon sequestration, reducing stormwater runoff, and improvement of air quality. (Chapter 5 of the Natural Resources Inventory discusses the benefits of urban trees in more detail.)

Cultural areas are second largest habitat type in Poughkeepsie. These consist of areas that are actively managed yet not paved, such as mowed lawns, public parks, athletic fields and golf courses. Due to high levels of management these areas may not support a large diversity of plant and animals species. However, a few rare species that have adapted to urban areas occur in or near the City, including the state endangered peregrine falcon and state special concern common nighthawk (Appendix F). Additionally, cultural areas serve an important role in connecting more natural undeveloped habitats while offering open space for people, facilitating outdoor activities and engagement with nature in this otherwise paved and built landscape (See Chapter 6 Cultural, Recreational and Historic Resources).

Access to these public greenspaces is important when considering their benefit to the health of Poughkeepsie residents. Studies have shown the positive impacts of greenspaces and parks on both the mental and physical health of residents (Liu, Li, Li, & Zhang, 2017; Richardson, Pearce, Mitchell, & Kingham, 2013; Wood, Hooper, Foster, & Bull, 2017). Living close to (within 1/3 mile) parks or open spaces, especially those that allow interactions with nature, has been significantly associated with mental health benefits such as increased self-confidence and relaxation (Liu, Li, Li, & Zhang, 2017). Residents living within a 10-15 minute walk (1 mile) of a park or greenspace, whether nature focused, recreation, or athletic, had more positive states of mental well-being, with a corresponding increase in mental well-being as the number of and access to parks increased (Wood, Hooper, Foster, & Bull, 2017). Additionally, the risk of cardiovascular disease decreased in neighborhoods with >15% greenspace (Richardson, Pearce, Mitchell, & Kingham, 2013). Hudsonia's report identifies areas that are within walking distance (500m, 10-minute walk) of habitat areas located on public land (Map 4.3).[8] Several areas in the City have been identified as lacking in public greenspace, including the area near Main Street and Cannon Street and the south-central portion of the City.

8 Hudsonia, 2018 pg. 40

Map 4.1 Significant Habitat Areas in the City of Poughkeepsie

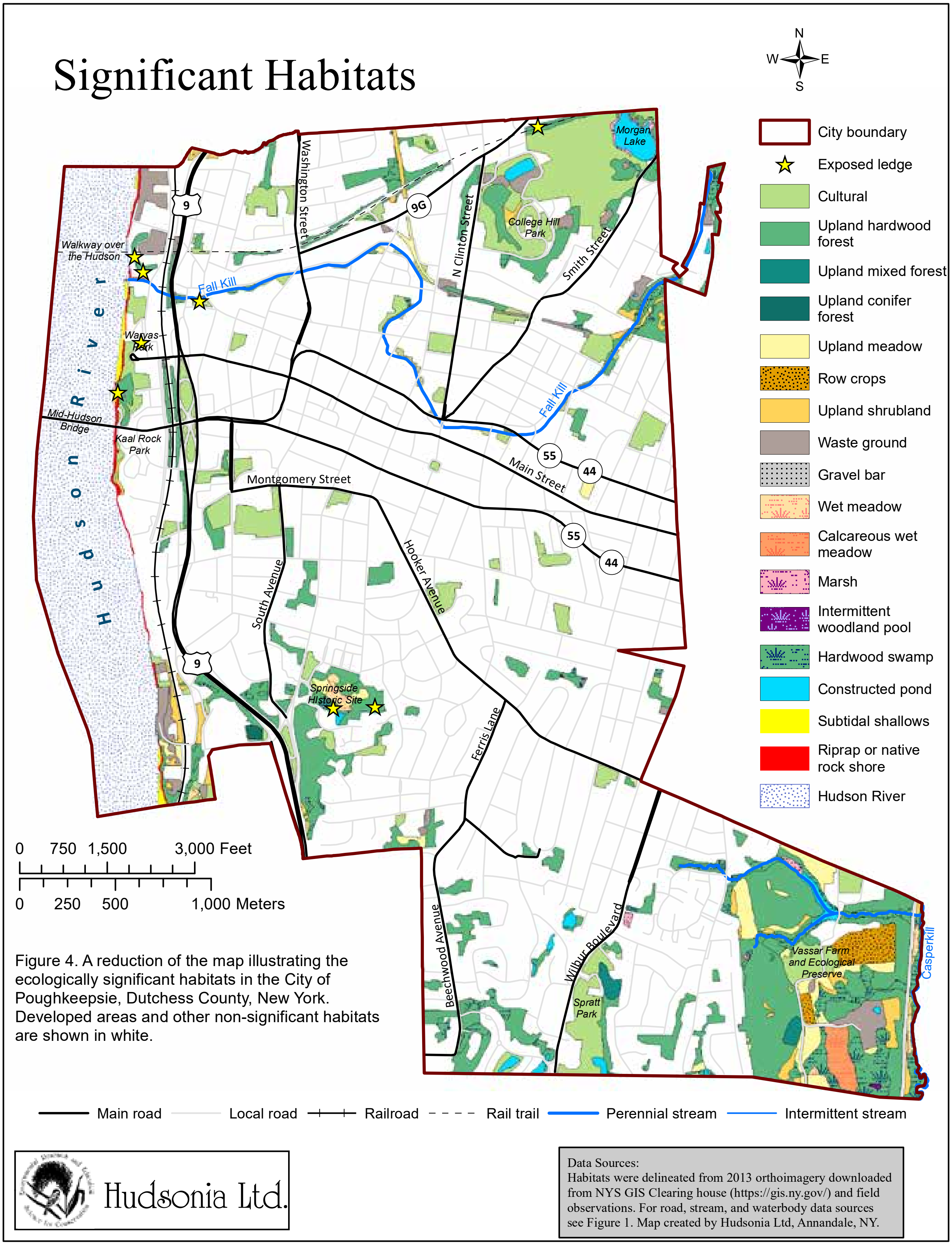

Figure 4. A reduction of the map illustrating the ecologically significant habitats in the City of Poughkeepsie, Dutchess County, New York. Developed areas and other non-significant habitats are shown in white.

Data Sources:
Habitats were delineated from 2013 orthoimagery downloaded from NYS GIS Clearing house (https://gis.ny.gov/) and field observations. For road, stream, and waterbody data sources see Figure 1. Map created by Hudsonia Ltd, Annandale, NY.

Map 4.2 Shoreline materials and models of the sea – level rise in the City of Poughkeepsie

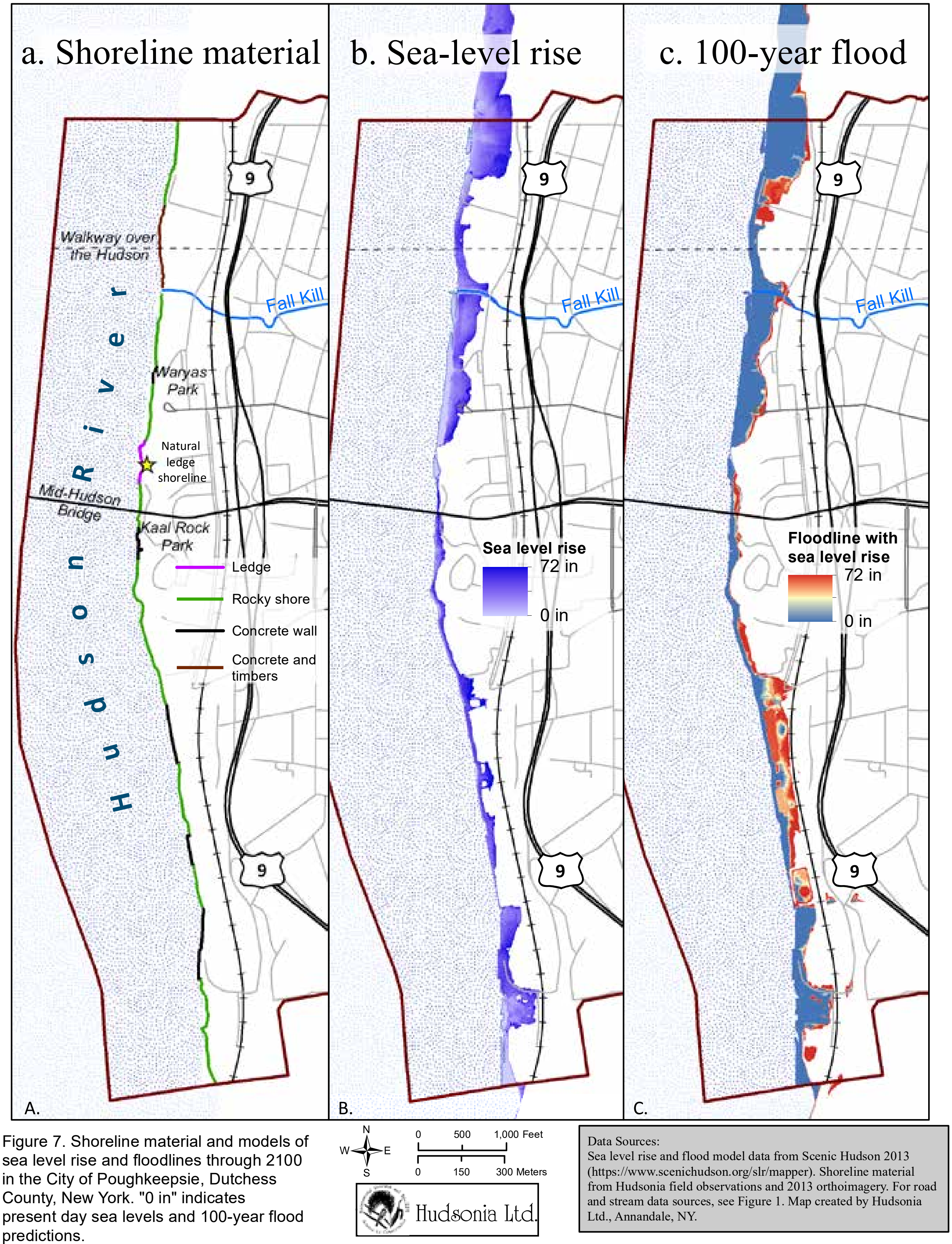

Figure 7. Shoreline material and models of sea level rise and floodlines through 2100 in the City of Poughkeepsie, Dutchess County, New York. "0 in" indicates present day sea levels and 100-year flood predictions.

Data Sources:
Sea level rise and flood model data from Scenic Hudson 2013 (https://www.scenichudson.org/slr/mapper). Shoreline material from Hudsonia field observations and 2013 orthoimagery. For road and stream data sources, see Figure 1. Map created by Hudsonia Ltd., Annandale, NY.

Map 4.3 Public Access Greenspaces in the City of Poughkeepsie

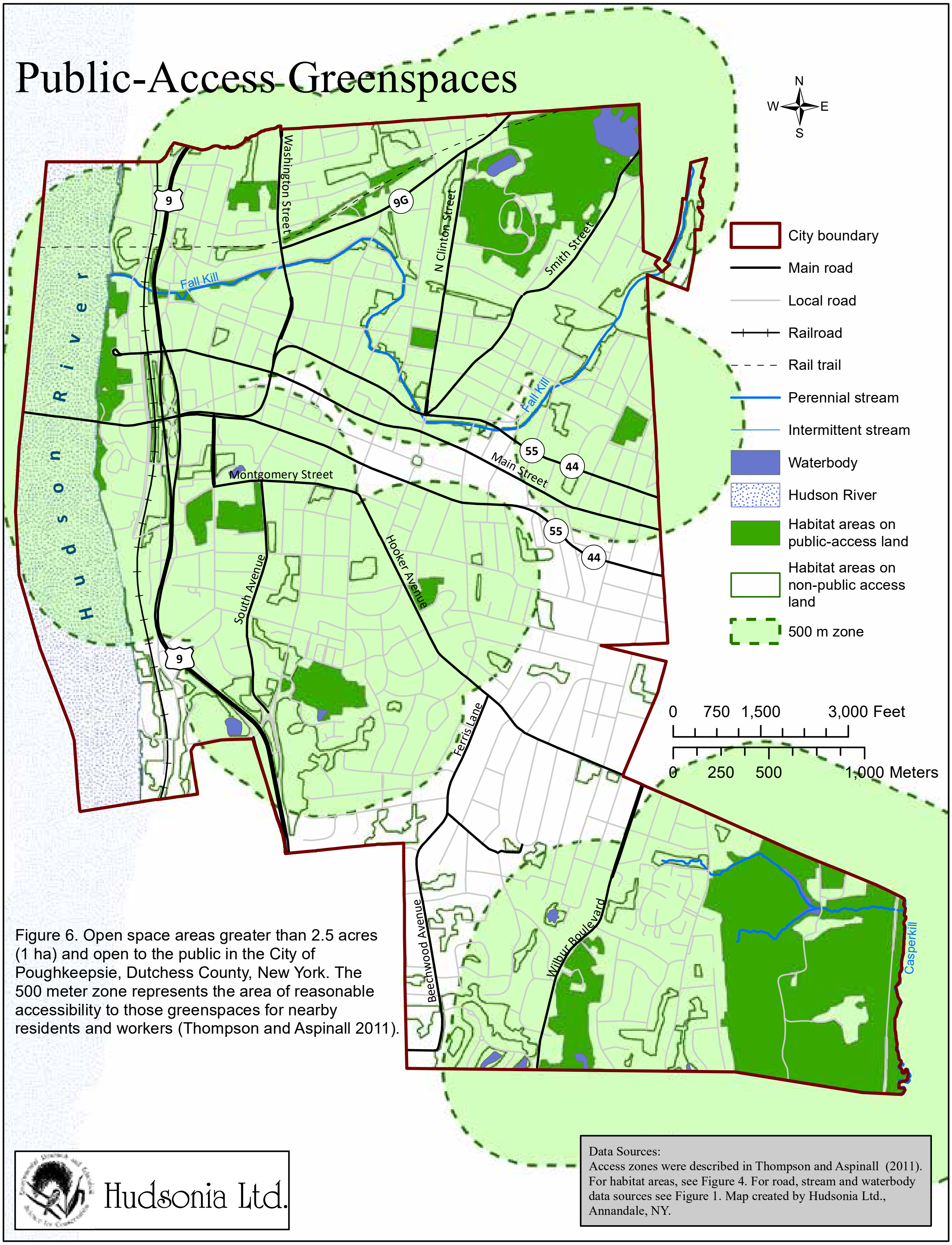

Figure 6. Open space areas greater than 2.5 acres (1 ha) and open to the public in the City of Poughkeepsie, Dutchess County, New York. The 500 meter zone represents the area of reasonable accessibility to those greenspaces for nearby residents and workers (Thompson and Aspinall 2011).

Data Sources:
Access zones were described in Thompson and Aspinall (2011). For habitat areas, see Figure 4. For road, stream and waterbody data sources see Figure 1. Map created by Hudsonia Ltd., Annandale, NY.

Conservation Priorities and Planning

The City of Poughkeepsie is a predominantly developed landscape. However, of the 3,258 terrestrial acres of the City, 658 acres (20.2%) of the landscape is undeveloped at present. This number represents the 162 acres (5%) of intensively managed parkland and recreation areas and the 496 acres (15.2%) of undeveloped areas that are considered ecologically significant habitat.98 These habitats are explained in Table 4.2 and include representative species that might occur in these habitats although have not necessarily been recorded in the City of Poughkeepsie. Hudsonia provides a detailed list of conservation strategies specific to each priority habitat, and these recommendations can be found beginning on p. 85 of the full report.

Table 4.2 Priority habitats and conservation zones in the City of Poughkeepsie identified by Hudsonia, 2018.[10]

Priority Habitat	Representative Species or Group of Concern	Priority Conservation Zone	Rationale
Large contiguous forest	Forest interior-breeding birds	Unfragmented areas with a high percentage of forest cover and/or wetland complexes	Maximizes the occurrence and breeding success of species.
Large meadow	Grassland-breeding birds	Unfragmented patches greater than 10 ac (4 ha)	Required for successful breeding and maintenance of viable populations.
Intermittent woodland pool	Pool-breeding amphibians	750 ft. (50 m) from stream edge	Encompasses non-breeding season foraging and refuge habitats and dispersal routes between pools.
Fall Kill and intermittent streams	Aquatic communities of streams	160 ft. (50 m) from stream edge	Provides streamside habitats, helps to reduce and filter surface runoff, provides shading vegetation, and provides organic material that supports the food web and habitat structure of the stream.
Casperkill	Aquatic communities of streams and wood turtle	650 ft. (200 m) from stream edge	Encompasses most of the critical habitat including hibernacula, nesting areas, spring basking sites, foraging habitat, and overland travel corridors.
Hudson River shoreline zone	Hudson River freshwater tidal communities	400 ft. (120 m) from mean high water	Accommodates for storm surges, and allows for inland migration of tidal habitats in response to sea level rise.

9 Hudsonia, p. 74.
10 Hudsonia, p. 78 (full references for table information as well).

Many historical land use decisions in the region have been made on a site-by-site basis without considering the ecological impacts on the surrounding lands. The goal of presenting detailed ecological information is that both individual landowners and City officials and planners will become more familiar with how their lands fit in with the larger ecological landscape, and that this will inspire habitat protection measures. With these measures, the City of Poughkeepsie can curb the loss of natural resources that can result from urban development. Additionally, the maintenance and conservation of greenspaces (both managed and natural) benefit the human population of the City. Aside from the aesthetic and ecological services provided by natural areas in urban settings, these spaces can be used for recreation, social gathering, community gardens, and environmental education. In these ways, greenspaces can benefit the social networks and foster place-based belonging in a community.

The means of habitat protection can be both regulatory and non-regulatory. Some examples include: volunteer conservation efforts, master planning, zoning ordinances, tax incentives, land stewardship incentives, changing permit conditions, and public education. Hudsonia suggests that the City can implement some of these general City-wide practices to foster biodiversity and habitat conservation[11].

- Protect large, contiguous, undeveloped tracts wherever possible;
- Protect high quality isolated habitat patches;
- Plan landscapes with interconnected networks of undeveloped habitats;
- Preserve natural disturbance processes;
- Restore and maintain broad buffer zones;
- Direct human uses toward the least sensitive areas and previously-disturbed areas and minimize the alteration of natural features;
- Encourage development of altered land instead of unaltered land;
- Encourage and provide incentives for developers to consider environmental concerns early in the planning process;
- Minimize areas of impervious surfaces;
- Establish land uses along the riverfront that are resilient to flooding;
- Expand public access to the Hudson River shoreline;
- Restore degraded habitats wherever possible;
- Modify the urban landscape to provide more habitat elements; and
- Promote the establishment of conservation agreements on parcels of greatest ecological value.

11 Hudsonia, 2018 p.71.

More information on all of these practices can be found beginning on p. 71 of Hudsonia's full report.

Specific recommendations for City-wide conservation planning include[12]:

1. Protecting and Restoring Habitats – large blocks of habitat that were identified as priority areas in the City of Poughkeepsie include the area along the Fall Kill near and adjacent to the DPW transfer station, Springside, and the Vassar Farm and Ecological Preserve. Specific recommendations for the conservation and management of habitats found in the City can be found starting on page 85 of the Hudsonia report.
2. Enhancement of Developed Areas – Within developed areas of the City small habitat patches exist. These small areas are important for many species and act as buffers to intact habitats and provide travel corridors as well as food and refuge for a number of different wildlife species. Specific activities that will enhance small habitats, as well as examples of ways to minimize disturbance to resident and migratory biota, can be found starting on page 89 of the Hudsonia report.

Two tools specific to the City of Poughkeepsie in the Hudsonia report are a map of Habitat Envelopes and Potential Corridors (Map 4.4) and a map of Conservation Zones (Map 4.5). Often green spaces in urban areas that provide habitat for organisms and services to the human population are quite small. However, these areas such as hedgerows, vacant lots, and even backyard trees can provide stepping stones between large habitats or refuge for many important species as well as aesthetic benefits to local neighborhoods. The Habitat Envelopes and Potential Corridors map identifies these small areas that are not large enough to be mapped as "significant habitat" but are likely acting as habitat and connecting larger habitat patches.

Conservation zones in the City of Poughkeepsie focuses on areas adjacent to the waterways located within the City: the Hudson River, Fall Kill and the Casperkill Creek. Much of the adjacent land to these waterways is already developed, but when possible actions to restore the buffer, plant trees, and create pocket parks can occur. These actions will not only increase the amount of small habitats within the City but also improve in-stream conditions.

As the City of Poughkeepsie undergoes revitalization, the natural habitats now present and possible in the City should be considered and understood as ways to reduce flooding, increase cooling, beautification, foster social cohesion and community pride, and sustain biodiversity.

12 Hudsonia, 2018 p.85

Map 4.4 Habitat Envelopes and Potential Corridors in the City of Poughkeepsie

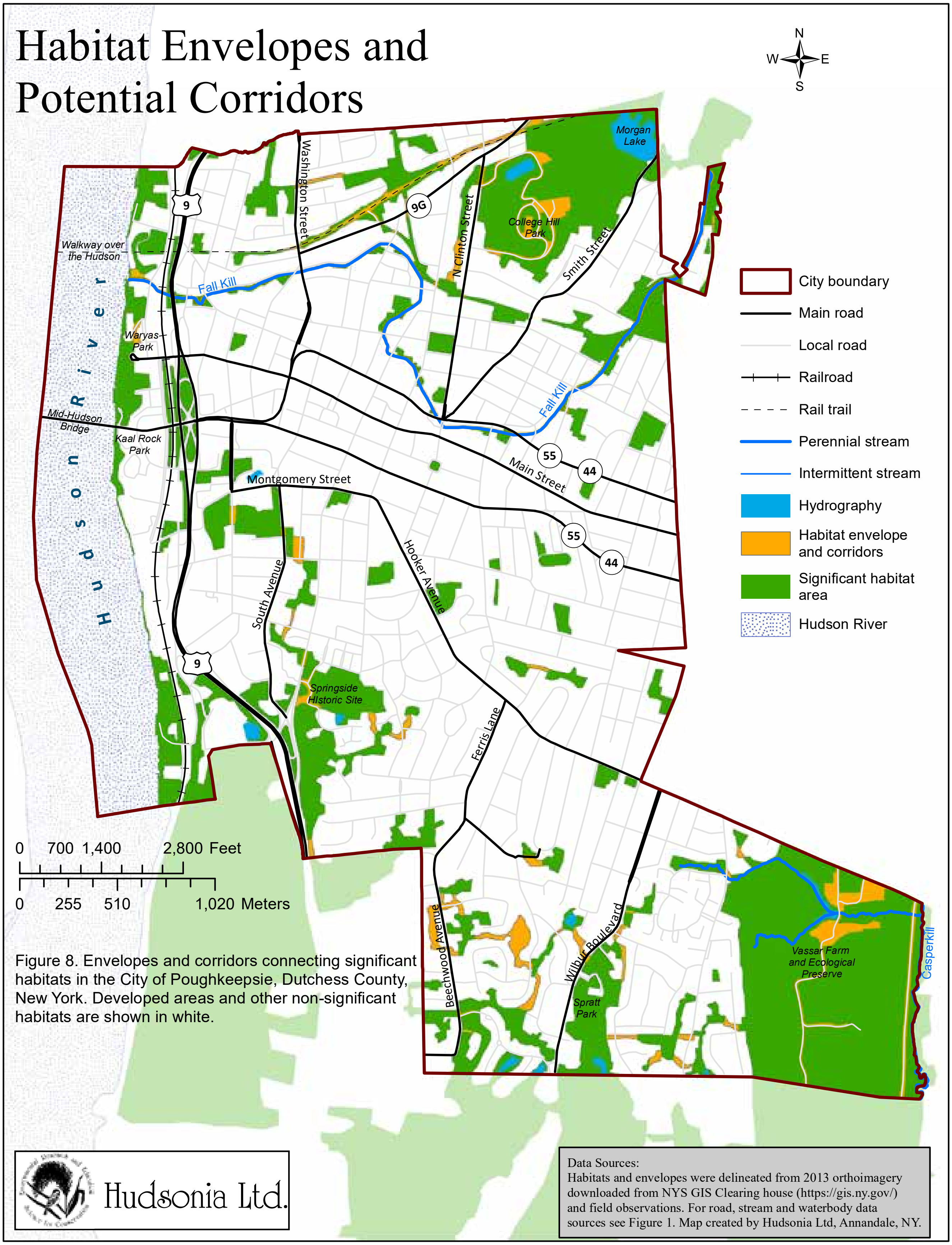

Figure 8. Envelopes and corridors connecting significant habitats in the City of Poughkeepsie, Dutchess County, New York. Developed areas and other non-significant habitats are shown in white.

Map 4.5 Conservation Zones in the City of Poughkeepsie

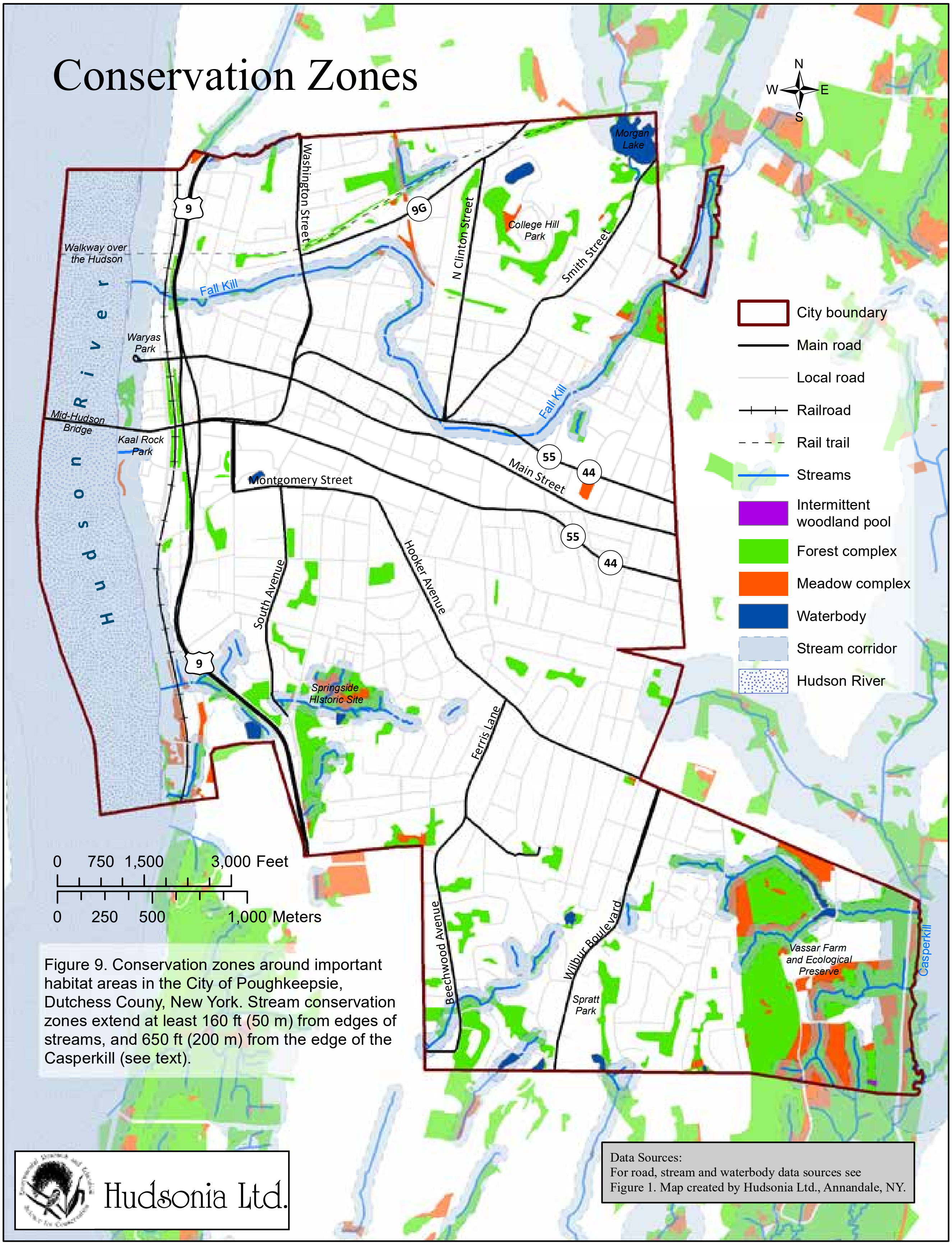

Figure 9. Conservation zones around important habitat areas in the City of Poughkeepsie, Dutchess Couny, New York. Stream conservation zones extend at least 160 ft (50 m) from edges of streams, and 650 ft (200 m) from the edge of the Casperkill (see text).

Full Citation:

Heffernan, Elise, and Gretchen Stevens. *Significant Habitats in the City of Poughkeepsie, Dutchess County, New York*. Hudsonia Ltd., 2018, pp. 1–123.

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Wood, L., Hooper, P., Foster, S., & Bull, F. (2017). Public green spaces and positive mental health - investigating the relationship between access, quantity, and types of parks and mental well-being. *Health and Place, 48*, 63-71.

Chapter 5: Land Use

Camelia Manring, Elise Chessman, India Futterman, Mitchell Davis, Neil Curri and Jennifer Rubbo

Upper Landing Park.
Photo credit: Camelia Manring

Land use is a general term that refers to "human activities on land which are directly related to the land" (Clawson, 1965). Land use includes the stewardship of natural landscapes such as forested and wetland areas, as well as the regulation and management of developed areas, including residential, commercial, and industrial sites. Some examples of land use management that have implications for natural resources are zoning, surveying, real property tax regulations, and conservation efforts. This chapter explores and identifies current land use in the City of Poughkeepsie and looks closely at status and management of the urban forests.

Zoning

The City of Poughkeepsie implements zoning regulations intended to promote public health, safety, and general welfare of its inhabitants.

Section 19.1-2 of the City's zoning code elaborates on the key purposes of local land use regulations, explaining that the zoning code is in place to ensure "the continued viability and improvement of the City's residential environment and economy and the assurance of adequate and necessary sites for a full range of residential, industrial, commercial, recreational, open space and public and quasi-public uses reflecting local and appropriate regional needs." (1979 City of Poughkeepsie Zoning Ordinance)

From "residential" and "commercial" uses to "recreational" and "public" uses, the City of Poughkeepsie's zoning code exists for the improvement, management, and protection of the City's land and inhabitants, fulfilling its purpose through a series of specific regulatory standards. These standards are applied to different zones throughout the City designated for specific types of land uses.

Based on the current zoning map (City of Poughkeepsie Zoning Districts, 2017), there are 24 different zoning districts in the City of Poughkeepsie (Table 5.1). A copy of the zoning map is provided in Appendix G. In general, commercial use is permitted in the C zones, industrial use is permitted in the I zones, residential use is permitted in the R zones, and other uses are permitted in various other zones designated below.

Table 5.1. Zoning Districts in the City of Poughkeepsie

Zoning District (Abbr.)	Zoning District Name
C-1	NEIGHBORHOOD COMMERCIAL
C-2	RESEARCH AND DEVELOPMENT
C-2A	MAIN STREET COMMERCIAL
C-3	GENERAL COMMERCIAL
H-M	HOSPITAL MEDICAL
I-1	LIGHT INDUSTRIAL
I-2	GENERAL INDUSTRIAL
O-R	OFFICE RESIDENTIAL
PRD	PLANNED RESIDENTIAL DEVELOPMENT
R-1	LOW-DENSITY RESIDENCE
R-2	MEDIUM LOW-DENSITY RESIDENTIAL
R-2A	CENTRAL LOW DENSITY
R-3	MEDIUM-DENSITY RESIDENCE
R-3A	CENTRAL MEDIUM DENSITY RESIDENTIAL
R-4	MEDIUM HIGH-DENSITY RESIDENTIAL
R-4A	CENTRAL URBAN DENSITY RESIDENTIAL
R-5	HIGH-DENSITY RESIDENCE DISTRICT
R-6	URBAN DENSITY RESIDENCE
R-D	RESEARCH & DEVELOPMENT
W	WATERFRONT
WTOD	WATERFRONT TRANSIT ORIENTED DEVELOPMENT
G-OM	OFFICE MANUFACTURING
G-CM	MIXED-USE COMMERCIAL
G-RM	MIXED-USE RESIDENTIAL

Residential districts comprise about one third (> 1,000 acres) of the City's approximately 3,300 acres of land area (i.e., excluding the Hudson River). This represents the largest zoned use in the City compared to commercial, industrial, and other uses.

Since permitted land uses in different districts may have different impacts to natural resources or provide different opportunities for natural resource management and conservation, the location and extent of the districts indicate where those potential impacts and opportunities are present. City managers may wish to implement zoning regulations that incorporate mitigation and conservation strategies specific to uses within each district. For example, several industrial and commercial districts are located along the Fall Kill. Permitted uses within these districts may impact water quality in the creek from point or non-point source pollution. Therefore, Poughkeepsie officials may wish to require any new developments in these districts to implement management strategies and/or specific techniques to remove or mitigate their impacts to the creek.

Land Use

Map 5.1 illustrates the different land uses in the City of Poughkeepsie using real property tax assessment information for each land "parcel." The City of Poughkeepsie's assessor classifies the use of each parcel based on the New York State Department of Taxation and Finance property type classification codes (New York State Department of Taxation and Finance, 2018).

Many specific classification codes are provided in the New York State Assessor's Manual and used by the City's assessor to classify the uses of all the properties in the City as part of assessing their real property value. For the purpose of Map 5.1, the land uses were condensed into broader categories. For example, properties with the assessed land use classes for one-, two-, and three-family residences, and larger multi-unit residences are all represented in the map simply as "residential". Since the assessor's purpose in classifying properties is to ensure that land can be taxed appropriately, it is not necessarily suitable for land management or other natural resource management purposes. However, it does illustrate the general distribution of land uses across the City and reveals some land uses patterns in specific areas.

For example, land uses south of the eastbound US-44/NY-55 arterial and east of US-9 are largely residential. A commercial corridor is present along Main Street, between the east and westbound US-44/NY-55 arterial. The pattern of land use north of the westbound US-44/NY-55 arterial and west of US-9 is comprised of a heterogeneous mix of residential, commercial, industrial and other uses.

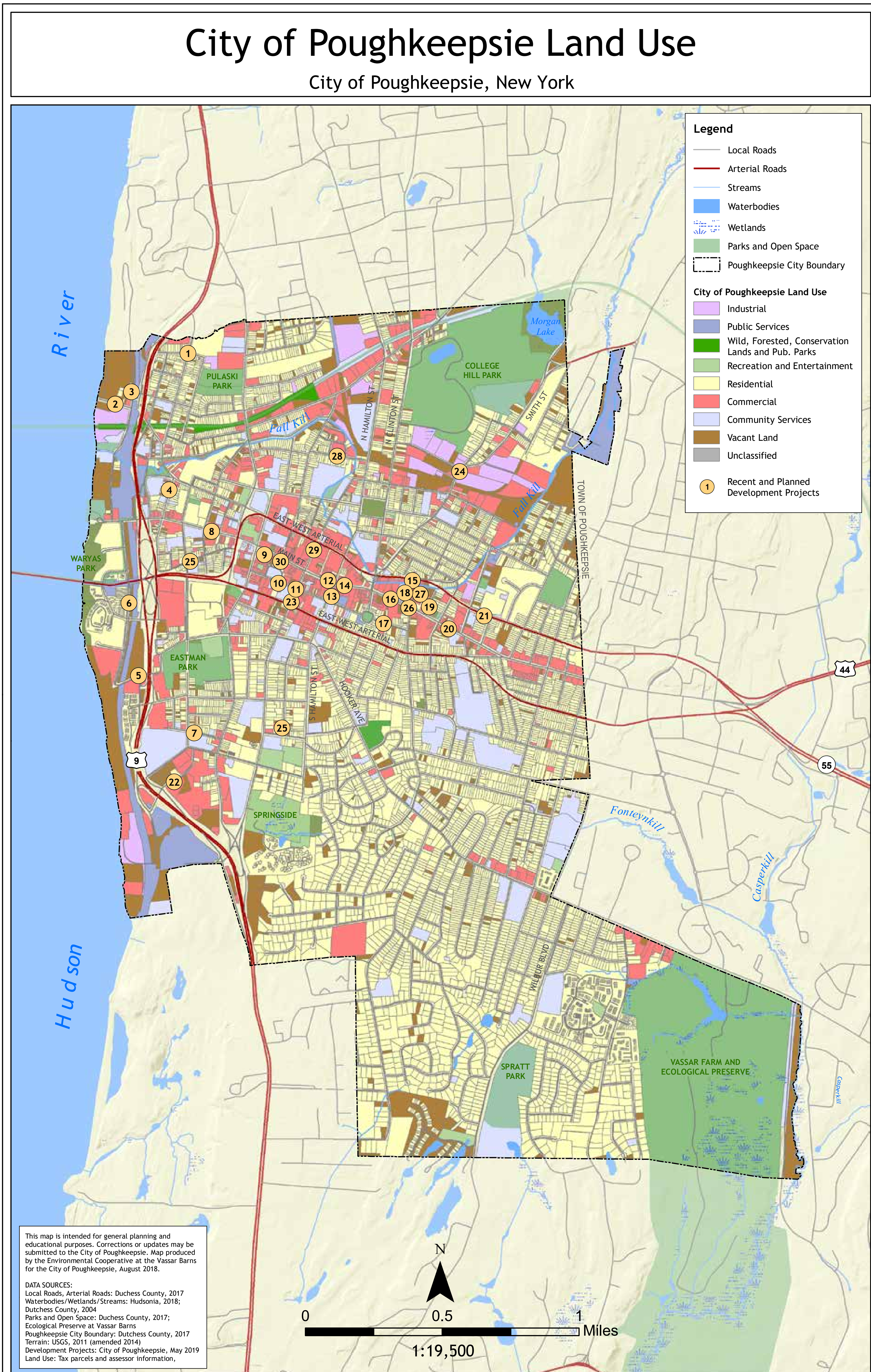
While those general patterns are not likely to change in the near future, there has been an increase in development as the City undergoes revitalization efforts, which will convert the uses of some individual properties over time as projects are completed. Map 5.1 (Table 5.3) includes sites that are in the process of or have been approved for development, based on information obtained from the City of Poughkeepsie (Quinn, 2019). For the most up-to-date information, please contact the city planning office using the contact information at http://cityofpoughkeepsie.com/building.

Table 5.2 Current development projects in the City of Poughkeepsie (Quinn, 2019)

Map Key #	Project Name	Address	Residential Units	Commercial (sf)	Status
1	North Point Centre	Delafield and Spruce St	18	12,000	Under Construction
2	One Dutchess Avenue	One Dutchess Avenue	300	13,800	Under Construction
3	141 N Water St	141 N. Water Street	15	-	Approved site plan
4	Pelton Manor	36 N. Clover Street	44	-	Planning Board
5	Water Club	36 Pine Street	136	-	Completed
6	Poughkeep-sie Landing (DeLaval)	Rinaldi Blvd	50	30,000	Pre-planning
7	Vassar Hospital Expansion	Reade Place	-	752,000	Under Construction
8	Queen City Lofts	178 Main Street	70	12,000	Under Construction
9	Up to Date	278-282 Main Street	19	11,000	Pre-planning
10	40 Cannon (Cardinal Court)	40-44 Cannon Street	49	7,000	Completed
11	23 Academy/77 Cannon	23 Academy/77 Cannon	30	6,000	Planning Board
12	387 Main Street	387 Main Street	22	4,200	Approved site plan
13	12 S. Hamilton	12 S. Hamil-ton Street	9	2,100	Completed
14	407 Main Street	407 Main Street	14	3,000	Under Construction
15	400 Maple Street	400 Maple Street	20	1,500	Under Construction
16	Trolley Barn Redevelopment	489 Main Street	1	28,000	Under Construction

17	148 Cannon Street	148 Cannon Street	13	-	Planning Board
18	Poughkeepsie Underwear Factory	8 N. Cherry Street	15	7,000	Completed
19	Fallkill Commons on Rose	Rose Street	78	-	Under Construction
20	560-564 Main street	560-564 Main Street	20	2,300	Approved site plan
21	Heart of the Block (Maple Street)	Maple Street	40	-	Under Construction
22	Marist Health Quest School of Medicine	Fox Street	-	100,000	Pre-planning
23	The Hive	33-35 Academy Street	28	24,000	Approved site plan
24	MPI Expansion	165 Smith Street	-	10,000	Approved site plan
25	84-86 Carroll Street	84-86 Carroll Street	16	-	Approved site plan
25	160 Union Street	160 Union Street	41		Planning Board
26	508-516 Main Street	508-516 Main Street	60		Common Council for Rezone
27	Cigar Factory	15 N. Cherry Street	40		Conceptual
28	27 High Street	27 High Street	60	-	Pre-planning
29	Crannell Square	35 Catharine Street	75		Planning Board
30	289 Main Street	289 Main Street	6	5,700	Planning Board

Map 5.1 Land use in the City of Poughkeepsie



Brownfields

A brownfield is an abandoned, idled, or underused industrial or commercial property whose redevelopment may be complicated by the presence or potential presence of contamination (US Environmental Protection Agency, 2018). Sources of environmental contamination at brownfields are often associated with former industrial and commercial operations involving the use or disposal of hazardous materials. In some cases, former uses at brownfields predate modern environmental laws regulating the handling, storage, and disposal of hazardous substances. Contamination at brownfields may also be the result of outdated, malfunctioning, or poorly-maintained equipment, leaking petroleum or chemical bulk storage tanks, accidental spills, improper handling of equipment and materials, or intentional dumping or on-site disposal of materials. Based on the anticipated use of the property, some contamination may remain at brownfields after remediation. These sites must have engineering controls (e.g., soil capping, subsurface venting systems, mitigation barriers, fences) and institutional controls (e.g., use restrictions, environmental easements) that are designed to prevent human exposure to contaminants.

Like many other former manufacturing and commercial centers in the northeastern US, Poughkeepsie contains several properties that may be considered brownfields due to their former industrial and commercial use and the presence or potential presence of environmental contamination. Some of these sites have been remediated through various programs implemented by New York State Department of Environmental Conservation (NYSDEC).

The U.S. Environmental Protection Agency (USEPA) and NYSDEC implement several environmental cleanup and brownfields programs to remediate contaminated sites and encourage their redevelopment. Abandoned hazardous waste sites placed on the federal National Priorities List (NPL) are eligible for remediation under the Superfund Program. NYSDEC implements environmental cleanup and brownfields programs on properties where a contaminant is present at levels exceeding the soil cleanup objectives or other health-based or environmental standards, criteria or guidance.

The City of Poughkeepsie contains 17 sites managed under the following NYSDEC environmental cleanup and brownfields programs (New York State Department of Environmental Conservation, 2019):

- State Superfund Program
- Brownfield Cleanup Program
- Environmental Restoration Program
- Voluntary Cleanup Program

For more information about these programs, see the NYSDEC Environmental Cleanup & Brownfields website at http://www.dec.ny.gov/chemical/brownfields.html.

The remediation sites are given a "Site Class" based on their inclusion in the state Registry of Inactive Hazardous Waste Disposal Sites, or "Registry." Sites listed on the Registry are commonly said to be sites in the "State Superfund Program" and whose cleanup status is indicated by a Site Class of 1 through 5. Non-Registry sites are those that are being investigated and remediated in a brownfield program or other environmental remediation program and are not listed in the Registry. The cleanup status of Non-Registry sites is indicated by a Site Class of A (Active), C (Completed), P (Potential), PR (Potential RCRA Corrective Action, and N (No Further Action at This Time).

There are two Registry sites in the State Superfund Program, classified as "2" (Table 5.3). The "2" Site Class is assigned to a site at which:

- the disposal of hazardous waste has been confirmed and the presence of such hazardous waste or its components or breakdown products represents a significant threat to public health or the environment; or
- hazardous waste disposal has not been confirmed, but the site has been listed on the Federal National Priorities List (NPL).

One of the two Registry sites in the City of Poughkeepsie is the Hudson River, part of the Hudson River PCB Sediments site that includes the entire river from Hudson Falls in Washington County, New York, to the Battery in New York City, and is also listed on the NPL.

Table 5.3 NYSDEC Environmantal Cleanup and Brownfields Sites in the City of Poughkeepsie

Site Name (link to the description on NYSDEC website)	NYSDEC Program	Site Class	Address
19, 21, & 23 Academy Street	Brownfield Cleanup Program	A	19, 21, & 23 Academy Street
400 Block Restoration Area	Environmental Restoration Program	C	413-441 Main St
A.C. Dutton Greenway City	Brownfield Cleanup Program	C	1 Dutchess Avenue
CH - Bayeaux Street Poughkeepsie MGP	State Superfund Program	C	Main Street and North Perry Street
CH - Laurel St. - Poughkeepsie MGP	Voluntary Cleanup Program	C	Laurel Street
CH - Water St. - Poughkeepsie MGP	Brownfield Cleanup Program	A	North Water Street
Former A.C. Dutton Lumber Yard	Brownfield Cleanup Program	C	1 Dutchess Avenue
Former City of Poughkeepsie Sewage Plant	Brownfield Cleanup Program	C	176 Rinaldi Boulevard
Former Hamilton Reproduction	Environmental Restoration Program	C	166-186 North Hamilton Street
HRH Lead Abatement Site	State Superfund Program	A	55 Garden Street
Hudson River PCB Sediments	State Superfund Program	2	Hudson River, Hudson Falls-NYC Battery
Hudson River Waterfront-DeLaval Property	Environmental Restoration Program	C	202-204 Rinaldi Blvd.
PURA -14 Property	Environmental Restoration Program	C	Pine Street
PURA-14 Site	Brownfield Cleanup Program	C	36 Pine Street
Qual Krom Site	Environmental Restoration Program	C	28 Orchard Place
Queen City Lofts	Brownfield Cleanup Program	C	178-188 Main Street and 11 South Bridge Street
Schatz Plant	State Superfund Program	2	70 Fairview Avenue

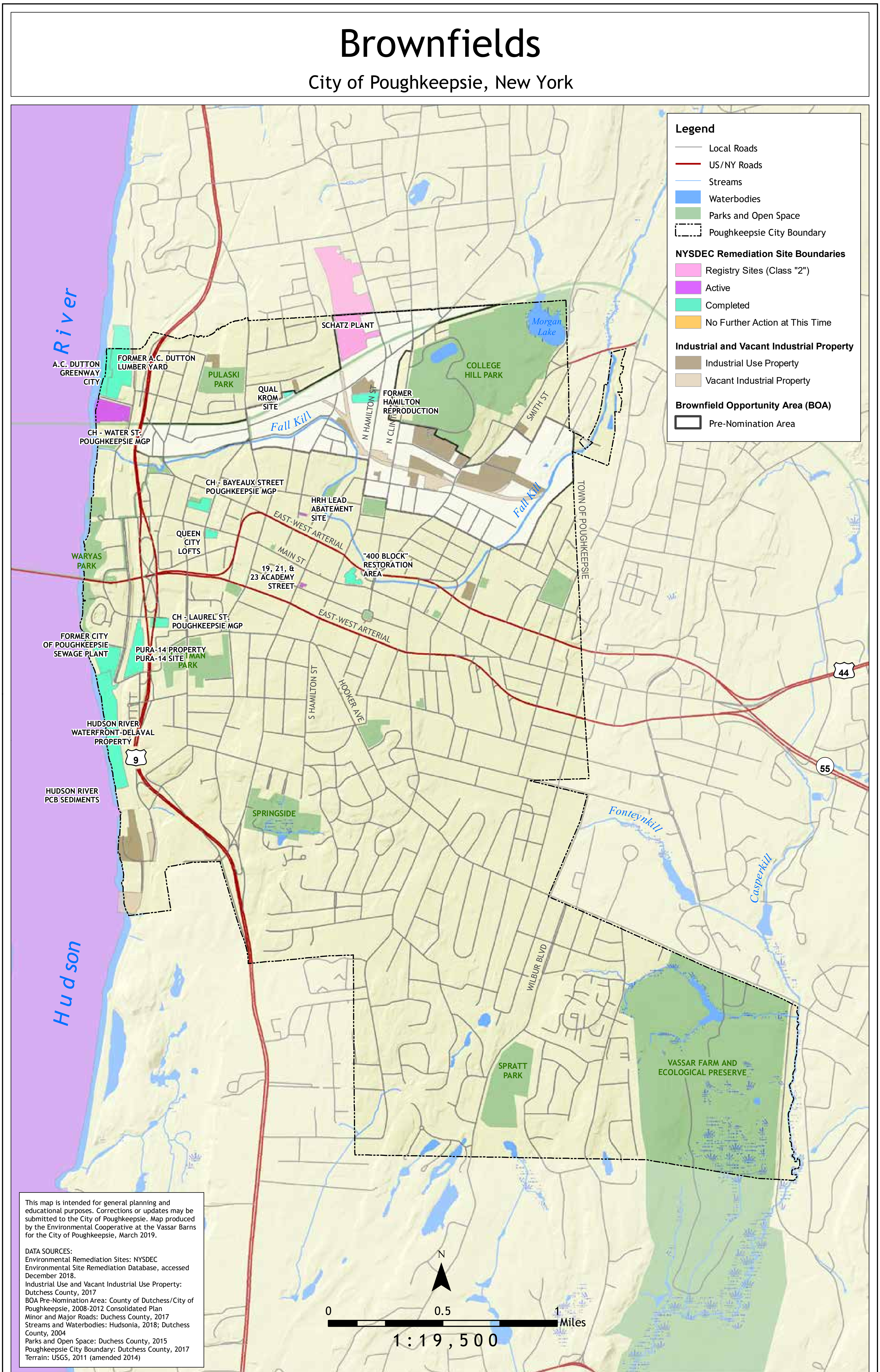
2 - Registry site / A – Active / C – Completed / N - No Further Action at This Time

Of the other 15 non-registry sites in the City of Poughkeepsie, three are designated Site Class A (active) sites and twelve are C (completed) (Table 5.3). Active sites are those in any of the state's programs where work is underway and not yet complete. Completed sites are those where remediation has been satisfactorily completed under one of the state's remedial programs. Sites classified as "No Further Action at this Time" may include sites deemed not warranted to place on the Registry; where conditions after initial waste removal did not require additional work; where the site was being addressed under another program; where remediation under a brownfield program was not completed; or where the site was withdrawn from the program. For more detailed descriptions of these classifications, see the NYSDEC Site Classification page at http://www.dec.ny.gov/chemical/8663.html.

In addition to programs for owners and developers to incentivize the clean-up of individual brownfield sites, New York State also implements the Brownfield Opportunity Areas (BOA) Program through the Department of State (NYSDOS). This program provides communities with guidance, expertise and financial assistance to complete BOA Nomination Plans, which are revitalization strategies for neighborhoods or areas affected by brownfields or economic distress. A pre-nomination study was conducted for the City of Poughkeepsie, which outlined a historically industrial area in the northern portion of the City along sections of the Fall Kill Creek and a former rail line (County of Dutchess, City of Poughkeepsie, 2007). This area contains several industrial and vacant industrial properties based on tax parcel and assessment data obtained from Dutchess County. No further steps in the BOA nomination process have been completed nor are any currently planned (Hesse, 2019).

Map 5.2 includes the NYSDEC environmental remediation sites listed in Table 5.3, the above-mentioned BOA pre-nomination area, and the assessed industrial and vacant industrial properties in the City of Poughkeepsie.

Map 5.2 Brownfields in the City of Poughkeepsie



Urban Canopy Cover

Urban canopy cover describes the area covered by trees within a city's limits, specifically street trees, trees on public parklands, and trees on private residences. This "urban forest" contributes significantly to local human and environmental health, economic prosperity, and the overall sustainability of an urban area. Among the most influential physical benefits of urban canopy cover are substantial storage and sequestration of carbon, reduction of air pollution and urban heat islands, interception of stormwater, wildlife habitat, and improvement of aesthetics and property value (Peper, et al., 2007, Mullaney, et al., 2015). There are social and psychological benefits to urban forests as well, improving the perceived safety of an area, alleviating mental stress, and providing social infrastructure for community building (Beyer, et al., 2014, Shanahan, et al. 2015, Beatly, 2017). These benefits of urban forestry quantify the environmental, economic, and social value necessary to ensure proper management, planning and policy decision-making.

Carbon Storage and Sequestration:

Carbon sequestration for urban forests can be defined as the amount of carbon annually removed from the atmosphere and stored within the biomass of trees. With the gradual increase of carbon emissions globally, urban trees will have a critical role in removing these harmful chemicals from our cities, improving the health and longevity of these environments. Urban forests in the United States are estimated to have stored 700 million metric tons of carbon at an annual rate of about 22.8 million metric tons. (Nowak & Crane, 2002)

Air Pollution and Heat Island Reduction:

As urban areas grow, so does their potential for increased pollutants. Poor air quality is known to be harmful to human and environmental health. Urban canopy cover can drastically improve air quality through the direct removal of airborne pollutants such as ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide (Nowak & Crane, 2002). This removal has implications beyond health improvements. Increased urban canopy cover reduces energy consumption in buildings, which consequently reduces air pollutant emissions from power plants and other sources (Nowak, Appleton, Ellis, & Greenfield, 2017). Urban areas are additionally experiencing severe heat island effects, whereby a built area is hotter than its peripheral rural areas, consequently increasing summertime peak energy demand, air conditioning costs, air pollution, greenhouse gas emissions, heat-related illness, and mortality, and negatively impacting water quality (US Environmental Protection Agency, 2019). Urban canopy cover can significantly reduce these negative externalities by providing shade and through evapotranspiration, effectively cooling surface and air temperatures (Nowak, Hirabayashi, Bodine, & Greenfield, 2014).

Stormwater Mitigation:

Vegetation intercepts rainfall and runoff during heavy rainfall events and can improve the resilience and safety of an urban area. The monetary value of this natural infrastructure in protecting a neighborhood from flooding or water damage far exceeds any built system. This does not only aid in protecting from storm events, but also helps to filter runoff before it enters local waterbodies, benefiting water quality, habitat values, and human water uses.

Increased Property Value:

With the percentage of the world's population expected to live in cities by 2050 nearing 70% (United Nations, 2018), conserving and prioritizing the natural environments of urban settings will be crucial. Property value is known to increase with proximity to parks and greenspace, as does the number of trees per lot, so maintaining and improving urban forests will serve to both increase property value as well as environmental integrity (Beatly, 2017).

Individual and Social Benefits:

Trees in an urban setting have profoundly positive social and health implications, ranging from reduced crime to alleviation of stress and overall happiness. There has been significant research on how more frequent contact with nature improves mental and physical health, is positively correlated with decreased crime and increased perceived safety of an area, and promotes general happiness of urban residence (Beatly, 2017).

Urban Canopy Cover in Poughkeepsie:

Dutchess County planning recently conducted a survey gauging the City's canopy cover at 30% (Wills, 2017). Map 5.3 illustrates that the tree canopy is highly concentrated in parks and preserve areas, and south of the Main Street corridor. Interestingly, there are parks and open spaces that currently do not have canopy cover, signifying the potential of the areas for future tree plantings. Trees provide the city with considerable benefits that can be amplified with awareness, maintenance, and improvement of the existing canopy. Urban canopy cover remains a vital but primarily unrecognized part of the urban ecosystem, especially for Poughkeepsie as it continues to develop.

Quantifying and protecting this resource and its myriad of environmental, social, individual, and economic assets will be critical to the future of Poughkeepsie's development and sustainable urban-nature balance. Tools such as i-Tree, a software that provides urban and rural forestry analysis and benefits assessment, can help the City understand the importance of urban canopy cover (USDA Forest Service, 2019).

The i-Tree software randomly selects points in a provided area in a Google Maps Aerial image to be determined either as tree canopy or not. These data are then compiled to produce a percentage of canopy cover for that specific area. Information about stormwater drainage, carbon sequestration, and heat reduction can then be calculated to help understand the benefit of the City's network of trees.

Map 5.3 Canopy Cover in the City of Poughkeepsie

Street Trees

The City of Poughkeepsie Shade Tree Commission was established in 1978 to oversee the planting and care of public street trees in the City of Poughkeepsie (City of Poughkeepsie, 2019). According to a 2006 street tree inventory commissioned by the Committee and conducted by Urban Forestry, LLC (Pleninger, 2006), there are 84 species of trees throughout the City, with a total of 6,987 individual street trees. Visualizing the locations and distributions of street trees is an important component of urban planning. The trees are displayed as points on Map 5.4 with no symbolic distinction between species (see Table 5.4 for individual species populations). It should also be noted that these points are based on the address of the property they are associated with, not their actual physical position. In other words, these points have not been "ground-truthed" in the field, and as such the location of these points on the map may be slightly different than the actual location of the trees. Moreover, many trees may have been removed or planted in the last decade since the 2006 inventory was created. Currently, the City of Poughkeepsie is in the process of updating the street tree inventory (City of Poughkeepsie, 2018).

i-Tree in Poughkeepsie – Future Analysis

A worthwhile future project for the City of Poughkeepsie would be to use i-Tree to analyze the current canopy cover. This would dovetail nicely with the current City tree inventory that focuses on street and park trees. To accurately analyze canopy cover of all trees in the City of Poughkeepsie we suggest plotting enough points in i-Tree to sufficiently account for the average parcel size and total number of parcels in city limits, resulting in about 11,500 points. i-Tree is simple to use and we feel this is a feasible goal if ample time can be devoted to it, perhaps through the help of local college interns. This analysis would provide a real world reference for understanding the presence and frequency of canopy cover in the urban environment to inform management of the urban forest. www.itreetools.org

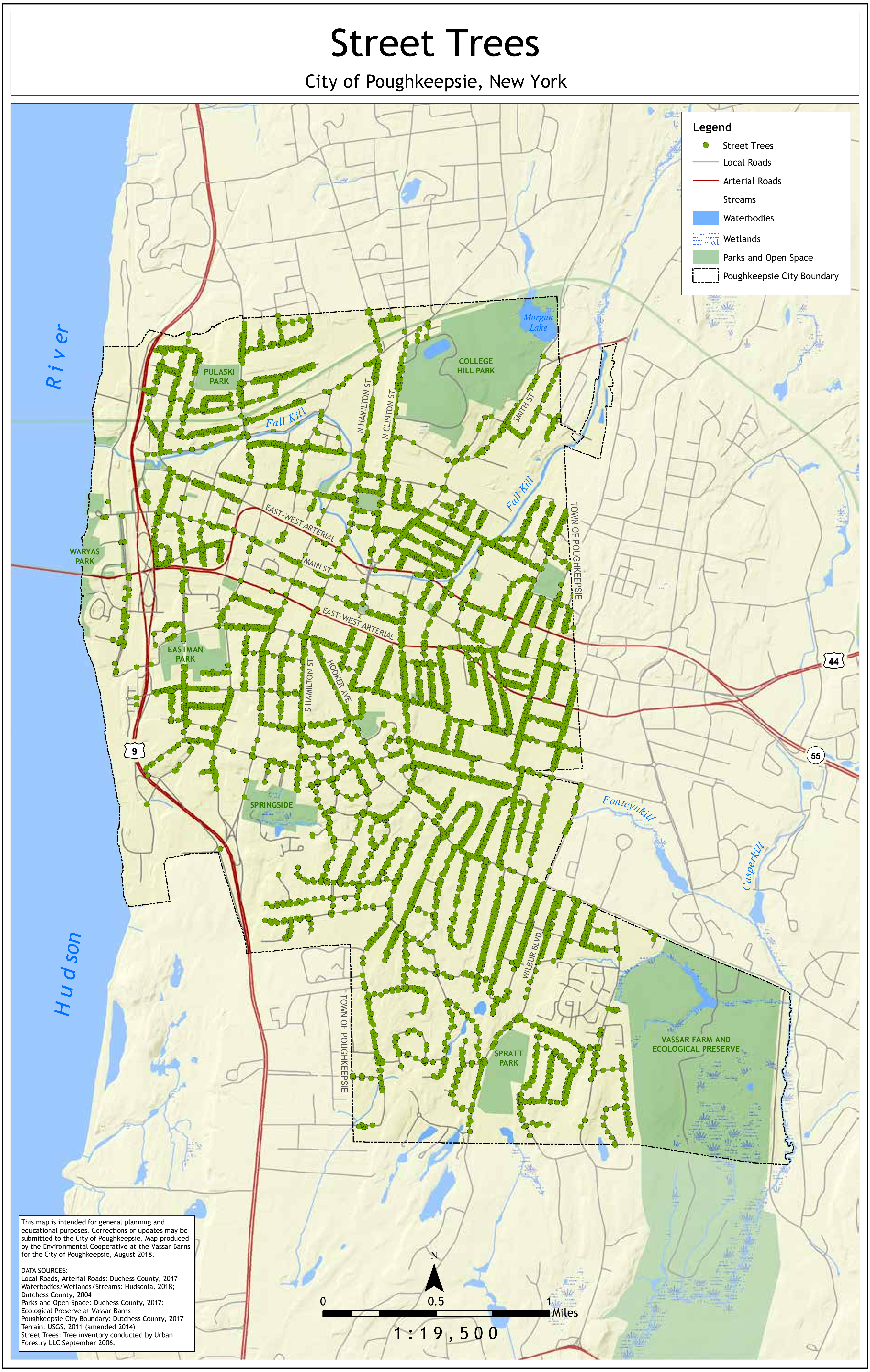
Table 5.4 Number of Street Trees Per Species (2006 Data)

Tree Species	**Population**
Acer platanoides (Norway Maple)	2,370
Malus species (Crabapple species)	753
Cercis canadensis (Eastern Redbud)	433
Prunus serrulata (Kwanzan Cherry)	383
Fraxinus pennsylvanica (Green Ash)	341
Gleditsia triacanthos (Honeylocust)	320
Quercus palustris (Pin Oak)	236
Pyrus calleryana (Bradford Pear Cultivars)	235
Tilia cordata (Littleleaf Linden)	217
Acer platanoides (Crimson King)	147
Acer rubrum (Red Maple)	125
Quercus rubra (Red Oak)	108
Acer saccharum (Sugar Maple)	106
Platanus x acerifolia (London Planetree)	102
Syringa reticulata (Japanese Tree Lilac)	72
Acer saccharinum (Silver Maple)	68
Crataegus species (Hawthorn species)	66
Ginkgo biloba (Gingko)	51
Pinus strobus (Eastern White Pine)	48
Prunus species (Cherry Plum species)	46
Acer ginnala (Amur Maple)	43
Fraxinus americana (White Ash)	42
Robinia pseudoacacia (Black Locust)	40
Ulmus americana (American Elm)	38
Picea pungens (Blue Spruce)	35
Acer campestre (Hedge Maple)	33
Acer platanoides Schwedleri	32
Platanus occidentalis (Sycamore)	29
Pyrus species (Pear species)	26
Prunus cerasifera (Purple Leaf Plum)	25
Picea abies (Norway Spruce)	24
Sophora japonica (Japanese Pagoda Tree)	24
Koelreuteria paniculata (Golden Raintree)	20

Pinus nigra (Austrian pine)	20
Populus deltoides (Cottonwood)	19
Morus alba (White Mulberry)	18
Crataegus phaenopyrum (Washington Hawthorn)	16
Pseudotsuga menziesii (Douglas Fir)	16
Ulmus pumila (Siberian Elm)	16
Juniperus virginiana (Eastern Red Cedar)	15
Ailanthus altissima (Tree of Heaven)	13
Zelkova serrata (Japanese Zelkova)	13
Acer hippocastanum (Horsechestnut)	12
Liquidambar styraciflua (American Sweetgum)	12
Phellodendron amurense (Amur Corktree)	12
Acer palmatum (Japanese Maple)	11
Cornus florida (Flowering Dogwood)	10
Carpinus betulus (European Hornbeam)	9
Malus sylvestris (Common Apple)	9
Prunus serotina (Black Cherry)	9
Catalpa speciosa (Northern Catalpa)	8
Picea glauca (White Spruce)	8
Quercus alba (White Oak)	8
Tsuga canadensis (Eastern Hemlock)	8
Juglans nigra (Black Walnut)	7
Acer negundo (Boxelder)	6
Acer pseudoplatanus (Sycamore Maple)	6
Fagus sylvatica (European Beech)	6
Prunus x yedoensis (Yoshino Cherry)	6
Betula pendula (European White Birch)	5
Carya ovata (Shagbark Hickory)	4
Magnolia species	4
Quercus macrocarpa (Bur Oak)	4
Cercidiphyllum japonicum (Katsura)	3
Cladrastis kentukea (Yellowwood)	3
Cornus kousa (Kousa Dogwood)	3
Rhamnus cathartica (Buckthorn)	3

Sorbus aucuparia (European Mountain Ash)	3
Tilia americana (Basswood)	3
Carya glabra (Pignut Hickory)	2
Castanea mollissima (Chinese Chestnut)	2
Celtis occidentalis (Hackberry)	2
Liriodendron tulipifera (Tuliptree)	2
Salix species (Willow species)	2
Thuja occidentalis (Eastern Arborvitae)	2
Cornus mas (Cornelian Cherry Dogwood)	1
Cotinus purpurea (Smoke Tree)	1
Ilex opaca (American Elm)	1
Larix decidua (Common Larch)	1
Prunus persica (Common Peach)	1
Prunus virginiana (Common Chokecherry)	1
Quercus coccinea (Scarlet Oak)	1
Quercus velutina (Black Oak)	1
Taxus species (Yew species)	1
TOTAL	6,987

Map 5.4 Street trees in the City of Poughkeepsie based on the 2006 tree inventory



Ash Trees and the Emerald Ash Borer

The emerald ash borer (EAB) is an invasive beetle first discovered in Michigan in 2002 after arriving in wooden packing material from Asia. It was first seen in New York State in 2009. The Emerald Ash Borer has become established in the Mid-Hudson Valley in recent years, and once a tree is infested with the insect it dies within 2-4 years (NYS Department of Environmental Conservation, 2019). The insect is well established among ash populations in Dutchess County, posing a serious threat to Poughkeepsie's ash tree population. Map 5.5 is the result of a 2017 survey of the City's street ash tree population, undertaken to assess the current impact of EAB on City trees. The map is based on data from the Shade Tree Commission's 2006 street tree inventory. Ash tree locations were identified from the 2006 tree inventory and each location was ground-truthed in the field, and points removed or added as needed. A total of 387 trees were assessed in the field.

In the summer of 2017, over half of the 387 ash trees in the City were symptomatic for EAB infestation (Figure 5.1). Symptomatic trees were defined as those displaying any combination of crown dieback, epicormic branching (branching at the base of the trunk), blonding (absence of outer bark due to woodpecker activity), and/or vertical bark splitting. 35 individual ash trees could be definitively diagnosed with EAB infestation, indicated by the presence of distinct d-shaped exit holes and s-shaped galleries underneath the bark. About a third of the ash trees surveyed displayed no noticeable symptoms of EAB or stress, and were thus designated "asymptomatic". The City has since developed a website to disseminate information about EAB to residents (http://cityofpoughkeepsie.com/shade-tree-commission/eab). A detailed report and management proposal for ash trees was also provided to the City of Poughkeepsie (Appendix B).

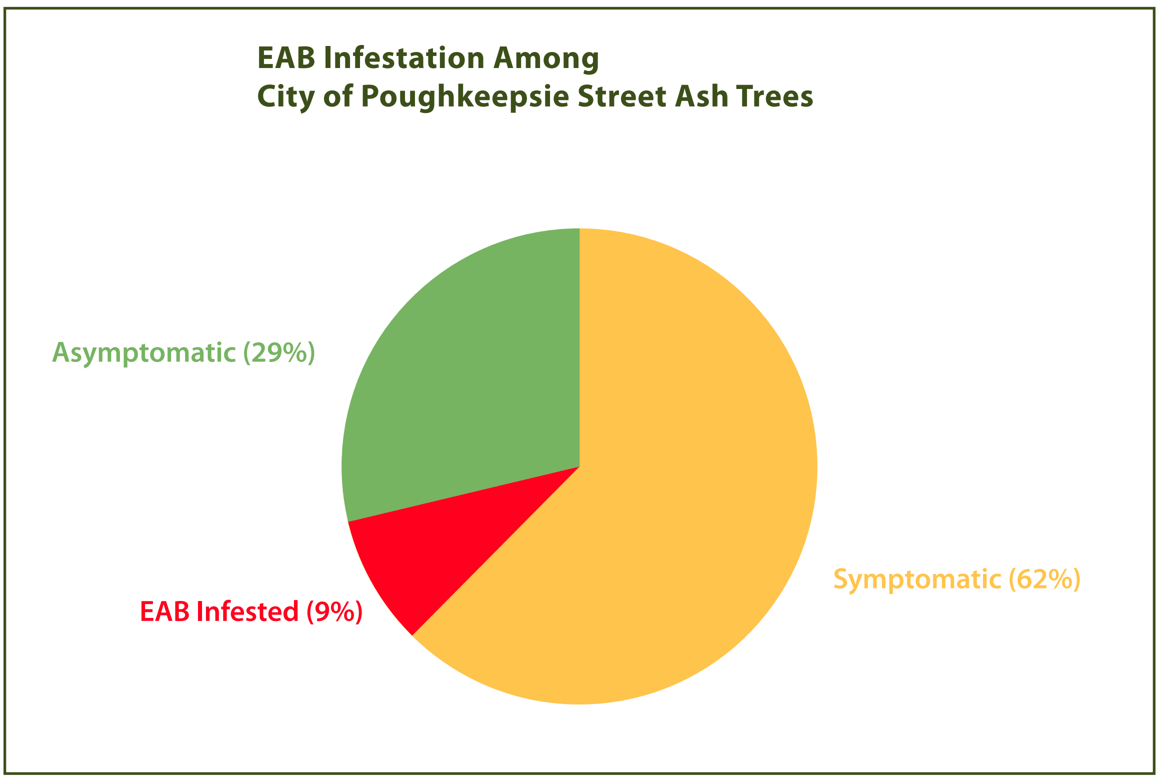


Figure 5.1 Percentage of ash trees along streets in the City of Poughkeepsie that were identified with signs of the Emerald Ash Borer, based on the 2017 survey.

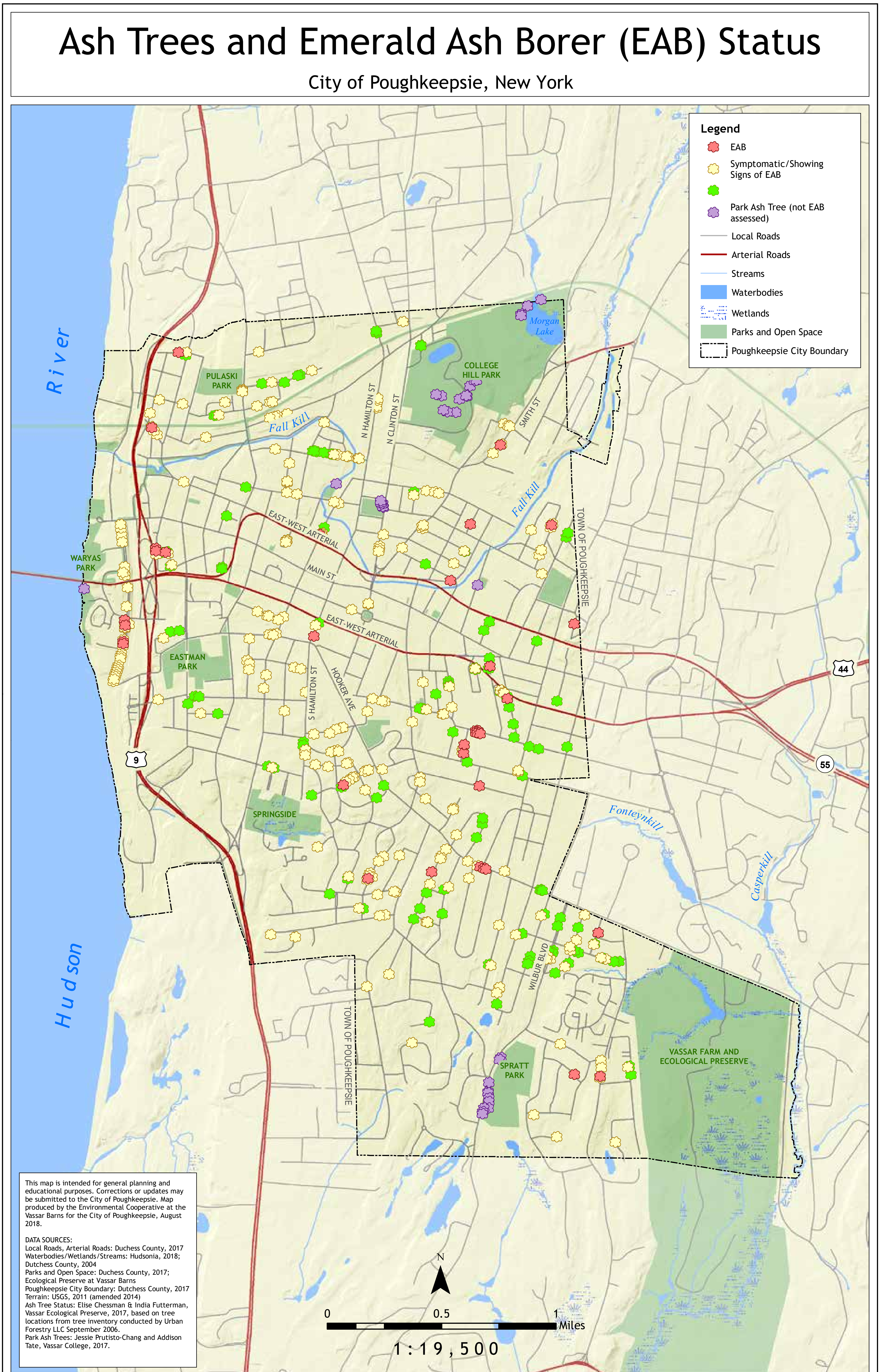
EAB will likely kill most, if not all of the City of Poughkeepsie's ash trees, both public and private, within the next few years. Because infested street trees were found at disparate locations throughout the city, rather than concentrated in one cluster or core of infestation, it will most likely be impossible to prevent EAB from spreading to non-infested ash trees across the city. The high numbers of symptomatic ash trees indicate that most of the City's ash are stressed if not already colonized by EAB, and are therefore more vulnerable to infestation. While it is generally considered too late to save most of Poughkeepsie's street ash trees, the following steps can be taken in response to EAB:

- Selected healthy, young (but mature), seed-bearing street trees may be treated with pesticides to ward off their infestation by EAB.
- EAB-infested street ash trees may be removed in a phased process: dead trees removed first, symptomatic trees closely monitored in successive years and removed accordingly, etc.
- Removed trees should be replaced as soon as possible with appropriate species, i.e., those that have comparable acid and pollutant tolerance, size, and canopy cover as ash trees.
- Private homeowners may assume responsibility for their own private ash trees, choosing to treat or remove depending on their financial and time resources.

Please see Appendix B for the full EAB Management Plan, including costs of pesticide treatments and removal, information on pesticides, and recommended replacement street trees.

The results of this survey indicate that EAB infestation is well underway in Poughkeepsie. Over half of Poughkeepsie's ash trees display clear symptoms of stress, while 9% are definitely infested. This percentage will only increase in the coming years, likely leading to the demise of the City's entire ash population. Ash trees are being carefully monitored and removed when necessary. Replacement trees should contribute to the urban forest diversity of Poughkeepsie in the event that another invasive pest should arrive and target another tree species.

Map 5.5 Ash Trees in Poughkeepsie that are impacted by the Emerald Ash Borer



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Chapter 6. Recreational Resources

Addison Tate, Jennifer Rubbo

Spratt Park,
Photo credit: Lauren White

Publicly-accessible recreational resources provide the opportunity for people to engage with the outdoors and have positive place-based experiences. Access to natural space is especially critical in the age of nature deficit disorder, where lack of time spent in nature has been shown to lead to a range of behavioral problems in children (Louv, 2008). Recreational areas also are essential to a healthy lifestyle by providing access to open spaces for outdoor sport and recreation. Furthermore, areas such as parks and sports facilities also act as dynamic community spaces, where education and community-building occur, and neighborhood identities are cultivated.

A variety of important recreational resources exist within and nearby the City of Poughkeepsie. Located in the Mid-Hudson region, many large recreational areas, including the Catskills, Shawangunks, Taconic Mountains, and Hudson Highlands, are within an hour's drive from the City, through farmland, forested hills, and a broad urban-rural gradient. Features such as the Hudson River, Dutchess County Rail Trail, Vassar Farm and Ecological Preserve, and Fall Kill Creek connect Poughkeepsie to the surrounding areas. Within the City, Poughkeepsie's many public parks provide green space, gardens, playgrounds, picnicking, and athletic fields and courts (Map 6.1, Table 6.1). The 24 public parks and green spaces in the City total nearly 500 acres, with about 250 acres located on the Vassar Farm and Ecological Preserve. The City of Poughkeepsie owns 18 of the recreational areas identified here and the recreation office, overseen by the City's Department of Public Works (DPW), oversees maintenance of these parks. Nubian Directions II, a local workforce skills development organization, assists the City DPW by maintaining many of the park's flower gardens, pots, and raised beds through a cooperative agreement. The remaining open spaces are privately owned or are part of the New York State Park system.

The City of Poughkeepsie Recreational Resources map displays parks and green spaces in the City and the recreational features that may be found there. Park, trail, and golf course data was procured from Dutchess County. Park data was updated and recreational resources mapped by Addison Tate (Environmental Cooperative at the Vassar Barns) with consultation from Natalie Quinn (City of Poughkeepsie) and Paul Hesse (Dutchess County Planning).

Table 6.1. Parks and recreation areas in the City of Poughkeepsie.

Name	Ownership	Amenities
Bartlett Park	City Park	Playground
Clinton House State Historic Site	NYS State Park	Historic building, flower garden
College Hill Park	City Park	Basketball court, playground, flower garden, hiking trails, historic site, golf course
Dongan Place	City Park	Basketball court, Fall Kill view
Earline Patrice Park	City Park	Flower garden, memorial
Eastman Park	City Park	Stitzel Field (baseball diamond)
Forbus Park	NY Champion Tree Project	Open space, historic relevance
Fall Kill Community Garden	Family Partnership Center	Community Garden, Fall Kill view
Hulme Park	City Park	Basketball court
Jardin de las Rosas	Hudson River Housing	Garden
Kaal Rock Park	City Park	River views, picnicking
King Street Park	City Park	Basketball court, baseball diamond, tennis court
Lincoln Park	City Park	Soccer field
Malcolm X Park	Poughkeepsie City School District	Basketball court, tennis court (not functional), Fall Kill views
Morgan Lake Park	City Park	Fishing, rail trail access point
Mural Square	City-owned lot	Event space
Murphy Park	Hudson River Housing	Gardens, play equipment

North Perry Street	City Park	Picnicking
Pershing Ave Park	City Park	Basketball court
Pulaski Park	City Park	Swimming pool, playground
Reservoir Square Park	City Park	Gardens, memorial
Soldiers Memorial	City Park	Gardens, a memorial fountain
Spratt Park	City Park	Pool, baseball diamonds, tennis court, dog park, golf course
Springside National Historic Landmark	Springside Landscape Restoration	Historic site, interpretive walking trails
Skate Park	City Park	Skateboarding facility, river views
Upper Landing Park	NYS State Park	River views, Elevator to Walkway Over the Hudson, picnicking
Vassar Farm and Ecological Preserve	Vassar College	Hiking trails, community garden, flower garden
Victor C. Waryas Park	City Park	Boat Launch, fishing, playground, picnicking, river views
Walkway Loop Trail	NYS State Park	Interpretive walking trail
Walkway Over the Hudson	NYS State Park	Interpretive walking trail
William R. Steinhaus Dutchess Rail Trail	County Park	Walking trail

The Hudson River has driven centuries of development in Poughkeepsie and continues to provide important recreational opportunity, natural habitat, and economic activity. Poughkeepsie's western waterfront along the Hudson consists of a number of parks. Upper Landing Park, opened by the Dyson Foundation in 2013, sits at the outflow of the Fall Kill into the Hudson River and provides access to the Walkway Over the Hudson State Historic Park's glass elevator. A walking bridge over the Fall Kill Creek leads from Upper Landing Park to the Mid-Hudson Children's Museum and waterfront pavilion, which hosts a fishing pier and the weekly Poughkeepsie Waterfront Farmers Market. Waryas Park Promenade skirts the shoreline to the south, passing the Poughkeepsie Skate Park. Victor C. Waryas Park sits at the foot of Main Street and includes a playground, green space, picnic tables, grills, a pavilion, a boat launch, and a dock. Further south, Kaal Rock is a high ledge and wooded area that sits to the north of Kaal Rock Park, a quieter park for picnicking along the waterfront. Kaal Rock Promenade leads south to Shadows Marina and Promenade.

The average size of parks in Poughkeepsie is about 14 acres, however, most parks in the City are less than ten acres. There are several larger parks and open spaces that serve important roles for recreation and access to nature in the City, specifically College Hill Park, Springside, and the Vassar Farm and Ecological Preserve. These have also been identified as significant habitat areas in the City and support not only human health and well-being but also a diversity of wildlife and plant communities (for more information about the habitat value of these spaces see Hudsonia's *Significant Habitats of the City of Poughkeepsie* Report, Appendix A). The Dutchess Rail Trail, Walkway Over the Hudson, and the Walkway Loop Trail are also important recreational assets that provide a connection to nature to those pursuing healthy lifestyle habits through walking, running and biking.

College Hill Park is the largest park in the City of Poughkeepsie, totaling around 100 acres including the College Hill Golf Course. Designated a local historic landmark in 2017, the park includes two local historic sites, the Guilford Dudley Memorial Shelter, and the Clarence Lown Memorial Rock Garden (Wahlberg, 2013). The Guilford Dudley Memorial is at the top the hill. Built in 1934, it sits at the highest point in the City of Poughkeepsie and marks the location of the Collegiate School, which occupied the space until 1865. This structure was added to the National Register of Historic Places in 1982 (Wahlberg, 2016). The Lown Memorial Rock Garden was added to the Local Register of Historic Places in 2014 (Wahlberg, 2013) and was partially restored in 2015. Restored areas are currently being managed as a pollinator garden and plans are underway to restore the remaining portion of the garden with native rock garden plants. College Hill Park is an important community resource as it also hosts a ballfield, basketball court, playground, and the privately-owned College Hill Golf Course. The park abuts Morgan Lake Park and the Dutchess County Rail Trail. College Hill Park is maintained by the City of Poughkeepsie and the Revive College Hill Park Coalition.

Springside is a designated National Historic Landmark and large green space that is owned and maintained by Springside Landscape Restoration (Springside Landscape Restoration, 2015). The property is the site of the country estate of Matthew Vassar, Poughkeepsie brewer, philanthropist and founder of Vassar College, and is the only landscape of Andrew Jackson Downing, famous landscape architect, to remain largely intact. The only remaining original structure on site is the Porter's Lodge/Gatehouse. The site is currently a part of the Hudson River Valley Greenway Trail and hosts a network of interpretive trails that are open to the public year round.

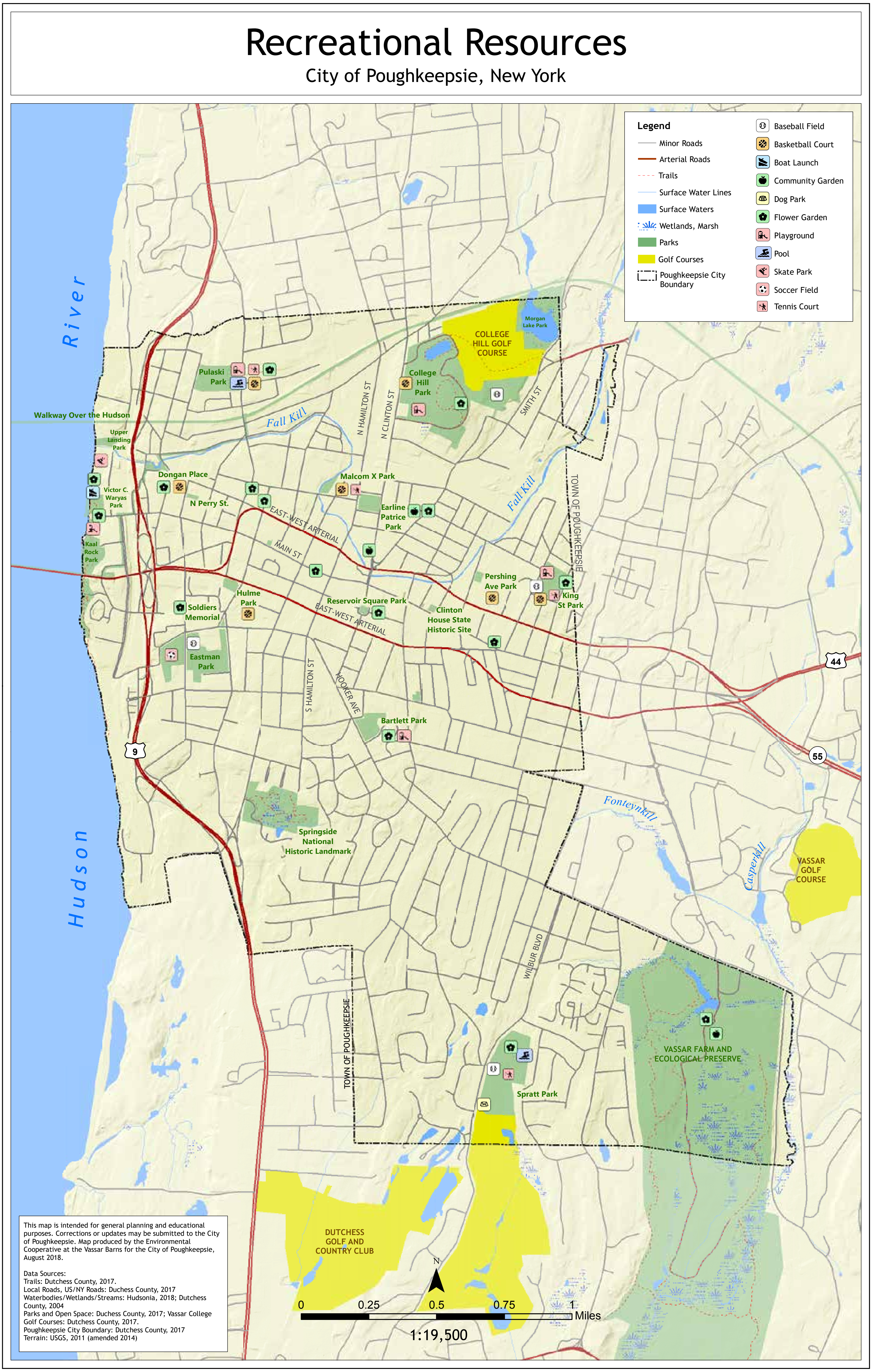
The Vassar Farm and Ecological Preserve (Vassar College, 2018) lies across the southern border of Poughkeepsie, with 243 of its 522 acres within city limits, and the remainder extending into the Town of Poughkeepsie. The land is privately owned by Vassar College, however, there are hiking trails open to the public from dawn to dusk daily. The area was farmed to provide food for Vassar College until 1957 and was converted into an ecological preserve in 1967. It features a network of hiking and biking trails, rugby fields, and a variety of ecological habitats. The Poughkeepsie Farm Project is located at the entrance to the Preserve and hosts a working farm with educational programs, community gardens, and community supported agriculture. Research and education opportunities occur on the Preserve through Vassar College, the Environmental Cooperative at the Vassar Barns, and the Student Conservation Association.

The William R. Steinhaus Dutchess Rail Trail (Dutchess County Government, 2018) and Walkway Over the Hudson State Historic Park (New York State, 2018) connect Poughkeepsie to broader Dutchess County and neighboring Ulster County. Since opening its first section in 2008, the Rail Trail has been converted from the Maybrook Rail corridor into a 13.4-mile paved trail that runs from Hopewell Junction to Poughkeepsie (Dutchess County Department of Planning and Development, 2014). It connects directly to the Walkway Over the Hudson, a paved scenic walkway that spans the Hudson River to reach Highland on the converted

Poughkeepsie-Highland Railroad Bridge. The Walkway is part of the Walkway Loop Trail, and also part of the Empire State, a 3.6-mile loop that includes the FDR Mid-Hudson Bridge and connects to trails in Dutchess and Ulster Counties.

Community gardens and farmers' markets in Poughkeepsie provide residents with opportunities to grow their own food and connect with farmers in the surrounding areas. Dutchess Outreach coordinates the Fall Kill Partnership Garden at the Family Partnership Center. Garden plots are also available at the Vassar Farm and Ecological Preserve. The Waterfront Farmers Market at the Mid-Hudson Children's Museum offers farm-fresh food Monday afternoons during the summer.

While parks are abundant in the City of Poughkeepsie, access to these spaces should be taken into consideration. Map 6.2 shows open space areas in the City of Poughkeepsie greater than 2.5 acres with a 500m (.31 miles) radius, representing a ten-minute walk, around each open space (Heffernan & Stevens, 2018). While much of the Northside of Poughkeepsie has access to public parks and open spaces, there are gaps near Main Street and on the Southside. Additionally, high traffic roads and park conditions need to be considered when discussing accessibility. In 2018, the City of Poughkeepsie began comprehensive parks improvement planning to address infrastructure in the City park system (City of Poughkeepsie, 2018).



Recreational Resources
City of Poughkeepsie, New York
Legend
Minor Roads
Arterial Roads
Trails
Surface Water Lines
Surface Waters
Wetlands, Marsh
Parks
Golf Courses
Poughkeepsie City Boundary
Baseball Field
Basketball Court
Boat Launch
Community Garden
Dog Park
Flower Garden
Playground
Pool
Skate Park
Soccer Field
Tennis Court
Hudson River
Walkway Over the Hudson
Pulaski Park
College Hill Park
COLLEGE HILL GOLF COURSE
Morgan Lake Park
Upper Landing Park
Victor C. Waryas Park
Kaal Rock Park
Dongan Place
N Perry St.
Malcom X Park
Earline Patrice Park
Fall Kill
EAST-WEST ARTERIAL
MAIN ST
N HAMILTON ST
N CLINTON ST
SMITH ST
TOWN OF POUGHKEEPSIE
Pershing Ave Park
King St Park
Hulme Park
Soldiers Memorial
Reservoir Square Park
Clinton House State Historic Site
Eastman Park
S HAMILTON ST
HOOKER AVE
Bartlett Park
Springside National Historic Landmark
Fonteynkill
Casperkill
VASSAR GOLF COURSE
WILBUR BLVD
VASSAR FARM AND ECOLOGICAL PRESERVE
Spratt Park
DUTCHESS GOLF AND COUNTRY CLUB
9
44
55
N
0 0.25 0.5 0.75 1 Miles
1:19,500
This map is intended for general planning and educational purposes. Corrections or updates may be submitted to the City of Poughkeepsie. Map produced by the Environmental Cooperative at the Vassar Barns for the City of Poughkeepsie, August 2018.
Data Sources:
Trails: Dutchess County, 2017.
Local Roads, US/NY Roads: Duchess County, 2017
Waterbodies/Wetlands/Streams: Hudsonia, 2018; Dutchess County, 2004
Parks and Open Space: Duchess County, 2017; Vassar College
Golf Courses: Dutchess County, 2017.
Poughkeepsie City Boundary: Dutchess County, 2017
Terrain: USGS, 2011 (amended 2014)

Map 6.2 Access to public green spaces from Hudsonia's Significant Habitats of Poughkeepsie Report.

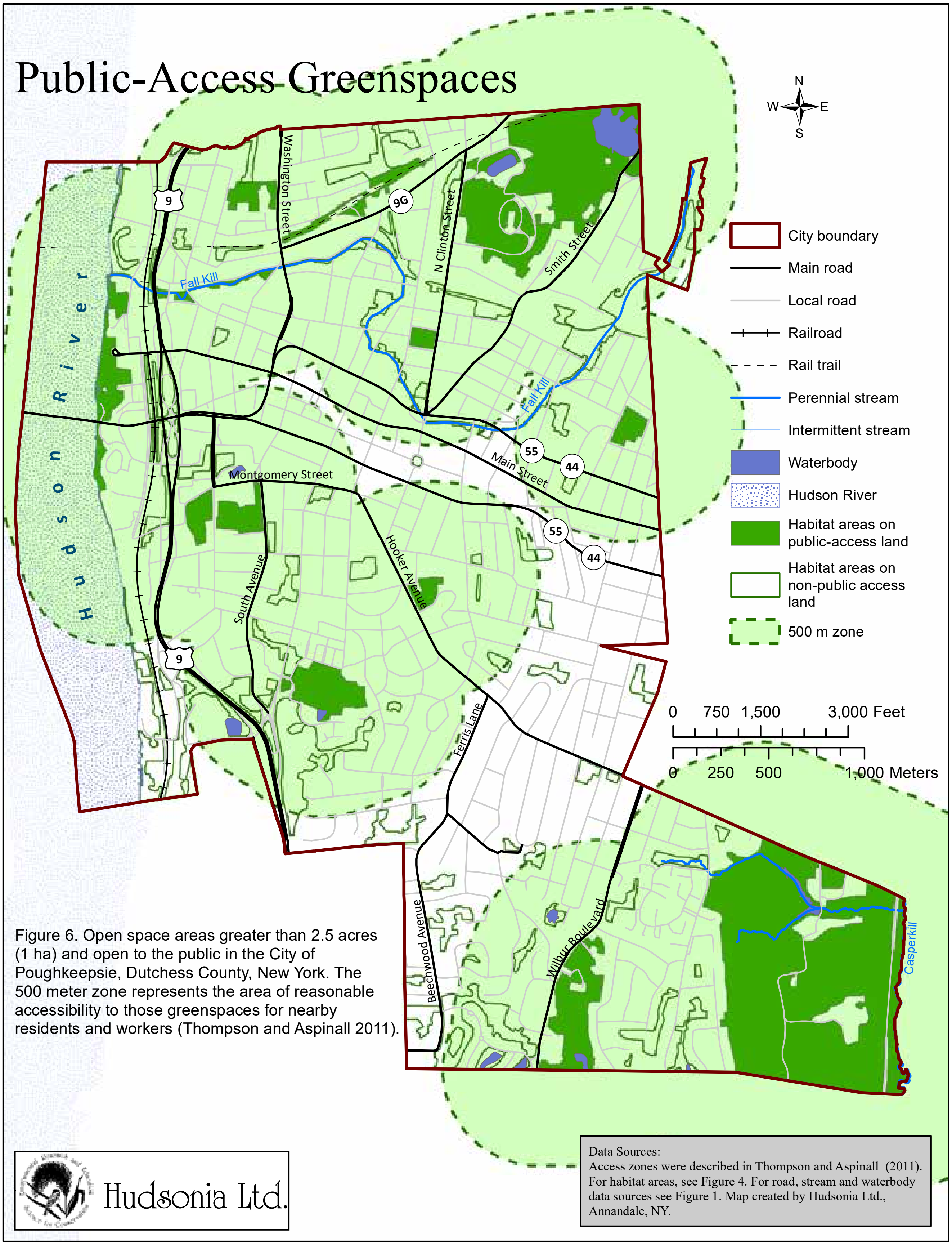


Figure 6. Open space areas greater than 2.5 acres (1 ha) and open to the public in the City of Poughkeepsie, Dutchess County, New York. The 500 meter zone represents the area of reasonable accessibility to those greenspaces for nearby residents and workers (Thompson and Aspinall 2011).

Hudsonia Ltd.

Data Sources:
Access zones were described in Thompson and Aspinall (2011). For habitat areas, see Figure 4. For road, stream and waterbody data sources see Figure 1. Map created by Hudsonia Ltd., Annandale, NY.

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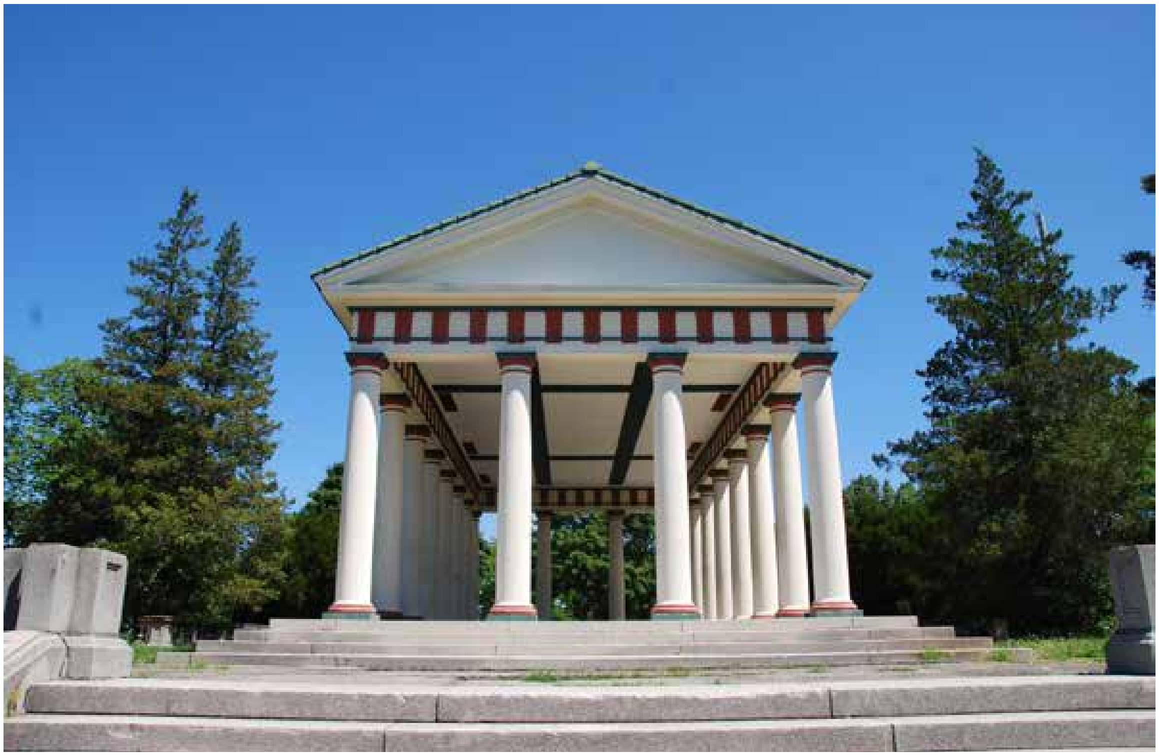
Chapter 7: Historical Resources

Harvey Flad, Addison Tate, and Jennifer Rubbo



The Dudley Memorial Shelter at historic College Hill Park.
Photo credit: Camelia Manring

Historic, cultural and recreational resources, like natural resources, are vital to the city's community and identity and are important to consider in land-use and development decision-making. Patterns of land use and development are often closely linked to the natural resources available to a community. For example the Hudson River and its tributaries have played an important role in the settlement and industrialization of the area. Open spaces in the City are also closely linked with Historic sites. Two of the largest green spaces in the city, Springside and College Hill Park are both designated historic landmarks. As the City moves forward with development and revitalization, it is important to understand why land use patterns exist, and how these patterns are impacting natural resources such as water resources and open spaces. Future development should take into account these past and potential future impacts.

The City of Poughkeepsie Historic Resources maps include a downtown map (Map 7.1), focused on the dense area of historic sites and districts in central Poughkeepsie, and a full city map that displays the widespread historic sites in the city (Map 7.2). Data for historic sites and districts was gathered from Dutchess County, New York State, and Historic District and Landmark Preservation Commissioner Holly Wahlberg. The map was presented to the Historic District and Landmark Preservation Commission for comment. Data was updated by Addison Tate at the Environmental Cooperative at the Vassar Barns with the consultation of Harvey Flad, Professor Emeritus of Geography at Vassar College. The following descriptions of historic locations identified in these maps were prepared by Harvey Flad, July 2018.

Historic Preservation and City of Poughkeepsie Natural Resource Inventory

By Harvey K. Flad, Professor Emeritus of Geography, Vassar College

The Introduction to the Dutchess County Natural Resource Inventory (2010) included a brief history of efforts over two centuries of compiling information about both natural and cultural resources for use in regional planning and local land use decision- making. Prior studies by members of the Dutchess County Historical Society and The Women's City and County Club of Dutchess County promoted concern for the preservation of the city's historic resources. In the ***Dutchess County Guide***, published in the American Guide Series (1937), sites of particular historical, cultural and contemporary interest, including local industries, were mentioned. It remains a useful guide to places that remain resonant to the city's cultural identity. The volume was a product of President Franklin D. Roosevelt's Works Progress Administration.

Following the passage of the Historic Preservation Act of 1966 and the creation of the National Register of Historic Places, specific historic sites, buildings and landmarks in the county began to be listed and described. For example, in the late 1960s, the county began a cultural resources survey to update New York State's Hudson River Valley Commission report ***Historic Sites and Buildings in the Hudson River Valley***. In the 1969 ***Landmarks of Dutchess County, 1683-1867***, published in the Architecture Worth Saving in New York series by the New York State Council on the Arts, over 300 structures were researched and photographed as a tool to guide "growth and development" and "encourage preservation of this inheritance." Several sites in the City of Poughkeepsie were included in the ***Landmarks*** survey such as the pre-Revolutionary era Frear/Freer House; Springside; and a proposed historic district encompassing Victorian-era houses on Garfield, Academy, and South Hamilton streets. The Dutchess County Landmarks Association shortly thereafter surveyed structures in the area of Union Street that were impacted by the development of the E-W Arterial. In 1971, the Union Street Historic District, containing approximately eight blocks and 122 historic structures, was officially listed on the National Register, along with the Garfield Place Historic District of two-dozen properties. The Academy Street Historic District with over forty properties was listed five years later. Another four historic districts have been created that acknowledge the diversity of architecture and social history throughout the city.

Sites Included on the Historic Maps of the City of Poughkeepsie

Settlement

In 1664 the lands along the Hudson River, known as New Netherland and controlled by the Dutch, came under English rule. Subsequently, the Crown divided the land into patents. In 1686, Robert Sanders, an Englishman and Myndert Harmense of Dutch heritage, purchased the land where Poughkeepsie would be located from the Wappinger Indians. Poughkeepsie would be named after a local spring, variously spelled as U-puku-ipi-sing or Apokeepsing, meaning "the reed-covered lodge by the little water place." Early settlers included both Dutch and English families who built houses and a mill along the Fall Kill at Upper Landing in the early decades of the 18th C. Although much of the pre-Revolutionary footprint has been lost, both the Hoffman House (1789) and Reynolds Homestead (1840) at Upper Landing remain as among the earliest existing structures in the city. In 2013 Upper Landing Park opened with extensive signage of the history of Poughkeepsie.

Early Settlers

Both the Dutch and English settlers built their own churches in the village's emerging downtown. The first English, or Anglican, church was located at the intersection of Church and Market Street, while a "glebe", or farm and rectory was purchased east on Filkintown Road (Main Street) for the rector Rev. John Beardsley. During the Revolution, Rev. Beardsley remained loyal to the King, and so was removed downriver to New York City, then under English command. Glebe House (1767) was sold by the church in 1792 and remained in private hands until 1929 when it was rescued from possible demolition by the Dutchess County Historical Society, the Junior League of Poughkeepsie, and the City of Poughkeepsie. As one of the earliest examples of efforts to preserve one of the city's historic resources, the city-owned property is currently enjoying a rebirth as a site to promote the city's 300-year history and managed by the Mid-Hudson Heritage Center. Christ Episcopal Church expanded as the village grew into a city after 1854 and eventually moved to the Old English Burying Ground on Academy Street and built an impressive "Early English" Gothic style church (1888). Two other Episcopal churches were also built during the 19th C. The Gothic Revival style Church of the Holy Comforter (1859-60) on Davies Place is a significant example of the work of the architect Richard Upjohn, while St. Paul's Church (1872) at Mansion Square repeated the Gothic Revival theme.

In the early 1700s the Van Kleeck family and other Dutch settlers built a Reformed Dutch Church in the center of downtown, but as its congregation grew, it rebuilt, and would eventually move from its property at the intersection of Market and Main Streets to the South Side. The Reformed (Dutch) Church of Poughkeepsie (1919-1923) now sits comfortably on Hooker Avenue next to Bartlett Park. The Art Deco architectural style Church Building (1920s) was built on its former site.

American Revolution (1775-1788)

Poughkeepsie had a significant role in the Revolution and its aftermath. During the early part of the war the British occupied New York City, so the Provincial capitol moved upriver to Kingston. However, after the British burned Kingston in 1777, Poughkeepsie became the temporary capitol. George Clinton, Governor of the State 1777-1783) lived in the Clinton House (1765, 1783) on Main Street, not far from the second courthouse at the intersection of Market and Main streets. However, as the war came to a close in 1785 the courthouse was destroyed by fire. A third courthouse was quickly constructed and in place for the New York State convention to ratify the Constitution. Clinton was an Anti-Federalist, but after debates with Federalists Alexander Hamilton and John Jay in the summer of 1788, agreed to a compromise that would become the amendments known as the Bill of Rights. Upon ratification, New York became the eleventh of the original thirteen colonies to form the United States of America. The third courthouse was burned in 1806, rebuilt in 1809, and replaced by the current Dutchess County Courthouse (1903-1904).

Churches

Religious institutions such as churches offer insight into the city's settlement and social history. The original locations of the Dutch and English churches on Market Street framed political, economic and social power in the village core, while the Poughkeepsie Meeting House (1927) on Hooker Avenue follows the architectural features of the early Quakers. The oldest surviving church building in the city is a relatively small Greek revival style structure on the corner of Vassar and Mill Streets. Constructed in 1835 as a Presbyterian church, reorganized as a Congregational church two years later, and in 1869 as a Jewish synagogue; it became the Second Baptist Church later in the twentieth century. Organized in 1837, the Smith Metropolitan AME Zion Church (1910-11) indicates clusters of early African-American settlement on Main Street's lower slope and on the northern margins. In the mid-19th C immigration from Germany and Ireland filled out the tenements on the lower slope with Germans locating in the Second Ward and Irish in the First Ward; for example the German-American Nativity Church (1853) in the Union Street Historic District. By the late 19th C and early 20th C, Italian immigrants displace the Irish, holding Roman Catholic services in Italian in the original Our Lady of Mount Carmel Church (1910), then moving to the previously Irish church Old St. Peter's Church (Our Lady of Mount Carmel) whose first church and rectory were built in 1837. In the 20th C the Italian community would purchase the former Victorian style Reynolds mansion as the Italian Center. As the Irish households joined the professional workforce such as the police and fire departments, they moved upslope into the city center and established both St. Mary's and Holy Trinity Roman Catholic churches. Meanwhile, early 20th C immigration by German and East European Jews built synagogues in both the Second and First Wards, such as Congregation Schomre Hadath (1923-24) on South Bridge Street. They would move their synagogues along Hooker Avenue and neighboring streets as their emerging middle-class congregations moved to houses on the South Side and in the Town.

Waterfront

From the beginning of settlement the waterfront from the Fall Kill to Kaal Rock was busy. Farms in the hinterland supplied grain, beef and other agricultural products for shipment downriver by sloops in the 18th C and steamboats in the 19th C. The Clearwater Sloop dock at Waryas Park promotes the role of Poughkeepsie in the early shipping and fishing industries as well as the role of the Clearwater Sloop Restoration, Inc. as a non-profit environmental educational and advocacy organization. The organization's office occupied the Fite House (1810) during the 1970s and 80s. The ferry dock at Upper Landing and steamboat dock at the foot of Main Street offered river access while the railroad became the main transportation mode for passenger and freight traffic. In 1888 the Poughkeepsie Railroad Bridge across the Hudson River was constructed to transport freight between New England and Pennsylvania. After a fire in the 1970s it was abandoned, but has been restored as the Walkway Over the Hudson (2009), "the longest pedestrian bridge in the world." The Hudson River has also been a recreational resource, with the Apokeepsing Boat Club established in 1879 and the famous Intercollegiate Regatta begun in 1895.

Waterfront industries over the course of the 18th and 19th centuries included:

Matthew Vassar's Brewery (1891); the Poughkeepsie Glass Works (1880); a cigar factory; a tannery that used hemlock bark from the nearby Catskill Mountains; an iron foundry (1801); ship building and ships' stores such as cooperage, rope, and black-smithing; and soap and candle making, including the Poughkeepsie Whaling Co. (1832). On the southern waterfront Adriance-Platt Buckeye Mower and Reaper Works was a major manufacturer of agricultural machinery in the 1890s and early 20th C, along with the city's largest employer De Laval Separator Co., maker of pumps for the dairy industry. All of these factories were abandoned and removed from the waterfront by Urban Renewal projects in the mid-20th C to make room for Waryas Park in 1975.

Industrial Age Economic Growth

In 1854 the city received its charter. The Industrial Age gained speed with numerous industries along the waterfront and the Fall Kill and the arrival of the Railroad in 1850-51; the impressive Poughkeepsie Railroad Station was built in 1918, modeled after New York City's Grand Central Station (1903-1913). Adjacent to the station on Water Street is the former Reynolds Warehouse (1872). Mill ponds along the Fall Kill served as water power for grain and grist mills, saw mills, and the fulling and carding of wool for cloth and rugs, for example carpets at Pelton Mill (1803-1892), as well as pins and nails. The Pelton family built Pelton Mansion (ca. 1859) on a small rock outcrop overlooking the mill and the Fall Kill. Innis Dye Works (1825) manufactured dyes from dyewoods at the mouth of the Fall Kill; it ceased operation in 1913 and reopened as Schmidt Piano Hammer Factory until 1934. The main building next to the waterfall on the Fall Kill has been renovated into apartments and a smaller structure on the waterfront is now occupied by the Children's Museum (2007). Also located nearby was the Arnold Chair Factory (1870s-80s). Further east along the Fall Kill were cotton mills and clothing factories, such as the Poughkeepsie Underwear Factory (1874; renovated 2017 as apartments, artist studios and a coffee brewer), and the J.O.Whitehouse Boot & Shoe Factory (1879) on Main and Cherry.

19th C Residential Expansion

As the population increased after the Civil War, residential housing included areas of high density tenements, rooming houses and workmen's dwelling on the lower slope, such as Union Street Historic District, and on the city's northern edges along the Fall Kill of one- and two-story homes, as well as mansions up into the Mill Street-North Clover Street Historic District, Upper Mill Street Historic District, and Balding Avenue Historic District. South of Main Street's retail establishments and apartments, single-family homes on large lots for the city's elite emerged, including the Victorian-era properties of Academy Street Historic District, Garfield Place Historic District, and South Hamilton Street Row, and later development of lots in the Dwight Street-Hooker Avenue Historic District, including many individually listed historic homes such as the Brinkerhoff (1860) house designed in the shape of a steamboat. Other individually listed houses are listed outside historic districts, such as Barrett House (ca. 1835) home of the artist Tom Barrett in the 1920s and 30s and now of the Barrett Art Center. Matthew Vassar established his summer estate Springside (1850-52) south along Academy Street, east of the Poughkeepsie Rural Cemetery (1852). Horticulturist Andrew Jackson Downing and architect Calvert Vaux designed the estate's landscape and buildings, such as the Springside Porter's Lodge. Many other historic residential properties from the 17th – 19th centuries are scattered south and east throughout the formerly agricultural lands.

City Downtown: Market Street

For 300 years, the financial, political, commercial, retail and cultural life of the city centered on the area of Market Street and Main Street. The location of the first courthouse established the village center and city with the Old City Hall (1831). Hotels were established near the courthouse, such as the Nelson House (1876), famous as the campaign headquarters for President Franklin Delano Roosevelt in the 1930s was demolished in 1965 to make way for the Dutchess County Office Building during urban renewal. Banks also clustered along the Market Street corridor, such as the Farmers & Manufactures Trust (1834-1835), Poughkeepsie Trust Company (1906-1907) and Poughkeepsie Savings Bank (1911-1912) with its stained glass panel of Henry Hudson's ***Half Moon*** above the vault. Lawyers chose offices close-by in

Market Street Row and the Church Building and often met others of the elite at the Amrita Club (1912). Civic and cultural institutions similarly located along Market Street, including the Bardavon (Collingwood Opera House, 1869), State Armory (1891) and Adriance Memorial Library (1898), south to Soldiers Fountain and Park (1870) and the Old YMCA (1909) at Eastman Park and Eastman Terrace (1872-1873).

City Downtown: Main Street

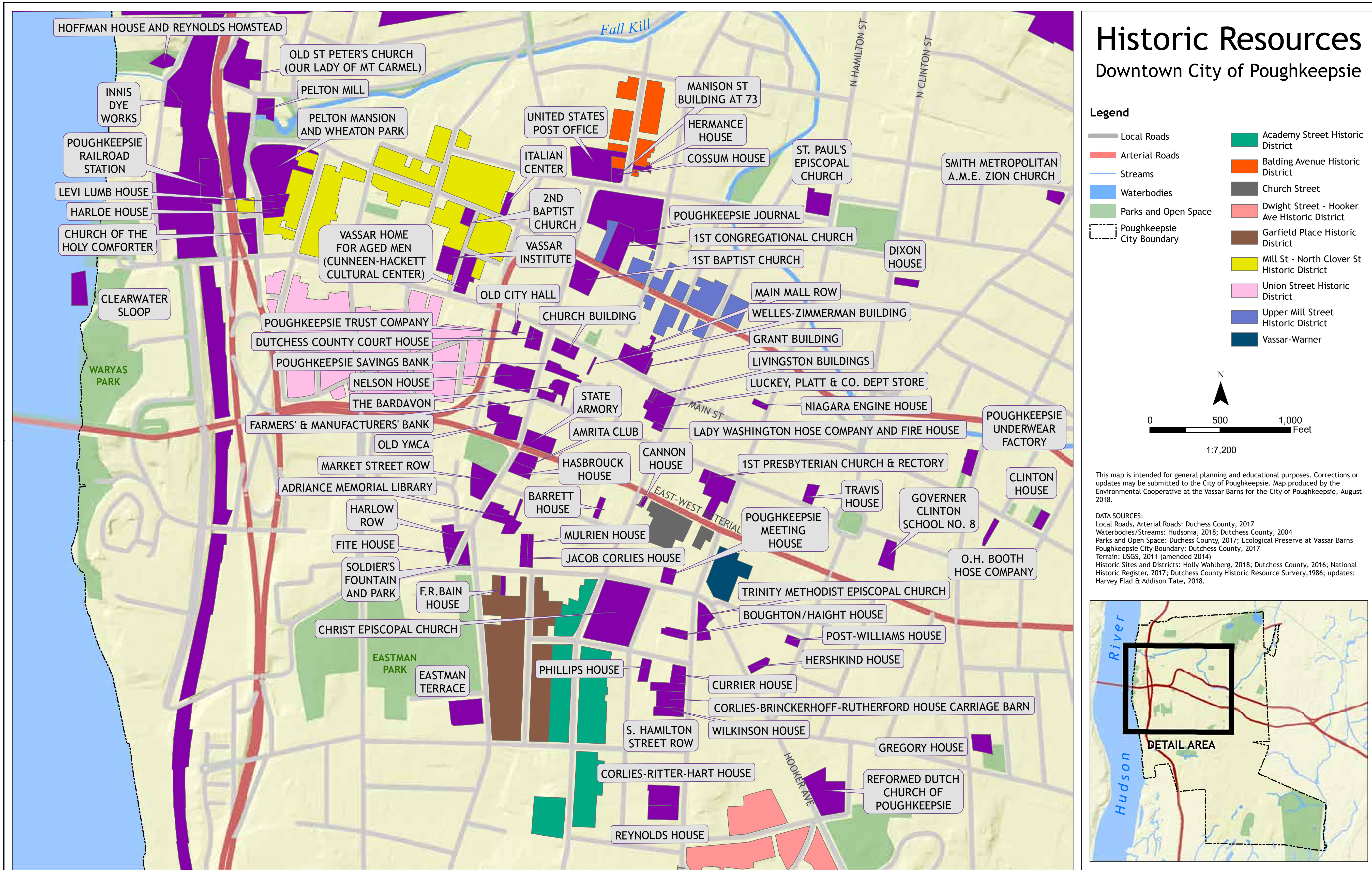
Main Street has been the commercial and retail hub for three centuries. Fires and remodeling of storefronts have altered many 19th C facades, but the streetscape retains its historic character. Main Mall Row is named after the pedestrian mall developed during urban renewal in the 1970s and 80s, and re-opened as Main Street in 2001. Individual buildings that offer a window into the city's retail history on the historic register include: the Grant Building, Welles-Zimmerman Building and Livingston Buildings. The Luckey, Platt & Co. Dept. Store (1901) advertised itself as the mid-Hudson Valley's department store with signs stretching eastward to the Connecticut border. Lady Washington Hose Company and Fire House, Niagara Fire House and O. H. Booth Hose Company are three of Poughkeepsie's early firehouses (1908-1909) located in the Main Street corridor.

Cultural and Civic History

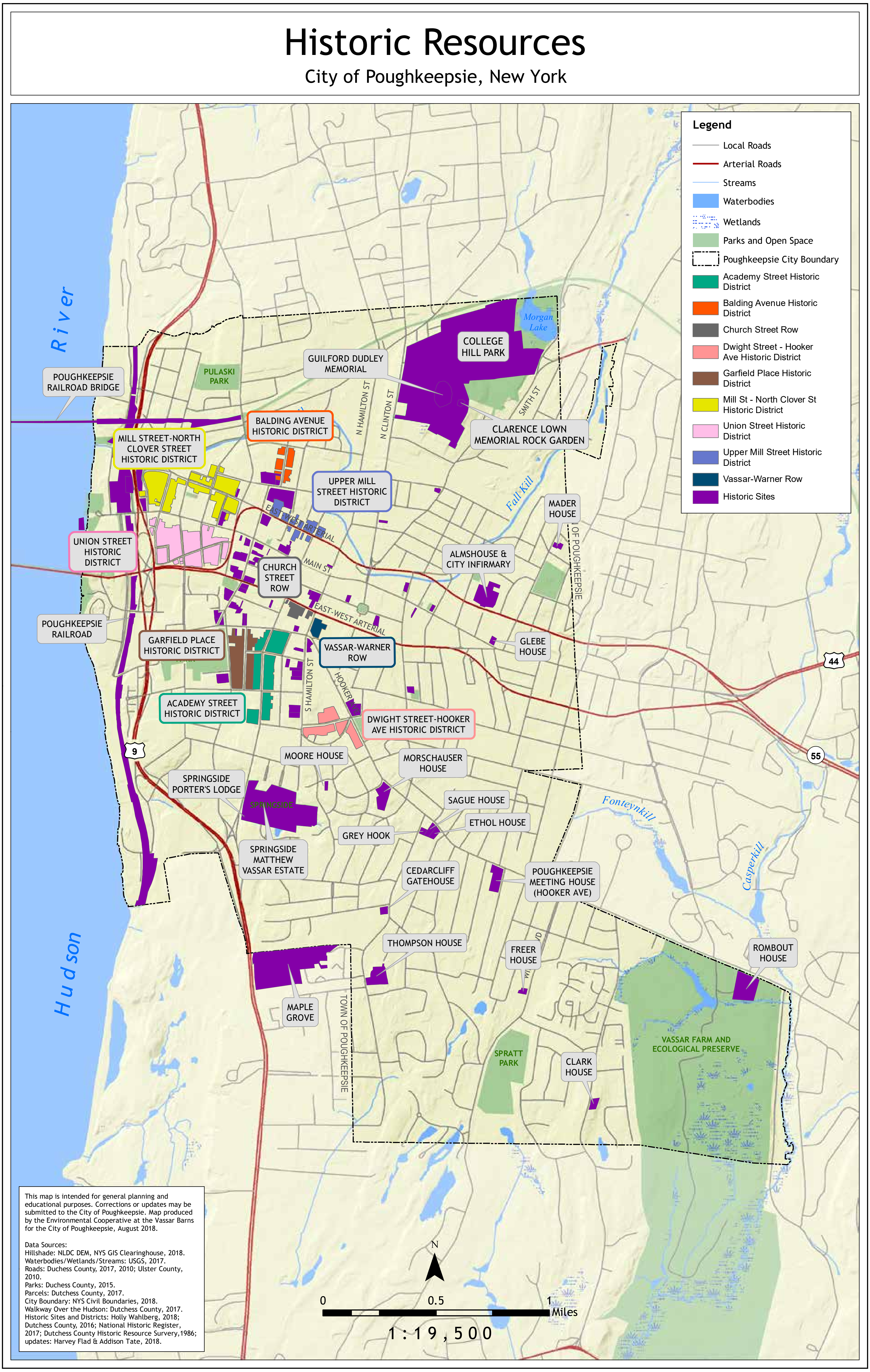
Historic sites offer insight into a city's civic duties and pride. Poughkeepsie was often called "the city of schools" after the number of collegiate schools located throughout in the 19th C. The Guilford Dudley Memorial (1931) on the crest of College Hill includes a 1937 "Parthenon" as a historical monument to the Collegiate Hill School and Riverview Military Academy that occupied the site during the late 19th C. William W. Smith purchased the site and offered it to the city as College Hill Park; the park includes a golf course and the historic Clarence Lown Memorial Rock Garden (1931). Ragged Lane was renamed Academy Street after a collegiate school; public schools included the 19th C Governor Clinton School No. 8, a number of elementary schools and the former Poughkeepsie High School (1911-14) on South Hamilton Street that became Our Lady of Lourdes parochial high school in the 1950s and subsequently the Family Partnership Center when Lourdes moved to the Town. In 1861 Vassar Female College opened its historic landmark Main Building at the east end of College Avenue. Matthew Vassar's nephews built the Vassar Home for Aged Men (Cunneen Hackett Cultural Center, including the Vassar Institute, on the site of Matthew Vassar's former city home, in 1880. Also, the Alms House & City Infirmary (1869) was located north and east of Main Street and the downtown; it now houses Maplewood senior apartments.

The Franklin Delano Roosevelt Mid-Hudson Bridge opened in 1930. As a federal project during the Depression, President Roosevelt had the United States Post Office (1937) built at the north end of Market Street. Its design resembles that of the third Dutchess County Courthouse where, in 1788, New York State legislators ratified the Constitution. Murals by local artist Olin Dows depicting the event, as well as the mythic spring of Poughkeepsie's name, adorn the second-floor balcony. The Old Dutch-inspired architecture of the Poughkeepsie Journal (1941-1943) building continues the historic theme of Poughkeepsie's origins. Other twentieth century historic, cultural and civic buildings have yet to be added to the official list of resources. Cultural venues such as The Chance, Mid-Hudson Heritage Center and the Trolley Barn inhabit 19th C buildings that reflect the city's growth into the 21st C.

Map 7.1 Historic Resources in the downtown area of the City of Poughkeepsie



Map 7.2 Historic sites and districts throughout the entire City of Poughkeepsie



Additional Resources for the Historical Map include:

National Register of Historic Places, National Park Service, U.S. Department of Interior

Bennett, James, *Poughkeepsie's Amazing Extraordinary History: A Year-by-Year Outline* (Poughkeepsie, NY: Riverflow Publications, 2017)

Flad, Harvey and Clyde Griffen, *Main Street to Mainframes: Landscape and Social Change in Poughkeepsie* (Albany, NY: The State University of New York, 2009)

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Puretz, Susan L., Garfield Place: *A Victorian Street in an Urban Setting*, 1971 and *Stages in the Life Cycle of a Street: Evolution of Academy Street, Poughkeepsie, New York,* 1983 (personal publications)

Rhoads, William, "Poughkeepsie's Architectural Styles, 1835-1940," *New Perspectives on Poughkeepsie's Past,* ed. Clyde Griffen (Poughkeepsie, NY: Dutchess County Historical Society Yearbook vol 72, 1987), pp. 18-35.

Wahlberg, Holly, Local National Historic Places List, 2018.

Public Historians: William P. Tatum III, County Historian; George Lucas, City Historian; Bill Jeffway, Dutchess County Historical Society executive director

Chapter 8. Climate Change

India Futterman, John Ammondson, Lauren White and Jennifer Rubbo

Solar panels at the Environmental Cooperative at the Vassar Barns, Vassar Farm and Ecological Preserve.
Photo credit: Karl Rabe for Vassar College

Climate Change in New York

There is widespread scientific consensus that the Earth's climate is changing as a result of human activity. Generated by the burning of fossil fuels and other industrial processes, greenhouse gases like carbon dioxide accumulate in the planet's atmosphere, trapping heat that would normally escape into space and heating the planet over time (NASA, 2018). The evidence is overwhelming: the planet's average surface temperature has risen 2° F since the late 19th century, sea levels are rising, and the number of extreme heat and weather events is increasing (NASA, 2018). In 2014, the New York State Energy Research and Development Authority (NYSERDA) updated their ClimAID, Responding to Climate Change in New York State,

Figure 8.1. Climate Regions of New York State (Rosenzweig 2011). Dutchess County is located in Region 5 – East Hudson and Mohawk River Valleys.

technical report with new projections of the impact of climate change in New York State, including Dutchess County (Region 5, Figure 8.1) (Rosenzweig, et al., 2011; Horton, Bader, Rosensweig, DeGaetano, & Solecki, 2014). Additionally, in 2014, Governor Andrew Cuomo signed the Community Risk and Resiliency Act (CRRA) requiring the adoption of sea-level rise projections for three geographic regions of the state (NYS Department of Environmental Conservaiton, 2019) (Figure 8.2).

	Region	Long Island					New York City/Lower Hudson					Mid-Hudson				
	Descriptor	Low	Low-Medium	Medium	High-Medium	High	Low	Low-Medium	Medium	High-Medium	High	Low	Low-Medium	Medium	High-Medium	High
Time Interval	2020s	2	4	6	8	10	2	4	6	8	10	1	3	5	7	9
	2050s	8	11	16	21	30	8	11	16	21	30	5	9	14	19	27
	2080s	13	18	29	39	58	13	18	29	39	58	10	14	25	36	54
	2100	15	21	34	47	72	15	22	36	50	75	11	18	32	46	71

Figure 8.2. NYS sea-level rise projections in inches by time period relative to 2000-2004 baseline data, 6 NYCRR Part 490. Poughkeepsie is located in the New York City/Lower Hudson Region

Air Temperature

Air temperature is predicted to increase in Poughkeepsie and the Hudson Valley (Figure 8.3). Based on the 2014 ClimAID Report (Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014), the annual average air temperature is projected to rise as much as 6.1-11.4 °F by the year 2100, with an estimated minimum rise in temperature of 4.4 °F . The annual average temperature of this region has already risen by 2.4°F since 1970, including a winter temperature increase of more than 4.4°F (NYS Department of Environmental Conservation, 2018), exceeding these low projections. Rising temperature can be a human health concern as warmer temperatures exacerbate asthma, allergies, and other respiratory conditions, especially in susceptible individuals such as young children and the elderly. Risk of Lyme disease may also increase: a lengthening of the warm season allows ticks to be active for longer and for a greater number of people to be exposed (United States Environmental Protection Agency, 2016).

AIR TEMPERATURE PROJECTIONS FOR REGION 5

	Baseline 1971-2000	2020s	2050s	2080s	2100
Annual average air temperature	50°F	52.3 - 53.2°F	54.5 - 56.2°F	55.6 - 59.7°F	56.1 - 61.4°F
Increase in annual average	-	2.3 - 3.2°F	4.5 - 6.2°F	5.6 - 9.7°F	6.1 - 11.4°F

Figure 8.3. Air temperature projections for Region 5 of the Hudson Valley, including Poughkeepsie. Table from *Climate Change Projections in the Hudson River Estuary* (Zemaitis, 2017); adapted from data presented in *Responding to Climate Change in New York State* (Rosenzweig, et al., 2011 and Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014).

Precipitation

Up to a 21% increase in precipitation can be expected for the Eastern Hudson Region of New York by the year 2100 (NYS Department of Environmental Conservation, 2014). Projections of total annual precipitation for the Hudson Valley show an increase from the baseline of 51 inches per year to as much as 61.5 inches in 2100 (Figure 8.4) (Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014). The year-to-year and decade-to-decade variability of precipitation in this region, and around the globe, is becoming more pronounced. Between 1958 and 2012, the Northeast saw a 71% increase in the precipitation that came down in heavy events (US Global Change Research Program, 2014). As precipitation increases in general, it is likely to increase in the winter and spring with no significant changes in the summer and fall (United States Environmental Protection Agency, 2016). Flash flooding will become more persistent with heavy rainfall and will increase the risk of erosion (NYS 2100 Commission, 2013).

PRECIPITATION PROJECTIONS FOR REGION 5

	Baseline 1971-2000	2020s	2050s	2080s	2100
Total annual precipitation	51"	52" - 54.5"	53" - 57"	53.5" - 58.5"	53.5" to 61.5"
% Increase in annual precipitation	-	2 - 7%	4 - 12%	5 - 15%	5 - 21%
# Days with precipitation > 1"	10	14 - 15	14 - 16	15 - 17	*
# Days with precipitation > 2"	1	3 - 4	4	4 - 5	*

Figure 8.4. Precipitation projections for Region 5 of the Hudson Valley, including Poughkeepsie. Table from *Climate Change Projections in the Hudson River Estuary* (Zemaitis, 2017); adapted from data presented in *Responding to Climate Change in New York State* (Rosenzweig, et al., 2011 and Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014)

Severe Weather

Flooding and drought are risks associated with both the increase of precipitation and air temperature. As temperatures get warmer, snow will melt earlier in the spring and evaporation will increase, causing drier soils in the summer. Combined with higher summer temperatures and flashier rain events, this will cause an increase in drought conditions (United States Environmental Protection Agency, 2016). Extreme heat events are described as days where the air temperature is at or above 90 °F, and heatwaves are when there are three days in a row when the temperature is at or above 90 °F (Figure 8.5) (Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014). Heatwave health concerns disproportionally affect low-income populations due to lack of access to air conditioning and green space. In cities with a high density of asphalt and buildings that absorb heat, a "heat island" effect can take place as the absorption of heat increases air temperature. Municipalities can combat increasing air temperature by planting trees in urban areas, creating a canopy of leaves that shades both asphalt and people from the sun and decreases the need for air conditioning, thus keeping energy needs low. Trees, especially conifers, can also shield buildings from cold winds in the winter, decreasing the energy used for heating (NYS 2100 Commission, 2013). Cooling centers are becoming common practice to provide relief for residents without access to air conditioning. In 2018, for example, a City cooling center was available at the Public Safety Building at 505 Main Street. In addition to increasing temperatures and rainfall, the occurrence of superstorms, such as Sandy in 2012, will increase. During Sandy, the City of Poughkeepsie measured the highest watermark in the Hudson Valley resulting in a 5.1 ft.

inundation (Blake, Kimberlain, Berg, Cangialosi, & Beven II, 2012). These storms are no longer abnormalities, and flooding events are predicted to increase in frequency due to climate change (Figure 8.6) (NYS 2100 Commission, 2013).

HEAT WAVE PROJECTIONS FOR REGION 5	Baseline 1971-2000	2020s	2050s	2080s	2100
# Days per year above 90°F	10	26 - 31	39 - 52	44 - 76	*
# Days per year above 95°F	1	2 - 4	3 - 10	6 - 25	*
# Heat waves per year	1	3 - 4	5 - 7	6 - 9	*
Average # days of each heat wave	4	5	5 - 6	5 - 7	*
# Days per year ≤ 32°F	155	127 - 136	104 - 119	84 - 109	*

Figure 8.5. Heat wave projections for Region 5 of the Hudson Valley, including Poughkeepsie. Table from *Climate Change Projections in the Hudson River Estuary* (Zemaitis, 2017); adapted from data presented in *Responding to Climate Change in New York State* (Rosenzweig, et al., 2011 and Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014)

FLOOD PROJECTIONS FOR COASTAL NY	Baseline 1971-2000	2020s	2050s	2080s	2100
Increase in probability of 100-year flood	0%	20 - 50%	70 - 190%	140 - 610%	*
Flood height of 100-year flood	15'	15.3 - 15.7'	15.9 - 16.8'	16.5 - 18.3'	*

Figure 8.6. Flood projections for Coastal NY. Table from *Climate Change Projections in the Hudson River Estuary* (Zemaitis, 2017); adapted from data presented in *Responding to Climate Change in New York State* (Rosenzweig, et al., 2011 and Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014)

Sea Level

Coupled with a projected increase in the probability of major flooding events in the coming decades, sea-level rise (SLR) poses a pressing challenge to Poughkeepsie's infrastructure. Projections estimate the potential for 8-30 inches of sea-level rise by the 2050s (Figure 8.7) (Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014). The higher the water level, the greater the potential for costly damage to waterfront property. For example, predictions from Columbia University's Center for International Earth Science Information Network (CIESIN) show that after 72 inches of sea-level rise, close to $3.4 million in damage following a 100-year flood event may occur (Figure 8.8) (Center for International Earth Science Information Network, 2018). This predicted cost includes 18 damaged buildings, four wastewater discharge sites, one mile of power transmission line, and 53 acres of total inundated land in Poughkeepsie's waterfront area. Based on projections of sea-level rise from these models, it would be in the City's best interest to consider flooding as a serious threat to infrastructure when discussing development projects along the Hudson River shoreline. Additionally, the census block groups impacted by such flood events are considered "highly socially vulnerable," a CDC definition that includes high poverty rates, lack of access to transportation, and overcrowded housing (Agency for Toxic Substance and Disease Registry, 2018; Center for International Earth Science Information Network, 2018).

Both Scenic Hudson and (CIESIN) (Center for International Earth Science Information Network, 2018; Scenic Hudson, 2013) offer interactive, online flood mapping tools for the Hudson Valley. Pictured below (Figures 8.9-8.13) is an example of one flooding model (72 inches SLR) for the City of Poughkeepsie from the CIESIN mapper (Center for International Earth Science Information Network, 2018).

Please refer to one or both of the following sites to explore the full range of future flood scenarios in the City of Poughkeepsie:

- CIESIN's Hudson River Flood Impact Decision Support System Version 2: newly updated in 2018 this is a sophisticated modeling tool. It allows the user to input different flood scenarios and gives information on the cost of damage as well as areas impacted.
  http://www.ciesin.columbia.edu/hudson-river-flood-map/
- Scenic Hudson's Sea Level Rise Mapper: User-friendly mapper allows a user to input different scenarios of sea level rise. Good for a non-technical audience.
  http://www.scenichudson.org/slr/mapper.

SEA LEVEL RISE PROJECTIONS FOR THE HUDSON

	Baseline 1971-2000	2020s	2050s	2080s	2100
Mid-Hudson region	-	1 - 9"	5 - 27"	10 - 54"	11 - 71"
NYC/Lower Hudson region	-	2 - 10"	8 - 30"	13 - 58"	15 - 75"

Figure 8.7. Ranges of projected sea level rise for the Hudson Valley. Graphs adapted from data presented in *Responding to Climate Change in New York State* (Rosenzweig, et al., 2011 and Horton, Bader, Rosenzweig, DeGaetano, & Solecki, 2014) and summarized in *Climate Change Projections in the Hudson River Estuary* (Zemaitis, 2017).

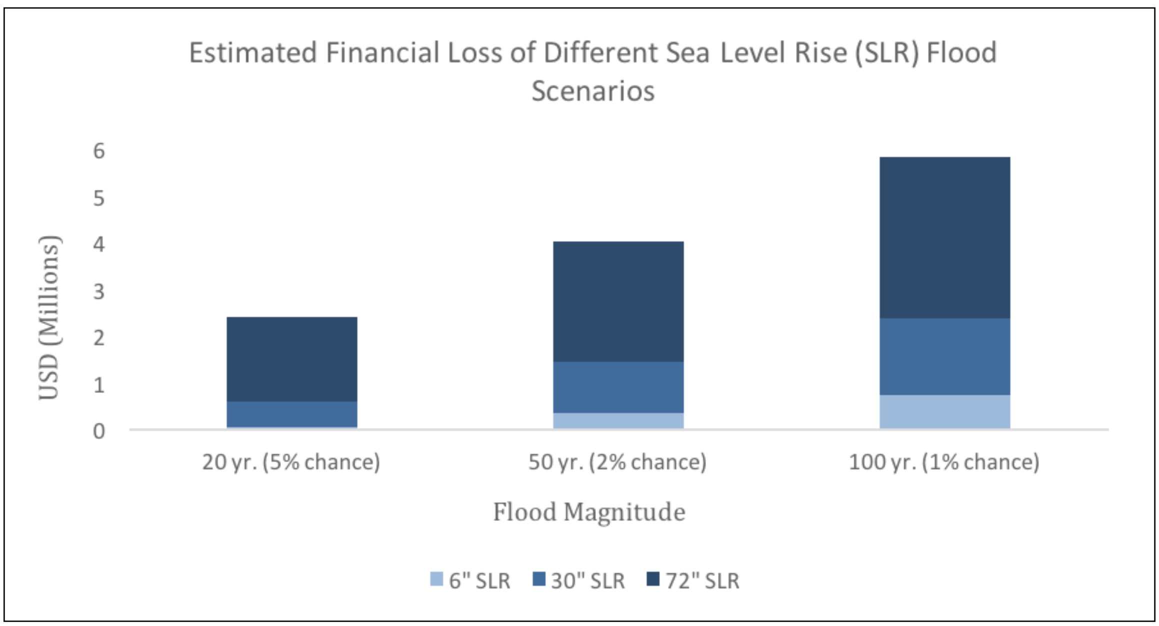


Figure 8.8. A comparison costs of different flood scenarios from CIESIN's Hudson River Flood Impact Decision Support System Version 2. Data from CEISN, 2018

Figure 8.9

Figure 8.10

Figures 8.9- 8.13. . A series of screenshots from the CEISIN flood impact mapper showing the extent of flooding along the shore of the Hudson in the City of Poughkeepsie. This flooding scenario was created using the mapper for a 100yr flood at 72 in of sea-level rise (Center for International Earth Science Information Network, 2018).

Figure 8.11

Figure 8.11

Figure 8.12

Climate Resiliency

Though the impacts of climate change are impossible to predict, many of the current and likely outcomes of climate change warrant an effective and comprehensive response at both the community and legislative scale. In 2018, Cornell Cooperative Extension, Dutchess County, completed a Climate Smart Resiliency Planning Tool (CSRP) for the City of Poughkeepsie (Gluck, 2018) (Appendix H). This tool evaluates opportunities, strengths, and gaps in the City of Poughkeepsie's planning process, focusing on improving resilience to flooding and climate change. The CSRP Tool lists recommendations for the City in regard to future Climate planning and are summarized in Appendix H, these include:

- Comprehensive Plan Update
- Zoning Code Update/Downtown Rezoning Initiative
- Creation of a Climate Resiliency Plan
- Local Waterfront Revitalization Project (LWRP) Update
- Creation of an Emergency Preparedness Plan
- Website Updates/Public Outreach Opportunities
- Creation of a Conservation Advisory Council

The CSRP was presented to the Waterfront Advisory Council which then submitted a recommendation to the City Council to adopt the NYS Climate Smart Communities Pledge on October 22, 2018. On May 20, 2019 the Poughkeepsie City Council passed a resolution (Resolution R19-53) approving the adoption of a Climate Smart Communities Pledge.

Many of the ecosystem services that natural areas provide assist in climate resiliency. Healthy natural areas are able to respond to environmental changes more easily and can buffer infrastructure and people from impacts due to climate change. These ecosystem-based approaches for climate adaptation and resiliency have been shown to be both cost-effective and broadly applicable for a variety of climate threats and scenarios while providing co-benefits such as neighborhood beautification (Munang, et al., 2013).

By taking stock of the natural resources within the City of Poughkeepsie, this NRI provides a foundation for future sustainability and climate adaptation efforts. Other chapters in the NRI provide information that is relevant to developing a climate resilient community (Table 8.1).

Table 8.1. An index of the NRI maps in relation to how the natural resources they illustrate are related to Climate Change impacts and resiliency.

Chapter	Maps	Comments
3. Water Resources	Culverts Water Quality Imperviousness Floodplains Wetlands Watersheds Groundwater & Aquifers	Knowing the locations of culverts and wastewater discharge areas, especially in relation to impervious surfaces and flood hazard areas, will help prioritize flood mitigation/Green Infrastructure projects. The wetlands, groundwater, and watershed maps show us where our water is flowing and collecting, which will help prevent contamination and flooding events as well as provide insight into sources of runoff and impacts on water quality and quantity.
4. Biological Communities/Habitats	(Hudsonia Maps) Significant Habitats Large Habitat Patches Public Access Greens-paces Shoreline Materials Habitat Envelopes Conservation Zones	Large open spaces and parks should be preserved to provide natural areas for the infiltration of groundwater and access by residents to shaded, cooler areas for recreation. Habitat envelopes and large habitat patches should be preserved throughout the city. Shore-line materials should be maintained to prevent major flooding damage. Sustainable shorelines that incorporate vegetation could be considered that create habitat as well as buffer flooding, tidal and storm impacts.
5. Land Use	Land Use Street Trees Canopy Cover EAB	Tree canopy along streets, parks, private lots and open spaces should be increased to help increase shade, reduce air temperature, and decrease runoff during rain events. The EAB map will help prioritize tree planting sites. The Land Use map will allow us to identify vacant lots/brownfields and other areas that can be used for green infrastructure or urban ecology projects.
6. Recreational Resources	Recreational Resources	Parks and other vegetated open spaces in the City provide resilience by cooling air, infiltrating precipitation and runoff, and sequestering atmospheric carbon.
7. Historical Resources	Historic Resources (Downtown and Full City)	These maps display important historic sites that may be at risk due to sea-level rise and flooding. These areas may be fortified to protect against potential damage or destruction. Locations of Historic Resources in relation to flood zones and other sensitive areas is important when considering future planning and development in the City.

Collaboration with neighboring communities—and especially those in the Fall Kill and Casperkill watershed—is important as storm events and flooding become more frequent and severe. For example, increases in impervious surfaces throughout the watershed will have an impact on the amount of water flowing into the City of Poughkeepsie. In 2009 a Memorandum of Agreement was signed by four of the five municipalities in the Fall Kill Watershed to create a Fall Kill Intermunicipal Council (Appendix I). This council has been inactive in recent years, but revisiting the effort may be worthwhile as the impact and costs of climate change become more apparent. The City of Poughkeepsie cannot work in isolation when considering climate change and collaborating with neighboring municipalities will help to promote solutions and adaptations that are more cost-effective and benefit more of the residents of the Hudson Valley.

Additional Resource:

New York State Climate Change Science Clearinghouse -https://www.nyclimatescience.org

Appendices

A: Significant Habitats in the City of Poughkeepsie

B: Ash Tree Assessment and Emerald Ash Borer Management Plan

C: College Hill Park Invasive Species Survey

D: Poughkeepsie Scenic Resources Inventory

E: Metadata for maps included in the Natural Resources Inventory

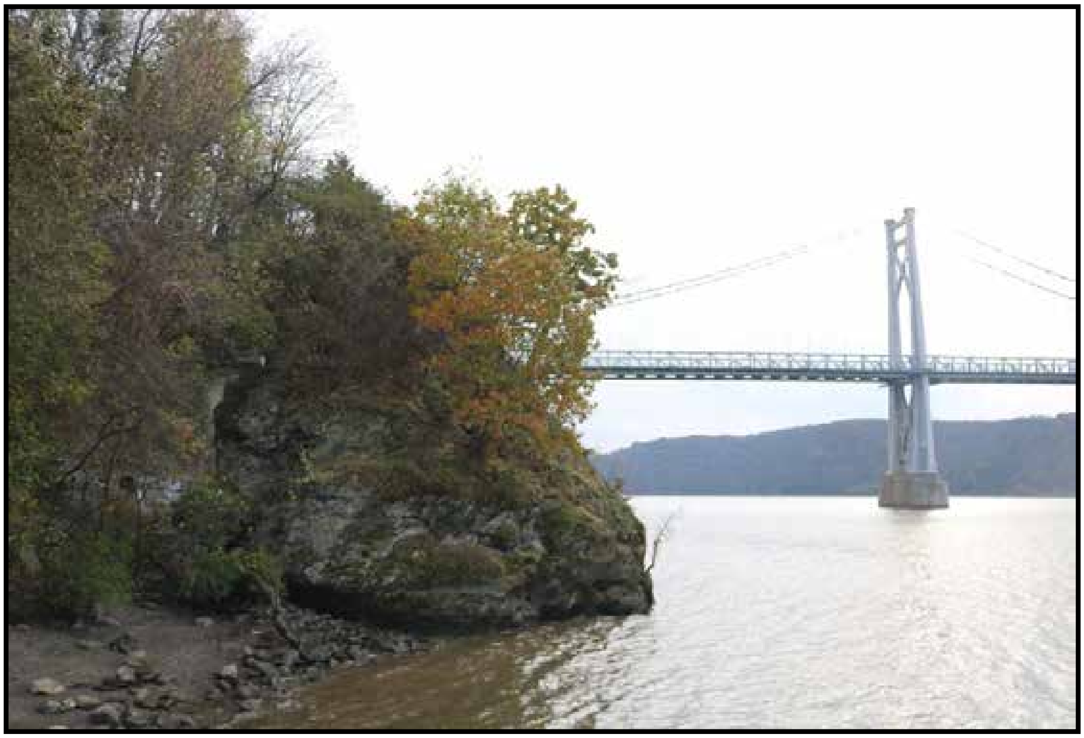
F: Species of Conservation Concern in the City of Poughkeepsie, NY

G: City of Poughkeepsie Zoning Map

H: Climate Smart Resiliency Planning for the City of Poughkeepsie

I: Fall Kill Intermunicipal Agreement

Significant Habitats
in the City of Poughkeepsie, Dutchess County, New York



Report to the Environmental Cooperative at the Vassar Barns
and the City of Poughkeepsie

By Elise Heffernan and Gretchen Stevens
Hudsonia Ltd.

May 2018

This report was prepared by
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for the Environmental Cooperative at the Vassar Barns
under the direction of Jennifer Rubbo

as a contribution to the Natural Resource Inventory
for the City of Poughkeepsie, New York.

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Cover photo: Ledge along Hudson River from Waryas Park Promenade in the City of Poughkeepsie, NY.

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The City of Poughkeepsie's cultural and economic history is closely tied to the Hudson River, which remains one of the great ecological and scenic assets and a source of local identity for the city. Other significant habitat areas throughout the city contribute to local and regional biodiversity and to the well-being of Poughkeepsie residents, workers, businesses, and institutions.

The Hudson River, including the main channel, the tidal shallows, the intertidal shore, and the tidal tributary mouth of the Fall Kill, constitutes the largest contiguous habitat area in the city. The next largest is at the Vassar Farm and Ecological Preserve, which has cultivated field, upland meadow, calcareous wet meadow, upland shrubland, upland hardwood and mixed forests, hardwood swamp, intermittent woodland pool, marsh, streams, and constructed ponds in a large contiguous area that extends into the Town of Poughkeepsie. Springside and College Hill Park also have large areas of contiguous habitats. Smaller habitat areas throughout the city, on both public and private land, provide habitat for resident and transient wildlife, and hold great value for the people of Poughkeepsie by providing areas for recreation and visual relief, moderating local air temperatures, absorbing rainwater and snowmelt, and providing other ecosystem services. "Cultural habitats," e.g., athletic fields, lawns, and other manicured areas, constitute much of the greenspace of the city.

The Hudson River tidal habitats are used by an array of shorebirds, wading birds, waterfowl, fishes, turtles, and other wildlife. Non-tidal streams, marshes, and constructed ponds are similarly used by wildlife, and are valued aesthetic components of the city landscape.

Large meadow areas at Vassar Farm support nesting eastern meadowlark, and could support bobolink and vesper sparrow, —grassland breeding birds of conservation concern. The grasses and forbs of those and other meadows in the city provide larval food and nectar sources for butterflies and moths, and nectar and pollen sources for native bees, honeybees, wasps, and other pollinators, as well as a host of other invertebrates, small mammals, and their predators such as foxes, coyotes, and raptors.

Forests, backyard forest groves, hedgerows, and even individual trees within manicured yards and parks are used by nesting and migratory songbirds, and could serve as summer roost sites for bats. The upland forests and swamp at Vassar Farm may support many kinds of wildlife, including, for example, some of the interior-forest bird species, such as scarlet tanager or ovenbird, that are unlikely to nest in smaller forest fragments in the city. The intermittent woodland pool at Vassar Farm provides springtime breeding and nursery habitat for wood frog, and could also support other pool-breeding amphibians—spotted salamander, Jefferson salamander, and marbled salamander,—that would occupy the nearby upland forest areas for the rest of the year.

Maintaining, restoring, and enhancing the ecological quality of the city's habitats would support native biological diversity, improve water management, strengthen people's connections to the land, and improve the resiliency of the landscape to the effects of climate change. Managing the shoreline zone to prepare for sea level rise and more frequent and severe storm events may be an issue of particular concern. The two shoreline parks, Kaal Rock Park and Waryas Park, offer public places for riverfront recreation and provide large areas of unpaved surfaces that can effectively absorb floodwaters. There may be opportunities for creating additional public-access greenspaces along the Hudson River that would also accommodate anticipated flooding and help to strengthen the city's place-based identity.

Creating or restoring greenspaces elsewhere in the city can benefit both people and ecosystems. Planting woody vegetation along the Fall Kill and smaller streams can improve the in-stream habitats (by providing shade and organic materials). Reducing the Fall Kill's channelization by removing crumbling walls in areas where flooding would not pose a threat to infrastructure can restore ecological connections between the stream and streamside habitats. Where possible, daylighting other streams in the city, softening the stream banks, and planting shading vegetation will improve stream habitats, biodiversity, water quality, and the aesthetic value of the streams.

Planting more street trees would add physical comfort to the urban environment and add habitat for migratory and resident birds and other wildlife. Transforming vacant lots into small greenspaces with, for example, butterfly gardens, benches, picnic tables, or public sculptures, would be especially beneficial in parts of the city where public and private greenspaces are few. This report identifies a few places where significant habitats could be expanded or improved, and where connectivity between and among existing greenspaces could be extended. It also offers ideas for enhancing the habitat values of backyards and other developed areas that can be carried out by private landowners on their own properties and by city agencies on public lands.

Sunset at the Poughkeepsie Farm Project on the Vassar Farm and Ecological Preserve.
E.Heffernan © 2018

INTRODUCTION

Background

In 2017 the Environmental Cooperative at the Vassar Barns began the preparation of a Natural Resource Inventory (NRI) for the City of Poughkeepsie, Dutchess County, New York. The NRI is a reference document for city-wide and site-specific land use planning and land management, as well as municipal policy-making and regulatory decisions. The Environmental Cooperative recruited Vassar College students to develop parts of the NRI, and Hudsonia Ltd. to identify, map, and describe ecologically significant habitats throughout the city. This report documents Hudsonia's findings and accompanies a large-format, city-wide habitat map.

Although the city's land cover is predominately structures and pavement, there are still remnant forests and meadows of the pre-urban landscape, as well as other areas that are highly disturbed but still provide islands of natural habitat in the urban matrix. Still other areas are intensively managed for recreation or aesthetics, and are of great value to Poughkeepsie residents even though they may have little habitat value for native plants and animals.

Urban greenspaces can serve as stopover habitat for migratory birds; nectar and pollen sources for butterflies and bees; summer and winter roosts for bats; hunting, foraging, and residence habitat for mesocarnivores (e.g., coyote, fox, skunk, raccoon) and other wildlife (e.g., chipmunk, squirrels); and habitat for native and non-native plants. Some rare species of plants and animals find ways to persist and even thrive in urban environments (Kiviat and Johnson 2013).

A human consequence of the intensification of urban land use is that urban populations are increasingly disconnected from the natural areas that define the region. By conserving, restoring and expanding natural habitats within the city, and creating connected corridors for people and wildlife, the City of Poughkeepsie can enhance its sense of place, maintain strong ecological connections with the larger landscape, and improve the quality of life for human residents, workers, and visitors.

Knowledge of the biological landscape will help landowners, planners, and regulatory agencies devise ways to balance economic, social, and environmental factors for a more livable and sustainable city. Although many land use decisions in the region are necessarily made on a site-by-site basis, the long-term viability of biological communities, habitats, and ecosystems requires consideration of whole landscapes. The availability of general biodiversity information for large areas such as entire towns, cities, watersheds, or counties allows landowners, developers, municipal planners, and others to better incorporate habitat protection and enhancement into day-to-day decision-making.

To address the need for comprehensive, regional planning, Hudsonia Ltd., a nonprofit institute for scientific research and education, based in Annandale, New York, has completed town-wide habitat maps and reports for twelve towns in Dutchess and Ulster counties, as well as many other large areas in Albany, Dutchess, Greene, Ulster, and Orange counties since 2001. In 2008, Hudsonia completed the habitat map for the Town of Poughkeepsie (Tabak and Stevens 2008) which borders the City of Poughkeepsie on three sides. These habitat mapping projects demonstrate how Hudsonia's *Biodiversity Assessment Manual for the Hudson River Estuary Corridor* (Kiviat and Stevens 2001) can be used to identify important biological resources over large geographic areas and inform local communities about biodiversity conservation.

Biologist Elise Heffernan conducted most of the work on this project from June through November 2017, with assistance from other Hudsonia biologists. Through map analysis, aerial photograph interpretation, and field observations, we created a map of ecologically significant habitats in the City of Poughkeepsie. Some of these habitats may support plants or animals of conservation concern, many provide habitat for common wildlife or ecological stepping stones between habitat areas, and many provide important services to the human community. The emphasis of this project was on identifying and mapping general habitat types; we did not conduct species-level surveys or map the locations of rare species.

To facilitate intermunicipal planning, we strive for consistency in the ways that we define and identify habitats and present the information, but we also work to improve our methods and products as the habitat mapping program evolves. Many passages in this report that are applicable to the region as a whole are taken directly from previous Hudsonia reports accompanying habitat maps in Dutchess County (e.g., Stevens and Broadbent 2002, Reinmann and Stevens 2007, Tabak and Stevens 2008, Graham and Stevens 2012) without specific attribution. This report, however, addresses our findings and specific recommendations for the City of Poughkeepsie. We intend for each of these projects to build on the previous ones, and believe that the expanding body of biodiversity information will be a valuable resource for site-specific, city-wide, and region-wide planning and conservation efforts.

We hope that the habitat map and this report will help landowners understand how their properties fit into the larger ecological landscape, and will inspire them to implement habitat protection and enhancement measures voluntarily. We also hope that the City of Poughkeepsie will engage in proactive land use and conservation planning to ensure that future development occurs with a view to long-term protection of its valuable biological resources and improvement of the quality of life for residents and visitors.

What is Biodiversity?

The concept of biodiversity, or biological diversity, encompasses all living organisms, their interactions and ecological processes. It includes ecosystems, biological communities, species and their genes, as well as their interactions with each other and the abiotic components of their environment, such as soil, water, air, and sunlight. Protecting native biodiversity is an important component of any effort to maintain intact, functioning ecosystems that sustain the human community and the living world around us. Healthy ecosystems make the earth habitable by moderating the climate, cycling essential gases and nutrients, purifying water and air, building soil, producing and decomposing organic matter, and providing many other essential services. Ecosystems also serve as the foundation of our natural resource-based economy.

The decline or disappearance of native species can be a symptom of environmental deterioration or collapses in other parts of the ecosystem. While we do not fully understand the roles all organisms play in an ecosystem and cannot fully predict the consequences of the loss of any particular species, we do know that each organism, including inconspicuous ones such as fungi or insects, plays a specific role in the maintenance of biological communities. Maintaining the full complement of native species in a region better enables an ecosystem to withstand stresses and adapt to changing environmental conditions.

What are Ecologically Significant Habitats?

For purposes of this project, a "habitat" is simply the place where an organism or population lives or where a biological community occurs, and is defined according to both its biological and non-biological components. Individual species will be protected for the long term only if their habitats remain intact. The local or regional disappearance of a habitat can lead to the local or regional loss of species that depend on that habitat. Habitats that we consider to be "ecologically significant" in the City of Poughkeepsie include:

1. Habitats that are rare or declining in the region, or those that support rare species and other species of conservation concern.
2. Common habitats that meet a minimum size criterion for the habitat type.
3. Complexes of connected habitats that, by virtue of their size, composition, or configuration, appear to have significant biodiversity value.

Because most wildlife species need to travel among different habitats to satisfy their basic survival needs, landscape patterns can have a profound influence on wildlife populations. The size, connectivity, and juxtaposition of both common and uncommon habitats in the landscape all have important implications for wildlife and biodiversity as a whole.

In addition to their importance from an ecological standpoint, habitat areas also provide immeasurable services to the human community. By illustrating the locations and configurations of significant habitats throughout the City of Poughkeepsie, the habitat map provides ecological information that can be incorporated into local land use planning and decision-making.

Benefits for People

The largest contiguous habitat, and greatest defining environmental feature of the City of Poughkeepsie, is the Hudson River. The River has been critical to Poughkeepsie's economic and cultural development, connects people to the natural world, and engenders a region-wide identity.

Greenspaces and natural settings provide many benefits to city infrastructure, energy use, and the health and well-being of city residents (Hausmann et al. 2015). Trees reduce air pollution and create cooler conditions, both indoors and outdoors, moderating the urban heat island effect (Hladnik and Pirnat 2011). Greenspaces absorb rainwater and snowmelt, reducing stormwater runoff and impacts on local waterways. Parks and public-access lands with athletic fields, picnic areas, walking trails, and other recreational features can be invaluable resources to nearby residents. Viewing natural spaces reduces stress (Frumkin 2001), and having parks and undeveloped land within cities can enhance people's connections to the greater environment (Szlavecz et al. 2011).

Park bench below habitat ledge in Upper Landing Park. E. Heffernan © 2018

The biological assemblages in urban habitats are often distinct from those of surrounding non-urban areas (Faeth et al. 2011). They are much influenced by past and present-day intensive horticulture and landscaping, and tend to be dominated by plants and animals that are highly adaptable to the conditions of the urban environment. Many of the plants that were brought in either for ornamental purposes or accidentally now persist in both managed and unmanaged areas, and they help to determine the kinds of animals that use these habitats.

Cities present a paradox for the relationship between people and their environment. The concentration of residences, businesses, industry, and infrastructure in urban areas reduces the footprint of human activities on the regional environment, but it also excludes many natural elements from the urban environment. Moreover, public greenspaces, and private lawns and gardens tend to concentrate in areas of higher-value business and residential real estate (Jennings et al. 2012). The expenses of land and landscaping (in time and money), short-term rent cycles, and other factors combine to reduce the feasibility of long-term investments in landscaping for residents with modest incomes (Szlavecz et al. 2011). The result is a skewed city matrix in which wealthier populations have greater access to greenspace (Jennings et al. 2012). The uneven distribution of residence-based landscaping makes city planning for habitat conservation important to the health of the whole city.

Study Area

The City of Poughkeepsie (Figure 1) borders the Hudson River in western Dutchess County in southeastern New York. It encompasses approximately 5.1 mi^2 (13.2 km^2) (excluding 0.5 mi^2 [1.4 km^2] of the Hudson River) and has a population of roughly 30,300 residents (United States Census Bureau 2016). The city's topography is of low hills with broad plains inbetween. Elevations range from sea level along the Hudson River to 376 ft (115 m) at the top of College Hill in the northeast corner of the city. All of the land in Poughkeepsie ultimately drains into the Hudson River, largely via the Fall Kill (Winnakee Creek) and the Casperkill (or Casper Creek, Casperkill Creek), but some areas drain directly to the Hudson River. The largest expanse of contiguous undeveloped land includes the large wetlands, upland forests and meadow complexes of the Vassar Farm and Ecological Preserve in the southeastern corner of the city.

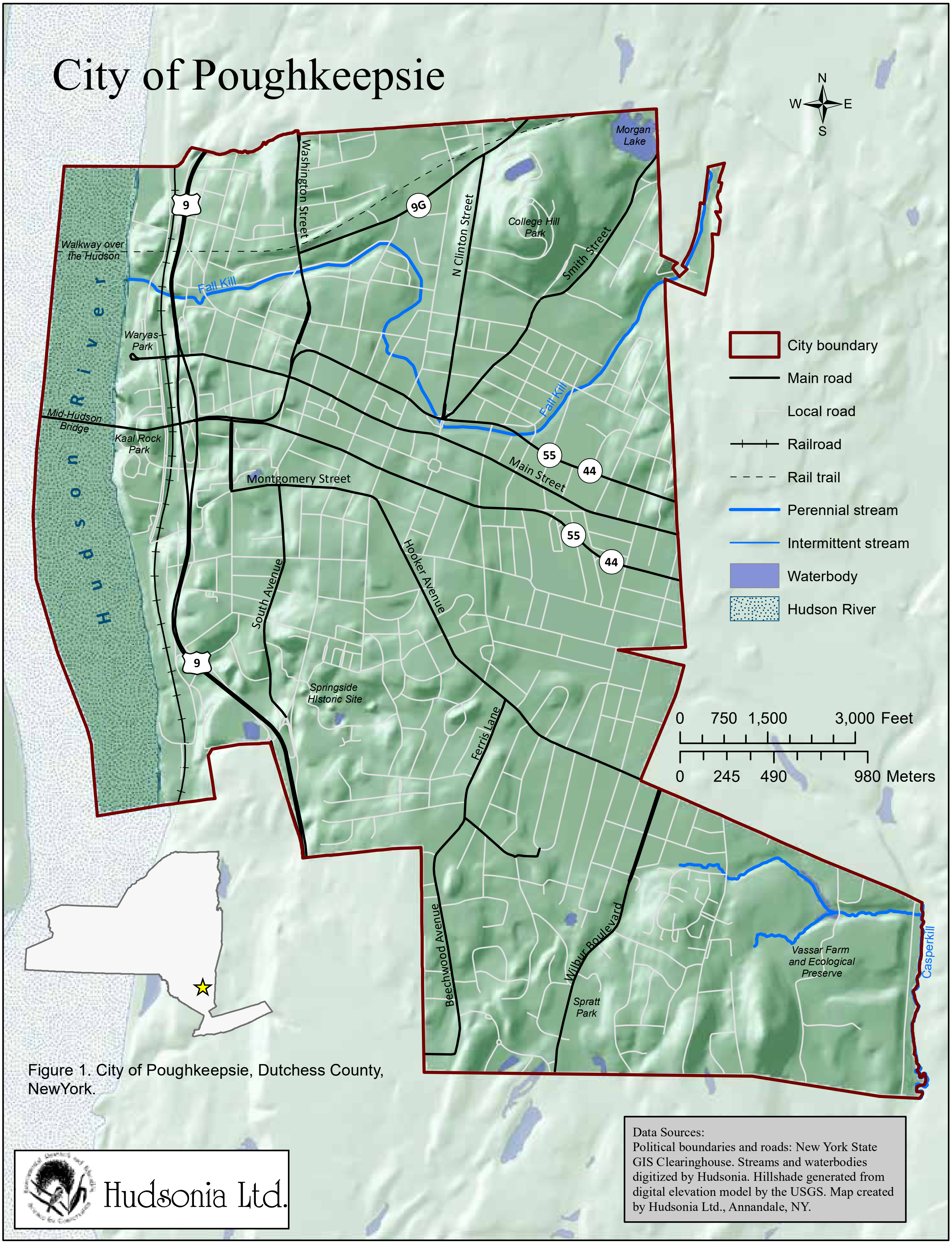


Figure 1. City of Poughkeepsie, Dutchess County, NewYork.

Notable topographic features are several elongate knobs (drumlins) oriented generally northeast-southwest. Smaller hills in the southeast are underlain by limestone (Fisher et al. 1970) (Figure 2). Poughkeepsie Mélange—bedrock composed of various rock fragments cemented together—is in a zone along the shoreline, often as an inclusion in shale formations. The surficial material in the city is primarily glacial till, but Cadwell et al. (1989) showed lacustrine deposits of sand, silt, and clay in the east and southeast, and large areas in the northeast and northwest where bedrock is at or near the ground surface (Figure 3). Although there may once have been a band of alluvium along the Hudson River shoreline, as mapped by Cadwell et al., today most of the shoreline zone is occupied by fill and/or pavement (Faber 2002) (Figure 3).

Land uses in the City of Poughkeepsie are dominated by residential and commercial development, but also include recreational, industrial and institutional facilities, and preserved open space. The great majority (96%) of land parcels in the city are small (1 acre [0.4 hectare] or less) and privately owned. Of the four parcels larger than 30 ac (12 ha), two are city-owned property (College Hill Park and Spratt Park), and the largest is the Vassar Farm and Ecological Preserve. All four are greenspaces open to the public.

The Stockbridge-Munsee Mohican tribe traces its roots to the Hudson Valley and Poughkeepsie region; the name Mohican derives from their name for the Hudson River, the Mohicannittuck, roughly "waters that are never still," a tribute to the tidal flows of the river. Before European colonization, land was managed for agriculture and subsistence hunting and fishing, and fruit, nuts, edible plants and medicinal herbs were collected from forests and meadows (Bonney Hartley, personal communication). The Hudson River and local streams were critical to human survival, and settlements were often located along waterways.

The Hudson River was a key source for food, transport, and trade. The Hudson River and other waterways also provide habitat for turtles and bald eagles, species of significance to the Stockbridge-Munsee Mohican tribe (Bonney Hartley, personal communication). Having been relocated from the Hudson Valley, the Stockbridge-Munsee Mohican tribe is based in Bowler, Wisconsin, but maintains an interest in their cultural and heritage lands. The Delaware Tribe and Delaware Nation also cite Dutchess County within their cultural areas of interest (Brooks 2018).

Cattails growing next to rail trail. E. Heffernan © 2018

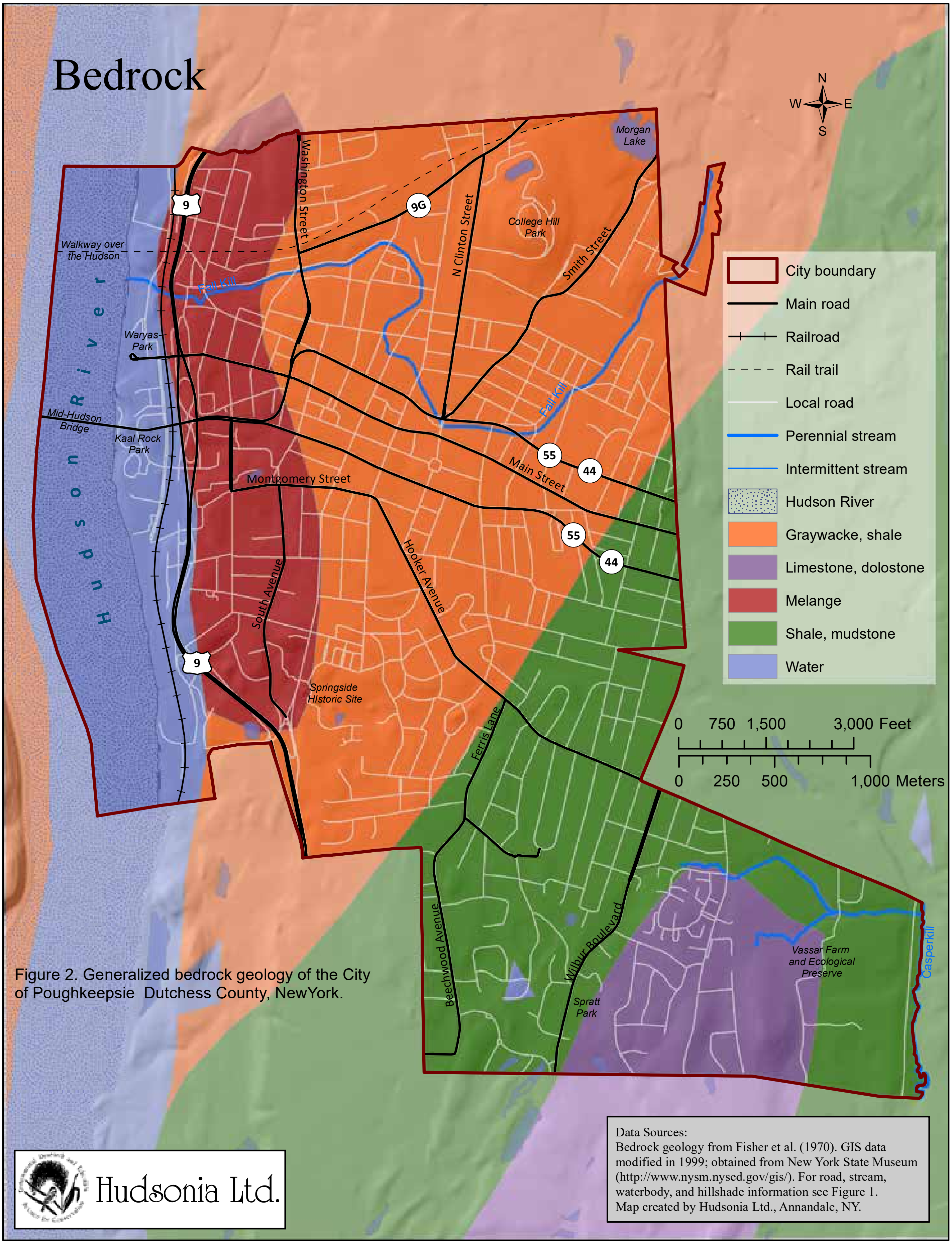


Figure 2. Generalized bedrock geology of the City of Poughkeepsie Dutchess County, NewYork.

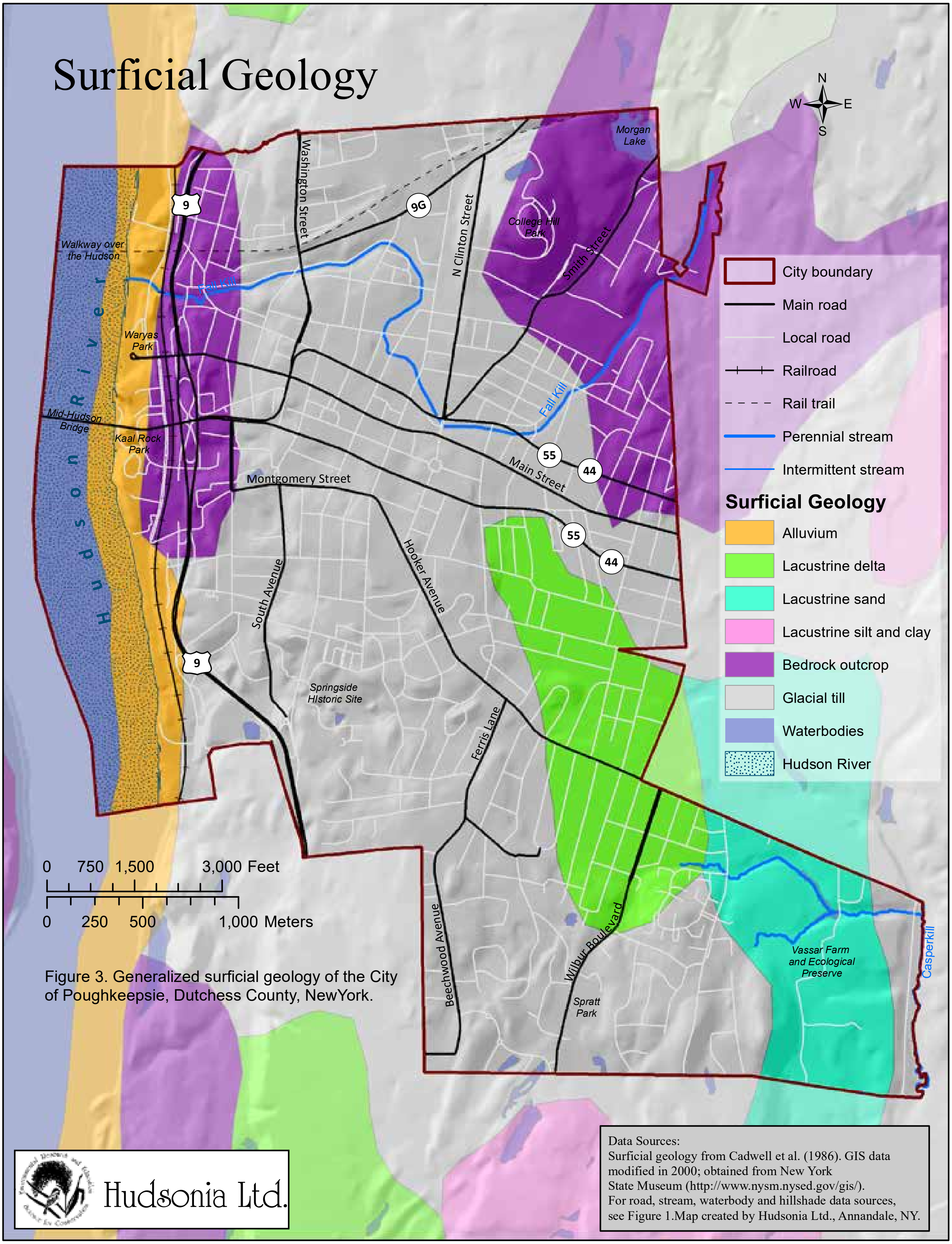


Figure 3. Generalized surficial geology of the City of Poughkeepsie, Dutchess County, NewYork.

View of the city from the Walkway Over the Hudson. E. Heffernan © 2018

METHODS

Hudsonia employs a combination of laboratory and field methods to identify habitats. Below we describe each phase in the Poughkeepsie habitat mapping project.

Gathering Information and Predicting Habitats

We use combinations of map features (e.g., topography, bedrock chemistry, and soil texture, depth, and drainage) and features visible on aerial photographs (e.g., exposed bedrock, streams, vegetation cover types) to predict the location and extent of ecologically significant habitats. In addition to previous studies conducted by Hudsonia biologists in Poughkeepsie and biological data provided by the New York Natural Heritage Program, we used the following resources for this project:

- *1:40,000 scale color infrared aerial photograph prints* from the National Aerial Photography Program series taken in spring 1995, obtained from the U.S. Geological Survey. Viewed in pairs with a stereoscope, these prints ("stereo pairs") provide a three-dimensional view of the landscape and are extremely useful for identifying vegetation cover types, wetlands, streams, and cultural landscape features.

- *High-resolution (1 pixel = 1 ft [30 cm]) color infrared digital orthophotos* taken in spring 2013, obtained from the New York State GIS Clearinghouse website (http://www.nysgis.state.ny.us; accessed June 2017). These digital aerial photos were used for on-screen digitizing of habitat boundaries.

- *U.S. Geological Survey topographic maps* (Poughkeepsie 7.5 minute quadrangle). Topographic maps contain extensive information about landscape features, such as elevation contours, surface water features, and significant cultural features. The contour lines can be used to predict the occurrence of habitats such as cliffs, intermittent woodland pools and other wetlands, intermittent streams, and seeps.

- *Bedrock and surficial geology maps* (Lower Hudson Sheets) produced by the New York Geological Survey (Fisher et al. 1970, Cadwell et al. 1989). Along with topography, surficial and bedrock geology strongly influence the development of particular soil properties and aspects of groundwater and surface water chemistry, and thus have important implications for the biological communities that become established at any site.

- *Soil Survey of Dutchess County, New York* (Faber 2002). Specific attributes of soils, such as depth, drainage, texture, and pH, strongly influence the types of habitats that are likely to occur in an area. Shallow soils, for example, may indicate the location of exposed ledges. Poorly and very poorly drained soils usually indicate wetland habitats such as swamps, marshes, and wet meadows.

- *GIS data*. A Geographic Information System enables us to overlay multiple data layers on a computer screen, greatly enhancing the efficiency and accuracy with which we can predict the diverse habitats that are closely linked to local topography, geology, hydrology, and soil conditions. GIS also enables us to create detailed, spatially accurate maps. We obtained most of our GIS data layers from the New York State GIS Clearinghouse, including roads, soils, bedrock geology, surficial geology, and wetlands. National Wetlands Inventory data prepared by the US Fish and Wildlife Service was obtained from the USFWS website. We also obtained 10 ft (3 m) contour data from the Dutchess Land Conservancy, and 2017 tax parcel data from the Dutchess County Office of Real Property Tax.

Preliminary Habitat Mapping and Field Verification

We prepared a preliminary map of predicted habitats based on map analysis and stereo interpretation of aerial photographs. We digitized the predicted habitats onscreen over the orthophoto images using ArcMap 10.6 (Environmental Systems Research Institute 2017) software. With these draft maps in hand we conducted field visits to as many of the mapped habitat units as possible to verify their presence and extent, and to assess their quality.

We identified landowners using tax parcel data, and before visiting field sites, contacted landowners for permission to walk on their land. We prioritized sites for field visits based both on opportunity (i.e., willing landowners) and our need to answer habitat questions that could not be answered remotely. In addition to conducting fieldwork on public and private land, we viewed habitats from adjacent properties, public roads, and other public access areas. Because the schedule of this project (and non-participating landowners) prevented us from conducting field visits to every parcel in the city, this strategy increased our efficiency while maintaining a high standard of accuracy.

Ultimately, we field-checked approximately 46% of the undeveloped area in Poughkeepsie (325 acres [132 ha]). Areas that could not be field-checked were nonetheless mapped remotely, but we assume that areas of the habitat map that were field checked are generally more accurate than areas we did not visit.

Defining Habitat Types

Habitats are useful for categorizing places according to apparent ecological function, and are manageable units for scientific inquiry and land use planning. We have classified broad habitat types that are identifiable largely by their vegetation and visible physical properties. Habitats exist, however, as part of a continuum of intergrading resources and conditions, and it is often difficult to draw a line to separate two habitat types. Also, some habitats are intermediates between two defined habitat types, and some habitat categories can be considered complexes of several habitats. In order to maintain consistency within and among habitat mapping projects, we adhere to certain mapping conventions for delineating habitat boundaries. Some of these are described in Appendix A. Because some parts of Poughkeepsie were only mapped remotely, and all mapped habitat boundaries are drawn without survey or GPS equipment, all of the mapped features should be considered approximations.

Each habitat profile in the Results section describes the general ecological attributes of places that are included in that habitat type. Developed areas and other areas that we consider to be non-significant habitats (e.g., structures, paved roads and driveways, other impervious surfaces, and small lawns, small meadows, and hedgerows) are shown as white (no symbol or color) on the habitat map. Areas that have been developed since 2013 (the orthophoto date) were identified as such only if we observed them in the field. For this reason, it is likely that we have underestimated the extent of developed land in the city.

Final Mapping

We corrected and refined the preliminary map on the basis of our field observations to produce the final habitat map. We printed the final large-format habitat map at a scale of 1:6,000 using a Hewlett Packard DesignJet 800PS plotter The GIS database that accompanies the map includes additional information about many of the mapped habitat units, such as the dates of field visits (including observations from adjacent properties and roads) and some of the plant and animal species observed in the field. The habitat map, GIS database, and this report have been given to the Environmental Cooperative for use in the Natural Resource Inventory and to the City of Poughkeepsie to inform land use planning and decision-making.

We request that any maps printed from this database for public viewing be printed at scales no larger than 1:6000, and that the habitat map data be attributed to Hudsonia Ltd. Although the habitat map was carefully prepared and extensively field-checked, there are inevitable inaccuracies in the final map. Because of this, we request that the following caveat be printed prominently on all maps:

> *"This map is suitable for general land-use planning, but is not suitable for detailed planning and site design, or for jurisdictional determinations (e.g., for wetlands). Boundaries of wetlands and other habitats depicted here are only approximate."*

Morgan Lake from the College Hill Golf Course. E. Heffernan © 2018

Significant Habitats

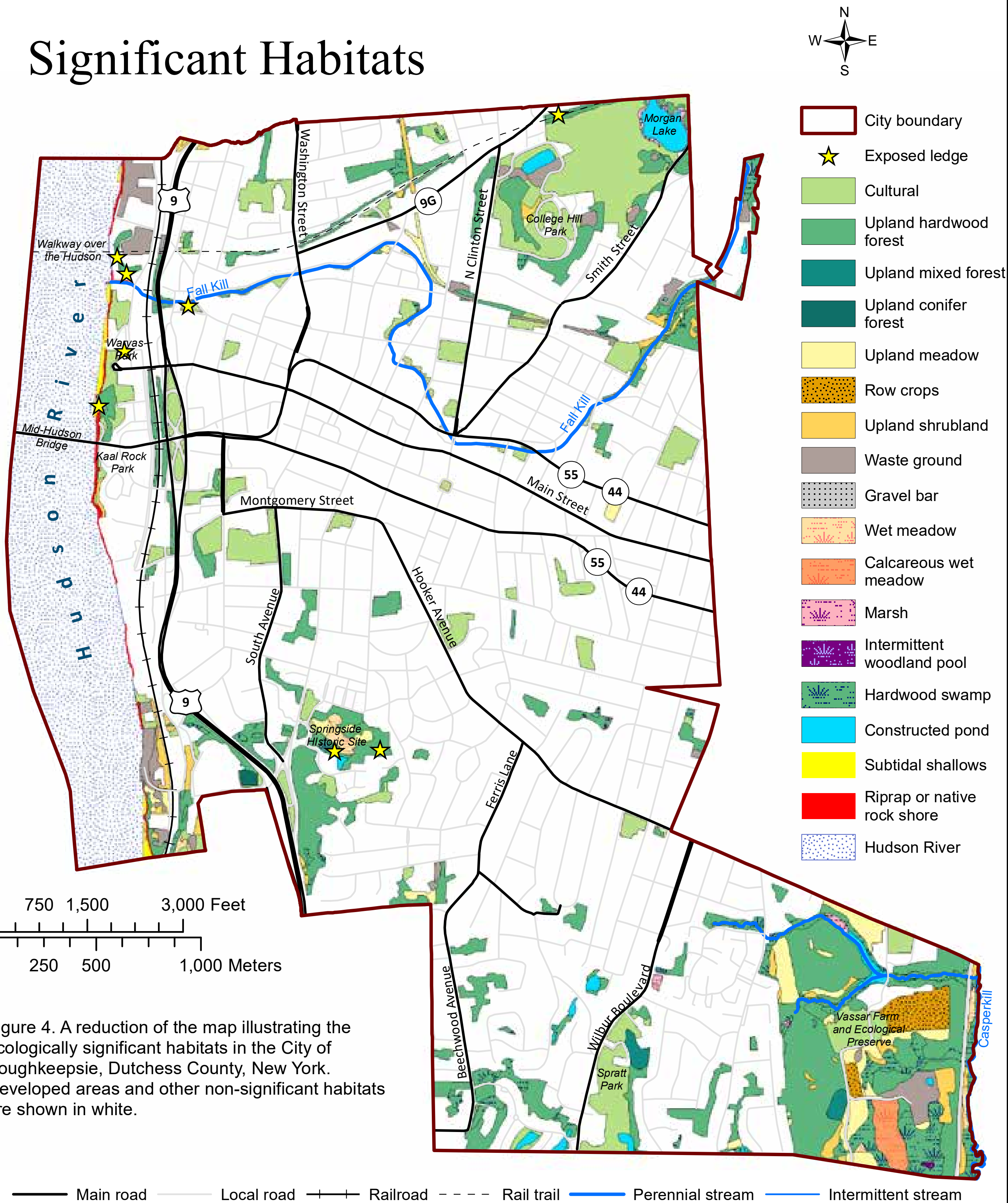


Figure 4. A reduction of the map illustrating the ecologically significant habitats in the City of Poughkeepsie, Dutchess County, New York. Developed areas and other non-significant habitats are shown in white.

Hudsonia Ltd.

Data Sources:
Habitats were delineated from 2013 orthoimagery downloaded from NYS GIS Clearing house (https://gis.ny.gov/) and field observations. For road, stream, and waterbody data sources see Figure 1. Map created by Hudsonia Ltd, Annandale, NY.

RESULTS

Overview

The large-format City of Poughkeepsie habitat map illustrates the ecologically significant habitats in the city and their configurations in the landscape. Figure 4 is a reduction of the completed habitat map. Of the total 5.1 mi^2 (13.8 km^2) terrestrial area of the city, approximately 19.4% was mapped as significant habitat. Including the Hudson River portion of the city brings the total area of significant habitats to 1.7 mi^2 (4.4 km^2), or 29.0 % of the city. Most of the undeveloped land is in disjunct patches. Figure 5 shows blocks of contiguous undeveloped habitat areas within the city, color-coded by size. Several types of common habitats cover extensive areas within these blocks. For example, upland forests, open meadows (managed and unmanaged) and swamps each occupy nearly 3% of the land in the city. “Cultural” areas, which are defined as highly managed habitats without pavement or structures (e.g., large lawns, golf courses, cemeteries), account for over 5% of the land in the city. Some of the smaller, more unusual habitats we documented include habitats associated with the Hudson River, such as the rocky shore and tidal tributary mouth. In total, we identified 20 general habitat types in the City of Poughkeepsie that we consider to be of potential ecological importance (Table 1).

Although the mapped areas represent ecologically significant habitats, each has been much altered by past and present-day human activities. Most or all areas of the upland forests, for example, have been cut repeatedly in the past 300 years, and many forested areas lack the structural complexity of long-undisturbed forests. Many of the wetlands in the city have been extensively altered by dams, filling, draining, pollution, and construction of railroads and roads. Non-native, invasive plants species (e.g., purple loosestrife, common reed, Bell’s honeysuckle, Norway maple, multiflora rose, garlic-mustard, water-chestnut) are widespread in upland and wetland habitats in the city.

We have documented the locations and extent of important habitats in Poughkeepsie (Figure 4), but only in some cases have we provided information on the quality and condition of these habitats. Notes in the GIS database provide some of these assessments.

Table 1. Ecologically significant habitats identified by Hudsonia in the City of Poughkeepsie, Dutchess County, New York, 2018.

Upland Habitats	Non-Tidal Wetland Habitats	Hudson River Habitats
Upland hardwood forest Upland conifer forest Upland mixed forest Crest/ledge Upland shrubland Upland meadow Cultural Waste ground	Hardwood & shrub swamp Intermittent woodland pool Marsh Wet meadow Spring/seep Constructed pond Open water Stream	Riprap and native rocky shore Tidal tributary mouth

Habitat Descriptions

Below we describe some of the ecological attributes of the habitats identified in the City of Poughkeepsie, and discuss some conservation measures that can help to protect these habitats and the species of conservation concern they may support. We have indicated species of conservation concern (those that are listed by state or federal agencies or considered rare or vulnerable by non-government organizations) that are generally associated with these habitats by placing an asterisk (*) after the species name. The conservation status of animal species mentioned in this report is given in Appendix C. Appendix D gives the common and scientific names of all plants mentioned in this report.

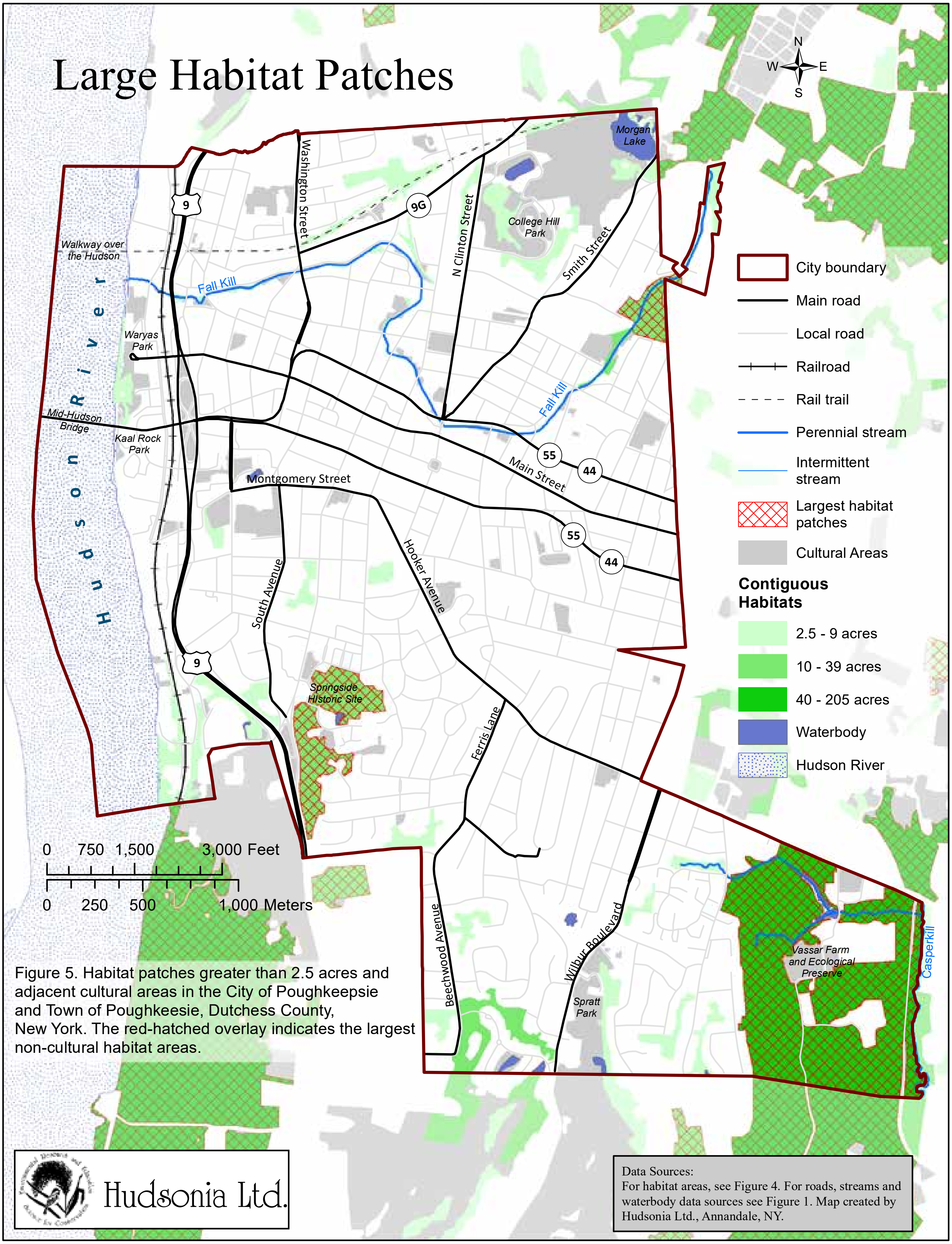


Figure 5. Habitat patches greater than 2.5 acres and adjacent cultural areas in the City of Poughkeepsie and Town of Poughkeepsie, Dutchess County, New York. The red-hatched overlay indicates the largest non-cultural habitat areas.

Upland Habitats

Upland forests

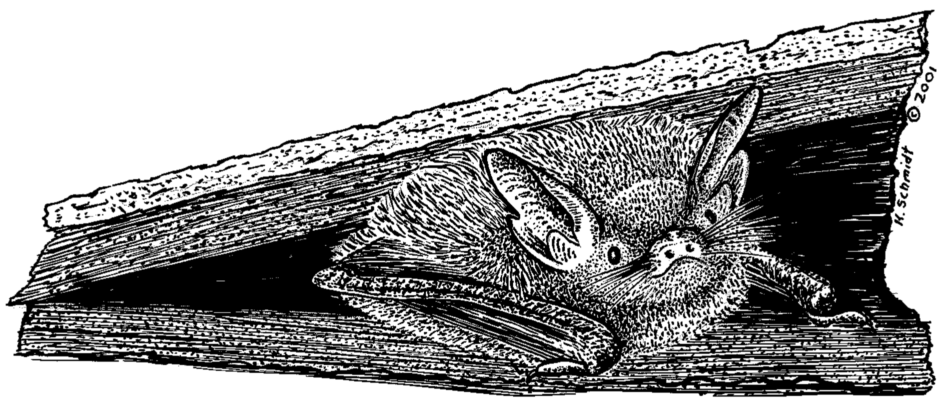
Ecological Attributes

We classified upland forests into three general types for this project: hardwood forest, conifer forest, and mixed forest. We recognize that upland forests are in fact much more variable, with each of these three types encompassing many distinct biological communities. However, our broad forest types are useful for general planning purposes, and are also the most practical for our remote mapping methods.

Upland Hardwood Forest

Upland hardwood forest is the most extensive habitat type in the region and the city, and includes many different types of deciduous forest communities. Upland hardwood forests are used by a wide range of common and rare species of plants and animals. Common trees of upland hardwood forests in Poughkeepsie include maples (sugar, red, Norway), oaks (black, red, white), hickories (shagbark, pignut), white ash, and black locust. Conifers such as eastern hemlock and white pine occur occasionally in hardwood forests. Common understory species include Bell's honeysuckle, spicebush, hop hornbeam, and a variety of wildflowers, sedges, ferns, and mosses.

Eastern box turtle* spends most of its time in upland forests and meadows, finding shelter under logs and organic litter. Spotted turtle* may spend several weeks resting in upland forests during the warm months of the year. Many snake species forage widely in upland forests and other habitats. Upland hardwood forests provide nesting habitat for raptors, including red-shouldered hawk,* Cooper's hawk,* sharp-shinned hawk,* broad-winged hawk,* and barred owl,* and many species of songbirds including warblers, vireos, thrushes, woodpeckers, and flycatchers. American woodcock* forages and nests in young hardwood forests. Pileated woodpecker uses large trees (live or standing dead) for foraging, roosting, and nesting (Bull and Jackson 1995). Wood thrush* and scarlet tanager* may require large forest-interior areas to maintain viable populations. Large mammals such as black bear,* bobcat*, and fisher* also seem to require large expanses of forest even though they will use many other parts of the landscape. Many small mammals are associated with upland hardwood forests, including eastern chipmunk, southern flying squirrel, and white-footed mouse. Hardwood trees greater than 5 inches (12.5 cm) in diameter (especially those with loose platy bark such as shagbark hickory or deeply furrowed bark such as black locust) can be used by Indiana bat* and other bat species for summer roosting and nursery colonies. Upland hardwood forests are extremely variable in their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other habitat factors. Other habitats, such as intermittent woodland pools, crest, and ledge, are sometimes embedded within areas of upland hardwood forest.



Indiana bat may use Poughkeepsie trees for summer roosts.. Kathleen A. Schmidt © 2001

Upland Conifer Forest

This habitat includes pole-sized (approximately 5-10 in [12-25 cm] diameter at breast height) to mature conifers in naturally occurring upland forests with conifers representing more than 75% of the canopy In Poughkeepsie there are a few instances of planted conifers—native and non-native—that are managed as forest. Because these forests were planted, they are more uniform in size and age of overstory trees, structure, and overall species composition than natural conifer stands.

Conifer stands are used by many species of owls (e.g., barred owl,* great horned owl, long-eared owl*) and other raptors (e.g., Cooper's hawk* and sharp-shinned hawk*) for roosting and sometimes nesting. Pine siskin,* red-breasted nuthatch,* black-throated green warbler,* evening grosbeak,* and purple finch* nest in conifer stands. American woodcock* sometimes use conifer stands for nesting and foraging. Conifer stands also provide important habitat for a variety of mammals, including eastern cottontail, red squirrel, and eastern chipmunk (Bailey and Alexander 1960). Some conifer stands provide winter shelter for white-tailed deer and can be especially important for them during periods of deep snow cover.

Upland Mixed Forest

The term "upland mixed forest" refers to non-wetland forested areas with both hardwood and conifer species, where conifer cover is 25-75% of the canopy. These areas are less densely shaded at ground level and support a higher diversity and greater abundance of understory species than conifer-dominated stands. There is an area of planted native and non-native conifers at the Vassar Farm and Ecological Preserve that are now interspersed with hardwoods.

Occurrence in the City of Poughkeepsie

Forested areas in the City of Poughkeepsie, including both forested wetlands and uplands, are shown in Figure 5. The two largest contiguous forests in the city occupy approximately 77 ac (31 ha) and 55 ac (22 ha) on the Vassar Farm and Ecological Preserve, and are part of a larger forest extending south into the Town of Poughkeepsie. Although large, these patches have a high ratio of edge (perimeter) to forest core (area). Forest edges tend to be warmer, brighter, drier, and windier than forest interiors (Vanwalleghem 2009) and are often occupied, in part, by non-native invasive plants, which are less likely to infest the undisturbed interior (Harper et al. 2005). A forest with more edge and less core habitat will have less of the cooler, moister, and shadier habitats of the deep forest, and hence less area for the plants and animals of conservation concern that benefit from those conditions. Less core will also expose some vulnerable animals—such as forest-interior songbirds—to the predators and nest parasites that frequent forest edges.

Elsewhere in the city are many small patches of forest—the amalgamation of backyard forests—that could serve as stepping stones for wildlife movement. Few of the forested areas in the city are large enough to support the forest dwelling animals of conservation concern mentioned in the habitat descriptions above, but many are still likely to host species adapted to smaller and more-disturbed forests and forest edge habitats.

Upland hardwood forest was the most widespread of the mapped habitat types in the city. All forests in the city have been cleared or logged in the past, but many large trees are present, most of them at College Hill Park or the Vassar Farm and Ecological Preserve. Upland hardwood forests were common in the floodplains of the Casperkill and its tributaries. The understories of these floodplain forests were often dominated by non-native shrubs such as Bell's honeysuckle and multiflora rose (a common condition in post-logging and post-agricultural forests in the Hudson Valley), and non-native vines such as oriental bittersweet and porcelain berry were often present in moist areas.

Upland hardwood forest at the Vassar Farm and Ecological Preserve. E. Heffernan © 2018

Upland mixed and conifer forests covered relatively small total areas (5.6 ac [2.3 ha] and 1.3 ac [0.5 ha], respectively); the largest were on the Vassar Farm and Ecological Preserve. Most of the mixed and conifer forests were plantations of Norway spruce, Scotch pine, white pine, or eastern red cedar.

Sensitivities/Impacts

Forests of all kinds can be important habitats for wildlife. Large forests that are unfragmented by roads, meadows, trails, utility corridors, or developed lots are especially important for certain organisms, but are increasingly rare in the region. Both paved and unpaved roads act as barriers that many species either do not cross or cannot safely cross, and many animals avoid breeding near traffic noise (Forman and Deblinger 2000, Trombulak and Frissell 2000).

In addition to fragmentation, forest habitats can be degraded in several other ways. Clearing the forest understory destroys habitat for birds such as wood thrush* which nests in dense understory vegetation, and black-and white warbler* which nests on the forest floor. Soil compaction and removal of dead and downed wood and debris have many negative impacts, including the elimination of habitat for mosses, lichens, fungi, cavity-using animals,

Canopy gap in forest at Vassar Farm and Ecological Preserve. E. Heffernan © 2018 amphibians, reptiles, small mammals, and invertebrates. Where dirt roads or trails cut through forest, vehicle and pedestrian traffic can harm tree roots and cause soil erosion. The roadway itself can provide nest predators (such as raccoon and opossum) and the brown-headed cowbird (a nest parasite) access to interior forest areas. Roads and trails can provide entry for non-native invasive weeds such as garlic-mustard and multiflora rose, and human activity along roads and trails can inhibit nesting of certain songbirds. Runoff from roads can pollute nearby areas with road salt, heavy metals, and sediments (Trombulak and Frissell 2000), and mortality from vehicles can significantly reduce the population densities of amphibians (Fahrig et al. 1995).

Norway maple, tree-of-heaven and Amur corktree were common non-native invasive trees found at the Vassar Farm and Ecological Preserve. Norway maples were common throughout the city as both planted street trees and dominant canopy trees in forest patches. Forests are also susceptible to invasion by shade-tolerant, non-native herbs and shrubs, and this susceptibility is increased by development-related disturbances. Gaps created by storms and disease can provide habitat for fast-growing, shade-intolerant, non-native species such as tree-of-heaven, Japanese barberry, and Bell's honeysuckle. Once established, many of these species are difficult to eliminate. Due to the highly fragmented nature of the city's forests and the ongoing human disturbance, most have some non-native species, and non-natives reach high densities in many places. Oriental bittersweet and porcelain berry, two non-native woody vines, are rampant in some parts of the city where they overtake forest and shrub canopies, and may suppress native species and alter forest composition (Ladwig and Meiners 2009). The forest at College Hill Park had small patches of wisteria, another non-native that can also be invasive.

Whatever the condition of their native plant communities, however, urban forests have special value for the human community. Forests, wooded hedgerows, and street trees improve the livability of cities by reducing pollution, moderating air temperatures, absorbing stormwater, providing visual relief, and connecting people to the natural environment (Greene et al. 2011). Forests and other habitat patches in the city can act as stepping stones for wildlife, and serve a similar function for human residents to connect them with the natural landscapes of the Hudson Valley While the Poughkeepsie habitat map depicts forest patches of 0.2 ac (900 m^2) or larger, street trees and backyard forests are also important habitat features both for urban wildlife and for people. Figure 8 outlines some hypothetical stepping stones and corridors between and among habitat patches.

Introduced forest pests are also threatening forest health in the city and other parts of the Hudson Valley. Of note is the hemlock woolly adelgid (HWA), an insect that has infested many eastern hemlock stands from Georgia to New England. The adelgid typically kills trees within 10-15 years and has the potential to eliminate most or all eastern hemlock trees in the region. In Poughkeepsie many hemlock stands are in some stage of decline due to the HWA, but there are still several areas with hemlocks exhibiting few if any signs of infestation.

The emerald ash borer (EAB) is a non-native tree borer (a jewel beetle) that infests ash species from New Hampshire to Georgia and west to Colorado, and is now found in 30 of New York's 62 counties (NYSDEC 2017). While the adults do little damage to the tree, the larvae feed on the inner bark of the trees; a heavy infestation will effectively girdle a tree, killing it within 2-4 years. Early detection of the emerald ash borer is difficult, and outbreaks are almost impossible to contain once identified. White and green ashes are common trees throughout the City of Poughkeepsie. White ash is frequent in upland forests and as a street tree, and green ash is common in floodplains and hardwood swamps. A 2017 ash survey conducted by Vassar College students found that over half of the 387 ash trees assessed in the city showed signs of stress, and approximately 9% had recognizable symptoms of EAB activity.

Woodpecker damage to ash tree due to emerald ash borer infestation.
E. Heffernan © 2018

(See the Conservation Priorities and Planning section for recommendations on preserving the habitat values and other values of large and small forests in Poughkeepsie.)

Crest and ledge

Ecological Attributes

Rocky crest and ledge habitats often occur together, so they are described and mapped together for this project. Crest and ledge habitats occur where soils are very shallow and bedrock is partially exposed at the ground surface, at the summit or shoulder of a hill or knoll (crest) or as a steep-sided rock outcrop (ledge). These habitats can occur at any elevation and are usually embedded within other habitat types, most commonly upland forest. Some crest and ledge habitats support well-developed forests, while others have sparse, patchy, and stunted vegetation.

Ebony spleenwort on ledge habitat.
E. Heffernan © 2018

Crest and ledge habitats often appear to be harsh and inhospitable, but they can support an extraordinary array of uncommon or rare plants and animals. Some species, such as wall-rue, smooth cliffbrake,* purple cliffbrake, and northern slimy salamander* are found only in and near such habitats elsewhere in the region. The communities and species that occur at any particular location are determined by many factors, including bedrock type, outcrop size, aspect, exposure, slope, elevation, biotic influences, and kinds and intensity of human disturbance.

Northern oak hairstreak* (butterfly) occurs with oak species which are host plants for its larvae, and olive hairstreak* occurs on crests with its host eastern red cedar. Rocky habitats with larger fissures, cavities, and exposed ledges may provide shelter, den, and basking habitat for eastern racer,* eastern ratsnake,* and northern copperhead.* Southern redback vole is found in some rocky areas in the region.

Occurrence in the City of Poughkeepsie

Crest and ledge habitats were small and scattered in Poughkeepsie. The largest areas with exposed rock were along the Hudson River shoreline and vicinity and along active and abandoned railroad beds. While most ledges were in forests, there were several areas of exposed Poughkeepsie Mélange bedrock along the river that supported no trees and only patchy herbaceous vegetation. The only crest area that we identified was the highly-disturbed opening above the ledge at Kaal Rock Park.

Ledge habitat along rail trail. E. Heffernan © 2018

Sensitivities/Impacts

Crest and ledge habitats often occur in locations that are valued by humans for recreational uses, scenic vistas, and house sites. Construction of trails, roads, and houses destroys or degrades crest and ledge habitats directly, and causes fragmentation of these habitats and the forested areas of which they are often a part. Rare plants of rocky habitats are vulnerable to trampling and collecting; and snakes that use these habitats are susceptible to road mortality, intentional killing or harassing, and collecting. The shallow soils of these habitats are susceptible to erosion from construction and logging activities, and from foot and ATV traffic. The only ledge feature along the shoreline is located between Kaal Rock Park and Waryas Park. The ledge could benefit from directed management of visitors to encourage responsible use of the habitat and discourage destructive social trails.

Upland shrubland

Ecological Attributes

We use the term "upland shrubland" to describe non-forested uplands with significant (≥20 %) shrub cover. In most cases these are lands in transition between meadow and young forest, but they also occur in recently cleared areas, or are maintained along utility corridors by cutting or applying herbicides. Recently cleared or disturbed sites often contain dense thickets of shrubs and vines, including the non-native Japanese barberry, Bell's honeysuckle, multiflora rose and oriental bittersweet. Abandoned agricultural fields and pastures often support diverse plant communities, including a variety of meadow grasses and forbs, shrubs such as meadowsweet, gray dogwood, northern blackberry, raspberries, and scattered seedling- and sapling-size eastern red cedar, hawthorns, white pine, gray birch, red maple, white ash, black cherry, quaking aspen, and oaks. Occasional large, open-grown trees (e.g., sugar maple, white oak, sycamore) left as shade for livestock may be present.

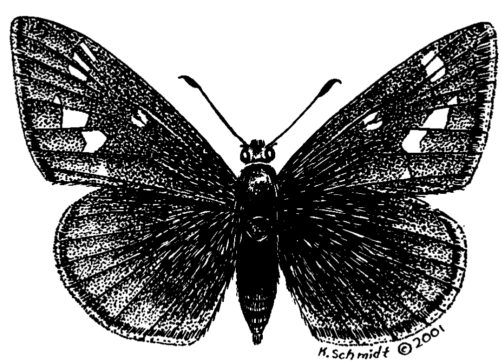
Rare butterflies such as Aphrodite fritillary,* dusted skipper,* and Leonard's skipper* may occur in shrublands where their host plants are present (violets for the fritillary and native grasses such as little bluestem for the skippers). Upland shrublands and other non-forested upland habitats may be used by turtles (e.g., painted turtle, wood turtle,* spotted turtle,* Blanding's turtle,* and eastern box turtle*) for nesting. Many bird species of conservation concern nest in upland shrublands and adjacent upland meadow habitats, including brown thrasher,* blue-winged warbler,* golden-winged warbler,* prairie warbler,* yellow-breasted chat,* clay-colored sparrow,* field sparrow,* eastern towhee,* American woodcock,* and northern harrier.* Extensive upland shrublands and those that form large complexes with meadow habitats may be particularly important for these breeding birds. Several species of hawks and falcons use upland shrublands and adjacent meadows for hunting small mammals such as meadow vole, white-footed mouse, and eastern cottontail.

Occurrence in the City of Poughkeepsie

Most of the upland shrublands of the city were in former agricultural areas, forest gaps, and utility corridors, and ranged from 0.01 to 4.1 ac (>0.01-1.7 ha), for a total of 25.7 ac (10.4 ha). The largest shrublands were those occupying former agricultural fields on the Vassar Farm and Ecological Preserve.

Sensitivities/Impacts

Shrublands and meadows (see below) have closely-related plant communities and share many of the same ecological values. Having a diversity of ages and structures in these habitats may promote overall biological diversity, and can be achieved by rotational mowing and/or brush-hogging. To reduce the impacts of these management activities on birds, mowing should be timed to coincide with the post-fledging season for most birds (e.g., September and later) and only take place every few years, if possible. To reduce impacts on turtle nests and hatchlings, mowing should be delayed until after September. Delaying mowing until even later will help preserve the late-season wildflowers that are an important food source for native bees, butterflies, and other pollinating insects. As in upland meadows, soil compaction and erosion caused by ATVs and other vehicles and equipment can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. If shrublands are left undisturbed, most will eventually become forests, which are also valuable habitats.



Dusted skipper caterpillars feed on little bluestem in shrublands. Kathleen A. Schmidt © 2001

Upland meadow

Ecological Attributes

This broad category includes active cropland and oldfields in Poughkeepsie. Upland meadows are typically dominated by grasses and forbs, and have less than 20% shrub cover. The ecological values of these habitats can differ widely according to the types of vegetation present and varied disturbance histories (e.g., tilling, mowing, grazing, pesticide applications). Undisturbed meadows develop diverse plant communities of grasses, forbs, and shrubs and support an array of wildlife, including invertebrates, reptiles, mammals, and birds. It is for both present and potential future ecological values that we consider all types of meadow habitat to be ecologically significant.

Several species of rare butterflies use upland meadows that support their particular host plants. Upland meadows can be used for nesting by wood turtle,* spotted turtle,* Blanding's turtle,* eastern box turtle,* painted turtle, and snapping turtle. Grassland-breeding birds such as savannah sparrow,* eastern meadowlark,* and bobolink* use extensive meadow habitats for nesting and foraging. Upland meadows often have large populations of small mammals (e.g., meadow vole) and can be important hunting grounds for raptors, foxes, and eastern coyote.

Occurrence in the City of Poughkeepsie

Upland meadow was a common habitat type in the City of Poughkeepsie, but accounted for only 4% of the total land area. Figure 4 illustrates the location and distribution of contiguous meadow habitat in the city (including both upland and wet meadows). Upland meadows were relatively small, ranging from smaller than 0.1 ac (0.04 ha) to nearly 6 ac (2.4 ha). The largest upland meadows were concentrated in the south part of the city, and consisted mostly of mowed fields rather than crop fields or pasture. A subset of upland meadow (15.6 ac, 6.3 ha) was the vegetable farm and community garden, classified as "row crops," at the Poughkeepsie Farm Project. Other community and school gardens throughout the city, while important, were too small (<900 m^2) to be mapped for this project.

Sensitivities/Impacts

The dramatic decline of grassland-breeding birds in the Northeast has been attributed to the loss of large areas of suitable meadow habitat; many of these birds need large meadows that are not divided by fences or hedgerows, which can harbor predators (Wiens 1969). Another threat to upland meadow habitats is the soil compaction and erosion caused by ATVs and other vehicles and equipment, which can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. Destruction of vegetation can affect rare plant populations and reduce viable habitat for butterflies, dragonflies, damselflies, and bees, and mowing of upland meadows during the bird nesting season can cause extensive mortality of eggs, nestlings, and fledglings. (See the Conservation Priorities and Planning section for recommendations for maintaining large meadow habitats.)

Cultural

We use the term "cultural" habitats for areas that are significantly altered and intensively managed (e.g., mowed), but are not otherwise developed with pavement or structures. These include large mowed lawns, athletic fields, golf courses, and similar areas. We identified this as an ecologically significant habitat type due to its benefits to people rather than its current habitat values, which are limited by frequent mowing, application of pesticides, or other types of management, and intensive human uses. Nonetheless, eastern screech-owl* and barn owl* are known to nest and roost in cultural areas. American kestrel,* spring migrating songbirds, and bats may forage in these habitats, and wood duck* may nest in such places. Individual ornamental trees can provide habitat for cavity-nesting birds, roosting bats (including Indiana bat* and small-footed bat*), and other animals.

Some cultural areas buffer less disturbed habitats from human activities, and link patches of undeveloped habitat together. Because cultural habitats are already significantly altered, their current habitat value for native wildlife is greatly diminished compared to relatively undisturbed habitats.

But many cultural areas have tremendous "open space" values for the human community, and are all the more precious in an urban setting. In Poughkeepsie, many of the cultural areas are athletic fields and manicured parks, which are important neighborhood resources. Many of these cultural resources are isolated within the city and could benefit from increased human connectivity by means of signage, bike lanes, or pedestrian walkways. Some ways to improve the habitat values for wildlife while retaining the utility of cultural areas as common outdoor space for public uses are explained below. (See the Conservation Priorities and Planning section for recommendations for maintaining cultural areas.)

Occurrence in the City of Poughkeepsie

Cultural areas were the second most common habitat type that we identified in the City of Poughkeepsie, and included golf courses, playing fields, and large lawns. The College Hill golf course covered 51 ac (20.6 ha) and is part of a larger habitat area of 114 ac (46.1 ha). The second largest cultural area was Spratt Park, which is part of a larger habitat complex extending

View of Waryas Park and Walkway Over the Hudson. E. Heffernan © 2018 into the Town of Poughkeepsie (Figure 4). At present however, many of the public-access parks and habitat areas are small (≤ 2.5 ac [1 ha]), and are so widely spaced (≥1500 ft, 500 m, or about a 10 minute walk) throughout the city that they are not easily accessible by all residents (Thompson and Aspinall 2011) (Figure 6). Residences and business on Main Street and Cannon Street in particular are isolated or on the peripheral limit of reasonable distance from parks for most of their length, and this access is further limited by the high traffic arterials (Route 44/55) that border these two roads (we did not consider traffic patterns when mapping reasonable distance areas in Figure 6). The south-central portion of the city is also bereft of public-access land, but does benefit from scattered habitat patches on private land, and houses that are more widely spaced. While most residences of the city are within walking distance of a public greenspace, single-use spaces such as baseball fields may not serve all the residents within walking distance. Additionally, the "pleasantness" of the area around a park will encourage or discourage use of the park (Thompson and Aspinall 2011).

Waste ground

"Waste ground" is a botanists' term for land that has been severely altered by previous or current human activity, but lacks pavement or structures. Most waste ground areas have been stripped of vegetation and topsoil, or filled with soil or debris but remain substantially unvegetated. This category encompasses a variety of highly impacted areas such as active and abandoned gravel mines, rock quarries, mine tailings, dumps, unvegetated wetland fill, unvegetated landfill cover, construction sites, and abandoned lots. The term "waste ground" does not necessarily imply dumpsites for refuse.

Although waste ground often has low habitat value, there are notable exceptions. Several rare plant species are known to inhabit waste ground environments, including rattlebox,* slender pinweed,* field dodder,* and slender knotweed.* Rare lichens and mosses may potentially occur in some waste ground habitats. Several snake and turtle species of conservation concern, including eastern hognose snake* Blanding's turtle,* spotted turtle,* and wood turtle,* may use the open, gravelly areas of waste grounds for burrowing, foraging, or nesting habitat. Bank swallow* and belted kingfisher typically nest on bare vertical banks of soil, such as high,

Public-Access Greenspaces

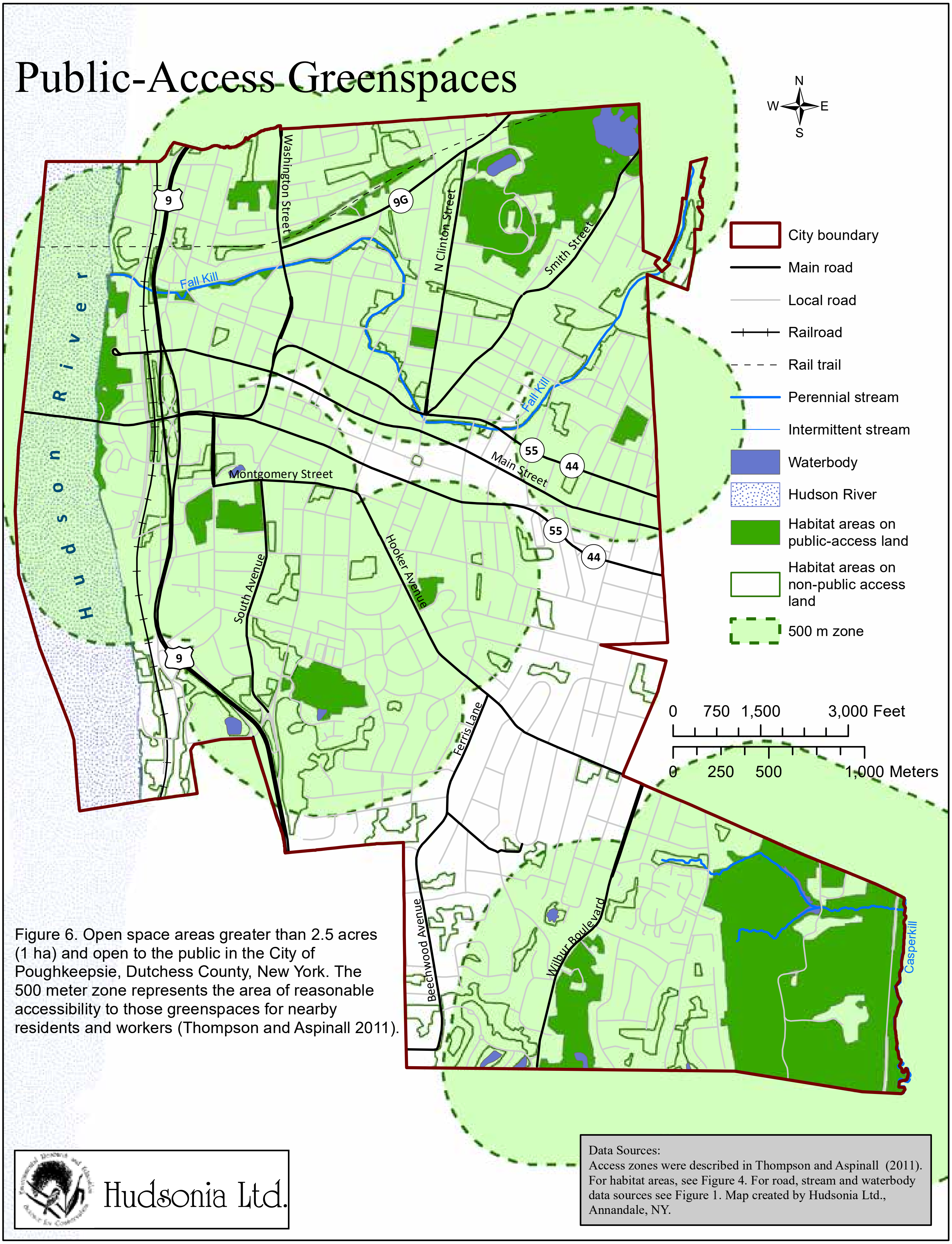


Figure 6. Open space areas greater than 2.5 acres (1 ha) and open to the public in the City of Poughkeepsie, Dutchess County, New York. The 500 meter zone represents the area of reasonable accessibility to those greenspaces for nearby residents and workers (Thompson and Aspinall 2011).

Hudsonia Ltd.

Data Sources:
Access zones were described in Thompson and Aspinall (2011). For habitat areas, see Figure 4. For road, stream and waterbody data sources see Figure 1. Map created by Hudsonia Ltd., Annandale, NY.

eroding stream banks or the stable walls of soil mines, but sometimes they nest in piles of soil or sawdust. Bare, gravelly, or otherwise open areas provide nesting habitats for spotted sandpiper, killdeer, and possibly common nighthawk.*

The biodiversity values of waste ground depend on site-specific conditions, which change over time as vegetation slowly becomes established, and the habitat becomes more similar to surrounding and nearby areas. Some of the rare species of these habitats depend on the early stages of habitat development, when soils are poor and vegetation is sparse. The City of Poughkeepsie has an extensive, post-industrial, waste-ground complex along the Hudson, with potential to be restored to a mixed-use area that would accommodate sea level rise and enhance the riverfront as a public asset (Figure 7).

Waste ground site below Walkway Over the Hudson. E. Heffernan © 2018

Wetland Habitats

Hardwood swamp

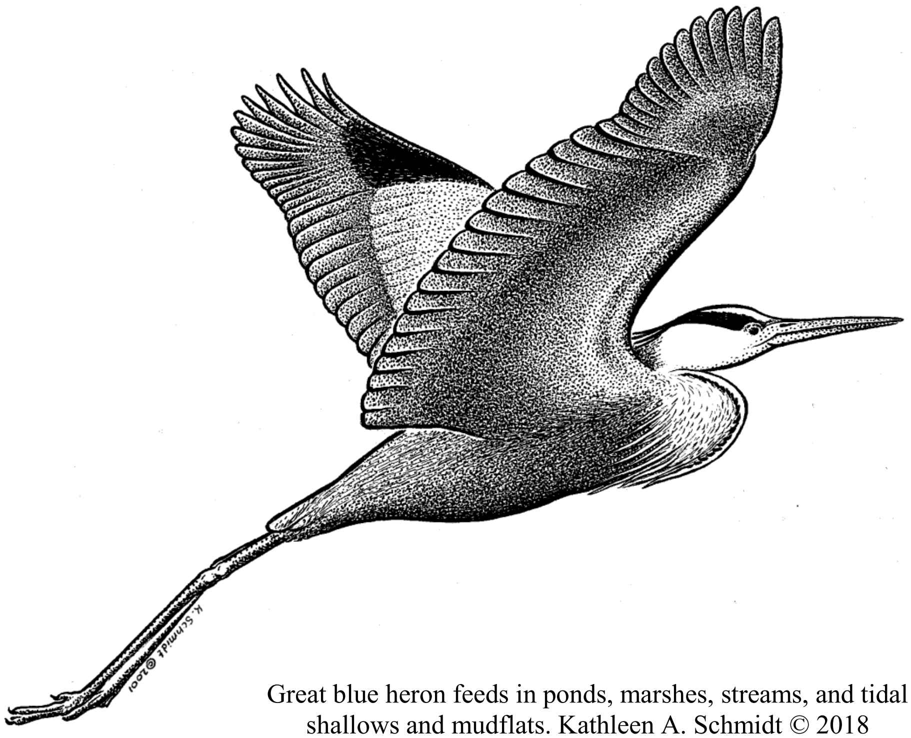
Ecological Attributes

A swamp is a wetland dominated by woody vegetation (trees and/or shrubs). We combined forested and shrub swamps into a single habitat type because the two often occur together and can be difficult to separate using remote sensing techniques. Red maple, green ash, American elm, slippery elm, pin oak, and swamp white oak are common trees of hardwood swamps in the region. Typical shrubs include silky dogwood, swamp azalea, spicebush, winterberry holly, and highbush blueberry; a few common herbaceous species are tussock sedge, sensitive fern, and skunk-cabbage.

Swamps are important to a wide variety of birds, mammals, amphibians, reptiles, and invertebrates, especially when swamp habitats are contiguous with other wetland habitats or embedded within large areas of upland forest. Hardwood and shrub swamps along the floodplains of clear, low-gradient streams can be an important component of wood turtle* habitat. Other turtles such as spotted turtle* and eastern box turtle* frequently use swamps for summer foraging, drought refuge, overwintering, and travel corridors. Pools within swamps are used for breeding by several amphibian species, and are the primary breeding habitat of blue-spotted salamander.* Four-toed salamanders* use swamps with rocks or abundant moss-covered downed wood or woody hummocks. Red-shouldered hawk,* barred owl,* great blue heron,* wood duck,* Canada warbler,* Virginia rail,* and white-eyed vireo* may nest in hardwood swamps.

Occurrence in the City of Poughkeepsie

Hardwood swamp covered a total of 73.1 ac (29.6 ha) in the City of Poughkeepsie (Figure 4). Swamps ranged from <0.1 to 12.2 ac (<0.04-5 ha), but most were small, averaging 1.16 ac (0.5 ha). Most swamps were in the floodplains of streams in the less-developed areas and many were contiguous with other wetland habitats such as marsh and wet meadow (Figure 4). The largest contiguous swamp was on the Vassar Farm and Ecological Preserve, and had predominantly forest cover.



Great blue heron feeds in ponds, marshes, streams, and tidal shallows and mudflats. Kathleen A. Schmidt © 2018

Some swamps were shrub-dominated (native or exotic), while others had a full canopy of trees. The typical overstory trees were red maple, green ash, and eastern sycamore. Water depth varied greatly, with some swamps drying completely in the summer months while others retained relatively deep pools. Swamps that were isolated from streams and other wetlands may have ecological roles similar to those of intermittent woodland pools, providing a seasonal source of water, fish-free breeding habitat for pool-breeding amphibians, and refuge for turtles (see below).

Sensitivities/Impacts

Some swamps (like other wetlands) are partially protected by federal or state laws, but most are still threatened by a variety of land uses. Some of the wetlands shown in Figure 4 are not delineated on the USFWS National Wetlands Inventory or NYS DEC Freshwater Wetlands maps and do not have protected status. Small swamps embedded in upland forest are often overlooked in wetland protection, but can have high biodiversity values, similar to those of intermittent woodland pools (see below). Swamps can easily be damaged by alterations to the quality, quantity, or timing of surface water runoff, or by disruptions of the groundwater sources feeding them. Swamps adjacent to agricultural land are subjected to runoff contaminated with agricultural chemicals, and those near roads and other developed areas often receive runoff high in nutrients, sediment, de-icing salts, and toxins. Polluted runoff and groundwater degrade the swamp's water quality, affecting the ecological condition (and thus habitat value) of the swamp and its associated streams. Maintaining flow patterns and water volumes in swamps is important to the plants and animals of these habitats. Connectivity between swamp habitats and nearby upland and wetland habitats is essential for amphibians that breed in swamps and for other resident and transient wildlife of swamps. Direct disturbance, such as logging, can damage soil structure, plant communities, and microhabitats, and provide access for invasive plants. Ponds for ornamental or other purposes are sometimes excavated in swamps, but the loss of habitat values of the pre-existing swamp usually far outweighs any habitat value gained in the new, artificial pond environment.

Intermittent woodland pool

Ecological Attributes

An intermittent woodland pool is a small wetland partially or entirely surrounded by forest, typically with no surface water inlet or outlet (or an ephemeral one), and with standing water during winter and spring that dries up by mid- to late summer during a normal year. This habitat is a forested subset of the widely recognized "vernal pool" habitat. Seasonal drying and lack of a stream connection ensure that these pools do not support fish, which are major predators on amphibian eggs and larvae. For this reason, these pools are the critical breeding and nursery habitat for a special group of pool-breeding amphibians that are especially vulnerable to fish predation. The surrounding forest supplies the pool with organic litter, the base of the pool's food web; the forest is also essential habitat for adult amphibians during the non-breeding seasons.

Intermittent woodland pools with suitable hydroperiods can support breeding wood frog, Jefferson salamander,* marbled salamander,* and spotted salamander.* These pool-breeding amphibians are especially vulnerable to upland habitat fragmentation. Each year adults migrate from upland forests to the intermittent woodland pools to breed, and then adults and (later) juveniles disperse from the pool back to upland forest habitats. The salamanders are known to migrate seasonally up to 2,050 ft (625 m) from their breeding pools into surrounding forests (Semlitsch 1998). A wood frog adult may travel as far as 3,835 ft (1,169 m) from a breeding pool (Calhoun and Klemens 2002). Both salamanders and frogs are susceptible to vehicle mortality where roads or driveways cross their travel routes; roads, especially networks of roads or heavily-traveled roads, have been associated with reduced amphibian populations (Fahrig et al. 1995, Lehtinen et al. 1999, Findlay and Bourdages 2000). Open fields and clearcuts are also barriers to forest-dwelling amphibians. Juveniles have trouble crossing open fields due to a high risk of desiccation and predation in that exposed environment (Rothermel and Semlitsch 2002). For these reasons, maintaining large intact areas of upland forest around woodland pools is key to maintaining local populations of these animals.

Despite the small size, pools that hold water through early summer can support amphibian diversity equal to or higher than that of much larger wetlands (Semlitsch and Bodie 1998, Semlitsch 2000). Reptiles such as spotted turtle* and Blanding's turtle* use intermittent woodland pools for foraging, rehydrating, and resting. Wood duck,* mallard, and American black duck* use intermittent woodland pools for foraging, nesting, and brood-rearing, and a variety of other waterfowl and wading birds use these pools for foraging. The invertebrate communities of these pools can be rich, providing abundant food for songbirds such as yellow warbler, common yellowthroat, and northern waterthrush.* Springtime physa* is a regionally rare snail associated with intermittent woodland pools. Large and small mammals use these pools for foraging and as water sources. Featherfoil* and swamp cottonwood* are two NYS Threatened plants that occur in intermittent woodland pools elsewhere in the Hudson Valley.

The intermittent woodland pool at Vassar Farm is within a large 313 (127 ha) habitat complex extending south into the Town of Poughkeepsie. Although no other woodland pools are in the portion of the farm within the city limits, there are other pools in the habitat complex in the town which may also have suitable habitat for pool-breeding amphibians.

Occurrence in the City of Poughkeepsie

We mapped four small intermittent woodland pools in the City of Poughkeepsie (Figure 4). Three of the pools were smaller than 0.1 ac (0.04 ha) and embedded in a small forest area surrounded by residences. The fourth was 0.34 ac (0.14 ha) in a large forested area at Vassar Farm and Ecological Preserve.

Wood frog lives in upland forests, but requires woodland pools for breeding in the spring.
L. Heady © 2018

Sensitivities/Impacts

We consider intermittent woodland pools to be one of the most imperiled habitats in the region. Although they are widely distributed, most pools are small and their ecological importance is often undervalued. They are frequently drained or filled by landowners and developers, used as dumping grounds, treated for mosquito control, and sometimes converted into ornamental ponds. They are often overlooked in environmental reviews of proposed developments. Even when the pools themselves are spared in a development plan, the surrounding forest so essential to the ecological function of the pools is frequently destroyed (Calhoun and Klemens 2002).

Intermittent woodland pools are often excluded from federal and state wetland protection due to their small size and their isolation from other wetland and stream habitats. It is these very characteristics of size, isolation, and intermittency, however, that make woodland pools uniquely suited to species that do not reproduce or compete as successfully in larger wetland systems.

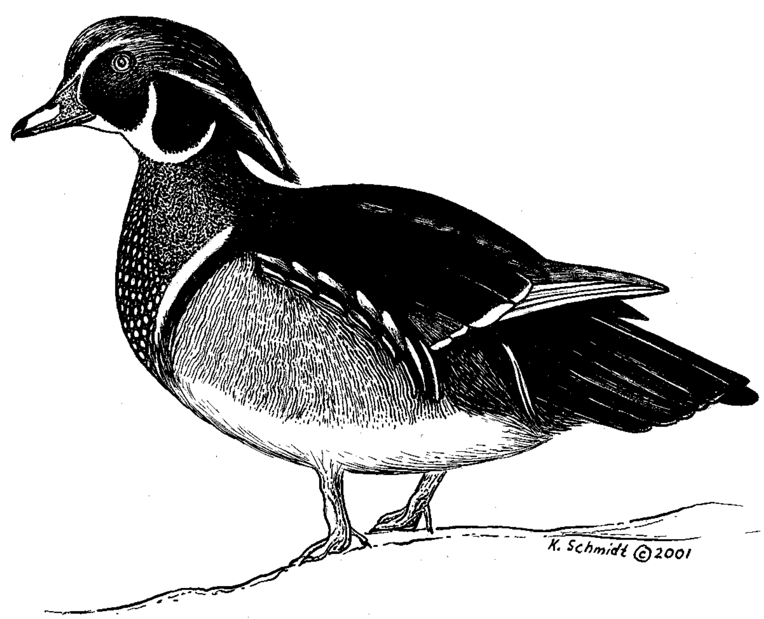
Three of the pools that we identified are surrounded by a small forest that is probably inadequate to support significant populations of pool-breeding amphibians during the non-breeding season. The pools could be used by others, however, such as spring peeper and green frog, and may certainly have habitat values for aquatic invertebrates, transient mammals, and other wildlife. The pool at Vassar Farm, however, seems to have adequate breeding and non-breeding habitat for pool-breeding amphibians, such as the wood frog; it is surrounded by a large area of hardwood swamp and adjacent upland hardwood forest and is part of a larger network of intermittent woodland pools and forest extending into the Town of Poughkeepsie. (See the Conservation Priorities and Planning section for recommendations on protecting the habitat values of intermittent woodland pools.)

Marsh

Ecological Attributes

A marsh is a wetland that typically has standing water for much or all of the growing season, and is dominated by herbaceous (non-woody) vegetation. Marshes often occur at the fringes of deeper water bodies (e.g., lakes and ponds), or in close association with other wetland habitats such as wet meadows or swamps. The edges of marshes, where standing water is less permanent, often grade into wet meadows. Cattail, tussock sedge, arrow arum, broad-leaved arrowhead, water-plantain, common reed, and purple loosestrife are some typical emergent marsh plants in this region. Deeper water may support rooted, floating-leaved plants such as pond-lilies, or submergent aquatic plants such as pondweeds, bladderworts, and watermilfoils.

Several rare plant species are known from marshes in the region, including buttonbush dodder.* Marshes are important habitats for reptiles and amphibians, including painted turtle, snapping turtle, spotted turtle,* Blanding's turtle,*green frog, pickerel frog, Atlantic Coast leopard frog,* and spring peeper. Numerous bird species, including marsh wren,* common



Wood duck nests in tree cavities in and near swamps, marshes, woodland pools and even constructed ponds. Kathleen A. Schmidt © 2001 gallinule,* American bittern,* least bittern,* great blue heron,* Virginia rail,* king rail,* sora,* American black duck,* and wood duck* use marshes for nesting, nursery, or foraging habitat. Many raptor, wading bird, and mammal species use marshes for foraging.

Occurrence in the City of Poughkeepsie

We mapped five marsh areas in the City of Poughkeepsie, covering a total of 3.7 ac (1.5 ha) (Figure 4). Most were along the margins of or embedded in hardwood and shrub swamps, wet meadows, or constructed ponds. Because it was sometimes difficult to distinguish marsh from shrub swamp or wet meadow on aerial photographs, all mapped marsh boundaries should be considered approximate. Common reed, purple loosestrife, cattail, and common duckweed were abundant in many of the marshes of Poughkeepsie. Most of the mapped marshes were small (<1 ac [0.4 ha]); the largest (approximately 2 ac [0.8 ha]) occupied the perimeter of Morgan Lake in College Hill and Morgan Lake Parks.

Sensitivities/Impacts

In addition to direct disturbances such as filling or draining, marshes are subject to stresses from up-gradient sources. Alteration of surface water runoff patterns or groundwater flows can lead to dramatic changes in the plant and animal communities of marshes. Polluted stormwater runoff from roads, parking lots, lawns, and other surfaces in developed landscapes carries sediments, nutrients, de-icing salts, toxins, and other contaminants into the wetland. Alteration of water levels by humans or beaver can also alter the plant community and, as with elevated nutrient and sediment inputs, can invite invasion by non-native plants such as purple loosestrife and common reed. Purple loosestrife and common reed have displaced many of the native wetland plants in recent decades and are now common in many of the marshes in the City of Poughkeepsie. Noise and direct disturbance from human activities can discourage breeding activities of marsh birds. Because many animal species of marshes depend equally on surrounding upland habitats to meet various needs throughout the year, protection of the ecological functions of marshes must go hand-in-hand with protection of surrounding habitats. (See the Conservation Priorities and Planning section for recommendations on preserving the habitat values of marshes within larger wetland complexes.)

Wet meadow

Ecological Attributes

A wet meadow is a wetland dominated by herbaceous (non-woody) vegetation and lacking standing water for most of the year. Its period of inundation is longer than that of an upland meadow, but shorter than that of a marsh. Some wet meadows are dominated by purple loosestrife, common reed, reed canary-grass, or tussock sedge, while others have a diverse mixture of wetland grasses, sedges, forbs, and scattered shrubs. Bluejoint, mannagrasses, woolgrass, soft rush, blue flag, sensitive fern, and marsh fern are some typical plants of wet meadows.

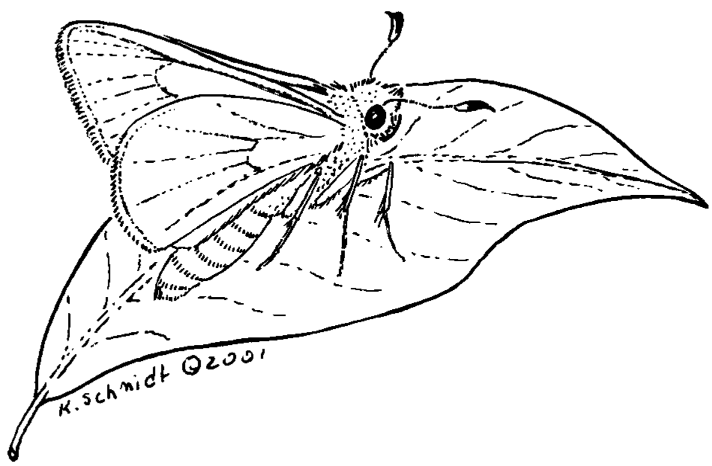
Wet meadows with diverse plant communities may have rich invertebrate faunas. Blue flag and certain sedges and grasses of wet meadows are larval food plants for several regionally-rare butterflies. Wet meadows provide nesting and foraging habitat for songbirds such as sedge wren,* wading birds such as American bittern,* and raptors such as northern harrier.* Wet meadows that are part of extensive meadow areas (both upland and wetland) may be especially important to species of grassland-breeding birds. Large and small mammals use wet meadows and other meadow habitats for foraging.

Occurrence in the City of Poughkeepsie

Many of the wet meadows of the City of Poughkeepsie were associated with swamps and streams. We mapped 11 wet meadows, covering 16.6 ac (6.7 ha) in the city. Most were smaller than 1 ac (0.4 ha). Many were dominated by non-native species such as purple loosestrife, and non-native genotypes of common reed and reed canary grass. The largest wet meadow was on the Vassar Farm and Ecological Preserve. It covered approximately 9.7 ac (3.9 ha), but was part of a larger meadow complex to the west and extending south into the Town of Poughkeepsie. The meadow is apparently calcareous, and supported native forbs such as wild bergamot and Joe-Pye weed, among many other plants.

Sensitivities/Impacts

Some wet meadows are able to withstand occasional mowing without significant harm, but frequent mowing or other disturbance can degrade the soil structure, eliminate sensitive plant species, and invite non-native weeds. Mowing in late summer or fall when the soils are drier is less damaging to the soils and plant community. Wet meadows that are part of larger complexes of meadow and shrubland habitats are prime sites for development or agricultural use, and are often drained or excavated. Because many wet meadows are omitted from state, federal, and site-specific wetland maps, they are frequently overlooked in environmental reviews of development proposals. (See the Conservation Priorities and Planning section for recommendations on preserving the habitat values of wet meadows within larger wetland complexes, and general recommendations on mowing practices.)



Butterflies, moths and many other pollinators rely on meadows for nectar.
Kathleen A. Schmidt © 2001

Constructed pond

Ecological Attributes

"Constructed ponds" include those waterbodies that have been excavated or dammed by humans, either in existing wetlands or stream beds, or in upland terrain. Most of these ponds are deliberately created for such purposes as fishing, watering livestock, irrigation, swimming, boating, or aesthetics. Some ponds are constructed near houses or other structures to serve as sources of water in the event of a fire. If constructed ponds are not intensively managed by humans, they can be important habitats for many of the common and rare species that are associated with natural open water habitats. Undisturbed, shallower ponds can develop into marshes or swamps over time.

Occurrence in the City of Poughkeepsie

We classified all of the open waterbodies in the City of Poughkeepsie as constructed ponds. Most were maintained for ornamental or water retention purposes (and located in industrial, commercial, or landscaped areas). Because of the potential value of constructed ponds as drought refuge and foraging areas for turtles and other wildlife, we mapped constructed ponds within developed areas as well as those surrounded by intact habitats.

Mute swan viewed through marsh at edge of Morgan Lake. E. Heffernan © 2018

Only nine of the 16 constructed ponds that we mapped were smaller than 1.0 ac (0.4 ha). Morgan Lake in College Hill Park was the largest, (measuring 10.5 ac [4.3 ha] including the marsh along its perimeter).

Sensitivities/Impacts

The habitat values of constructed ponds vary depending on factors such as the landscape context, extent of human disturbance, water quality, and degree of invasion by non-native species. In general, the habitat value is higher when the ponds have undeveloped shorelines, are relatively undisturbed by human activities, have more native vascular plant vegetation, and are embedded within an area of intact habitat. Because many constructed ponds are not buffered by sufficient natural vegetation and soil, they are vulnerable to the adverse impacts of septic leachate, and pesticide or fertilizer runoff from lawns and gardens. We expect that many of those maintained as ornamental ponds are treated with herbicides and perhaps other toxins, or contain introduced fish such as grass carp and various non-native game and forage fishes. Since constructed ponds serve as potential habitat for a variety of common and rare species, care should be taken to minimize these impacts.

The habitat values of constructed ponds (and especially intensively managed ornamental ponds) do not ordinarily justify altering streams or destroying natural wetland or upland habitats to create them. In most cases, the loss of ecological functions of natural habitats far outweighs any habitat value in the new artificially created environments.

Springs & seeps

Ecological Attributes

Springs and seeps are places where groundwater discharges to the ground surface, either at a single point (a spring) or diffusely (a seep). Springs often discharge into ponds, streams, or wetlands, but are most noticeable when these discharge conspicuously into upland locations. Springs and seeps originating from deep groundwater sources flow more or less continuously, while those from shallower sources flow intermittently. The habitats created at springs and seeps are determined in part by the hydroperiod and the chemistry of the soils and bedrock through which the groundwater flows before emerging. Springs and seeps are significant water sources for many streams, ponds, and wetlands, and they help to maintain the cool temperature of those habitats. Springs also serve as water sources for animals during droughts and during cold winters when other water sources freeze over.

Very little is known of the ecology of springs and seeps in the Northeast. Golden saxifrage is a plant more-or-less restricted to springs and groundwater-fed wetlands and streams. Northern dusky salamander* uses springs and cold streams. A few rare invertebrates are restricted to springs in the region. The Piedmont groundwater amphipod* could occur here (Smith 1988), as well as other groundwater-associated invertebrates, and gray petaltail* and tiger spiketail* are two rare dragonflies of seeps and coldwater streams. Springs emanating from calcareous bedrock or calcium-rich surficial deposits sometimes support an abundant and diverse snail fauna.

Occurrence in the City of Poughkeepsie

Because occurrences of springs and seeps are difficult to predict by remote sensing, we mapped only the one we saw—at the Springside National Historic Landmark; we expect there are others in the city. More detailed inventories of seeps and springs should be conducted as needed on a site-by-site basis.

Sensitivities/Impacts

Springs are easily disrupted by disturbance to up-gradient land or groundwater, altered patterns of surface water infiltration, or pollution of infiltrating waters. In many areas, groundwater has been polluted or drawn-down by pumping for human uses, affecting the quality or quantity of water issuing from seeps and springs.

Streams & riparian corridors

Ecological Attributes

"Perennial streams" are those that flow continuously throughout years with normal precipitation, but some may dry up during droughts. They provide an essential water source for wildlife throughout the year, and are critical habitat for many plant, vertebrate, and invertebrate species. We loosely define "riparian corridor" as the zone along a perennial stream that includes the stream banks, the floodplain, and adjacent steep slopes. We did not map riparian corridors.

Intact riparian areas tend to have high species diversity and high biological productivity, and many species of animals depend on riparian habitats in some way for their survival (Hubbard 1977, McCormick 1978). They can support a variety of wetland and non-wetland forests, meadows, and shrublands. Typical floodplain forests have trees such as eastern sycamore and eastern cottonwood, and a mixture of other upland and wetland plant species.

One area of the Fall Kill, just south of the transfer station, has not been heavily channelized. Both this portion of the Fall Kill and the Casperkill corridor in the southeastern corner, which is in a less developed area, hosted a similar complement of plant species. Trees such as eastern sycamore, eastern cottonwood, and red maple were common in floodplain forests (mapped as upland hardwood forest or hardwood swamp), and their understories had cinnamon fern or Japanese stiltgrass.

We know of many rare plants of streams and floodplains in the region, such as cattail sedge,* Davis' sedge,* goldenseal,* and false-mermaid. The fish and aquatic invertebrate communities of perennial streams may be diverse, especially in clean-water streams with unsilted bottoms. The Fall Kill is an important stream for American eel* (Bowser 2017), which moves from the tidal Hudson into non-tidal streams as a glass eel (juvenile stage), and remains in freshwater until maturity; eels migrate back to the Sargasso Sea as adults to spawn. A modest population persists in the stream reach below the dam at Fall Kill Lake (Stalzer et al. 2016). Brook trout* and slimy sculpin* are two native fish species that require clear, cool streams for successful spawning, and are unlikely to occur in the urban and suburban reaches of Poughkeepsie streams. Wood turtle* uses perennial streams with pools and recumbent logs, undercut banks, or muskrat or beaver burrows. Perennial streams and their riparian zones, including gravel bars, can provide nesting or foraging habitat for many species of birds, such as spotted sandpiper, belted kingfisher, tree swallow, bank swallow, winter wren, Louisiana waterthrush, great blue heron,* and green heron. Red-shouldered hawk* and cerulean warbler* nest in areas with riparian forests, especially those with extensive stands of mature trees. Bats, including Indiana bat,* use perennial stream corridors for foraging (US Fish and Wildlife Service 2007). Muskrat, beaver, mink, and river otter* are some of the mammals that use riparian corridors regularly. Riparian forests are particularly effective at removing dissolved nutrients from stream water, and produce high quality detritus (dead plant matter) important to the aquatic food web and habitat structure.

"Intermittent streams" flow only during certain times of the year or after rains, but some may flow throughout the growing season in wet years. They are the headwaters of most perennial streams, and are significant water sources for lakes, ponds, and many kinds of wetlands. The condition of these streams therefore directly influences the water quantity and quality of those water bodies and wetlands. Intermittent streams can be important local water sources for wildlife. Plants such as winged monkey-flower,* may-apple, and small-flowered agrimony* are associated with intermittent streams (and other habitats). Although intermittent streams have been little studied by biologists, they have been found to support rich aquatic invertebrate communities, including regionally rare mollusks (Gremaud 1977) and dragonflies. Both perennial and intermittent streams provide breeding, larval, and adult habitat for northern dusky salamander* and northern two-lined salamander. The forests and sometimes meadows adjacent to streams provide foraging habitats for adults and juveniles of these species.

Occurrence in the City of Poughkeepsie

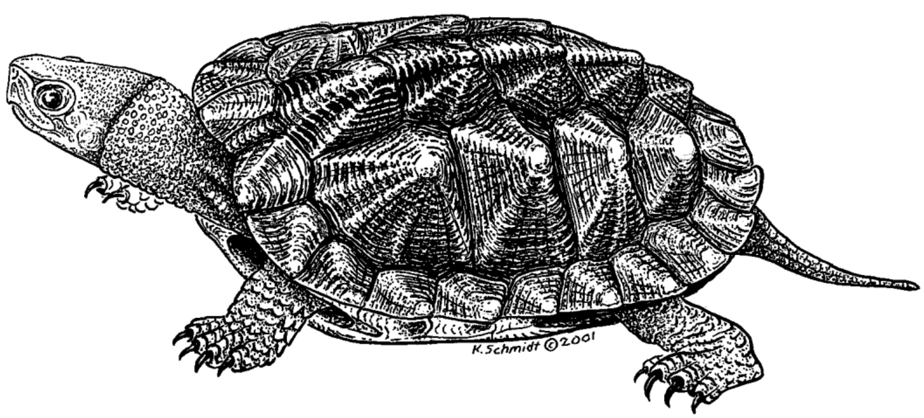
Though much altered by the surrounding development, perennial streams are prominent features in the City of Poughkeepsie. The Fall Kill, the largest perennial stream in the city, runs east-to-west for 3.0 miles (4.9 km) through the northern part of the city, and empties into the Hudson River at the Poughkeepsie Landing Park. Much of the Fall Kill was channelized during the Great Depression with steep concrete or stone riprap banks, many of which are now crumbling (Bean et al. 2006), and some areas are piped and buried. The Casperkill flows north-to-south for approximately 0.8 miles (1.3 km) along the southeastern border of the city and ultimately meets the Hudson just south of the Tilcon Plant at Clinton Point. Intermittent streams were common in the southern part of the city (Figure 4). The many stream fragments mapped throughout the city are portions of streams that are partially piped or buried so their complete paths were not detectable.

A channelized section of the Fall Kill.
E. Heffernan © 2018

Sensitivities/Impacts

Removal of trees or other shade-providing vegetation along a stream can lead to elevated water temperatures that adversely affect aquatic invertebrate and fish communities. Clearing of floodplain vegetation can reduce the important exchange of nutrients and organic materials between the stream and the floodplain. It can also diminish the floodplain's capacity for flood attenuation, leading to increased flooding downstream, scouring and bank erosion, and siltation of downstream reaches. Any alteration of flooding regimes, stream water volumes, runoff timing, and water quality can profoundly affect the habitat characteristics and species of streams and riparian zones. Hardening of the stream banks with concrete, riprap, gabions, or other materials reduces the biological and physical interactions between the stream and floodplain, and tends to degrade both stream and floodplain habitats. Channelized streams have higher velocities, which can be destructive during snow melt and rain events. Removal of snags and other woody debris from the streambed degrades habitat for fishes, turtles, snakes, birds, muskrats, and their food organisms. Stream corridors are prone to invasion by non-native weeds, including Japanese knotweed, an introduced plant that is spreading in the region (Talmage and Kiviat 2004). Stream burial, a common practice in developed areas, fragments the stream habitat, alters nutrient cycling and reduces drainage capacity (Beaulieu et al. 2015).

The habitat quality of a stream is affected not only by direct disturbance to the stream, its banks, or its floodplain, but also by land uses throughout the watershed. (A watershed is the entire land area that drains to a given water body.) Urbanization (including roads and residential, commercial, and industrial development) is linked to deterioration in stream water quality in the region (Parsons and Lovett 1993). Activities in the watershed that cause soil erosion, changes in surface water runoff, reduced groundwater infiltration, or contamination of surface water or groundwater are likely to affect stream habitats adversely. For example, impervious surfaces (roads, driveways, parking lots, and roofs) without well-designed stormwater management infrastructure tends to increase surface runoff, leading to erosion of stream banks and siltation of stream bottoms, and a consequent degradation of the habitat for invertebrates, fish, and other animals. Road runoff often carries contaminants such as petroleum hydrocarbons, heavy metals, road salt, sand, and silt into streams. Applications of fertilizers and pesticides to golf courses, lawns, and gardens in or near the riparian zone can degrade the water quality and alter the biological communities of streams. The Fall Kill is known to have experienced bacterial contamination throughout its course, likely due to sewage leaks and illegal drainage (Bean et al. 2006). For these reasons, stream habitats in urban areas are highly stressed. Many of these problems are intractable, and restoration of intact stream banks and riparian zones is often impossible due to the built environment. However, there are areas along the Fall Kill where restoration of the streambank and riparian corridor may be possible. For example, the stone revetments along the Fall Kill banks, built in the 1930s, are beginning to deterioriate in places. Allowing these walls to crumble where adjacent structures are not endangered would help to restore opportunities for some of the ecological interactions between the stream channel, banks, and riparian zone (Kim et al. 2012). (See the Conservation Priorities and Planning section for recommendations on protecting the habitat values of streams and riparian corridors.)



Wood turtles use streams with pools for hiding and logs for basking.
Kathleen A. Schmidt © 2018

Hudson River Habitats

Rock riprap and native rocky shore

Ecological Attributes

This habitat type includes artificially-placed riprap along the Hudson River shore, and the rock ledges in and above the intertidal zone of the Hudson River. Rocky shores along the Hudson are subject to regular tidal inundation or wetting by wave splash and wind spray. These habitats also experience rapid heating and cooling, ice scouring in winter, and intermittent wind and wave disturbance. The plant community is usually sparse in the intertidal zone, but may be moderately dense in the splash zone above the high water mark. Rare plants of the upper intertidal zone of freshwater reaches of the Hudson River include estuary beggar-ticks,* heartleaf plantain,* and terrestrial starwort.* Eastern prickly-pear has been found on a rocky shore in Rockland County, and river birch* on a rocky peninsula in Dutchess County. The faunal diversity supported by this habitat is poorly known. Ledge- and rock-nesting birds such as eastern phoebe, mallard, and American black duck* may nest above mean high water. Trees within or above the rocky bank provide hunting perches for bald eagle and nesting sites for fish crow. Map turtle* may bask and nest on rocky shores and harbor seal* may haul-out on isolated segments (Kiviat and Hartwig 1994). Mollusks, including the introduced zebra mussel, are prominent inhabitants at some locations.

Occurrence in the City of Poughkeepsie

Rock riprap and native rocky shore made up 70% of the city's Hudson River shoreline. The rest was vertical bulkheads of concrete or concrete and timber (Figure 7a), concentrated along the southern part of the shoreline an industrial site and a possible development site. The only area of native rock was a sparsely vegetated ledge north of Kaal Rock Park.

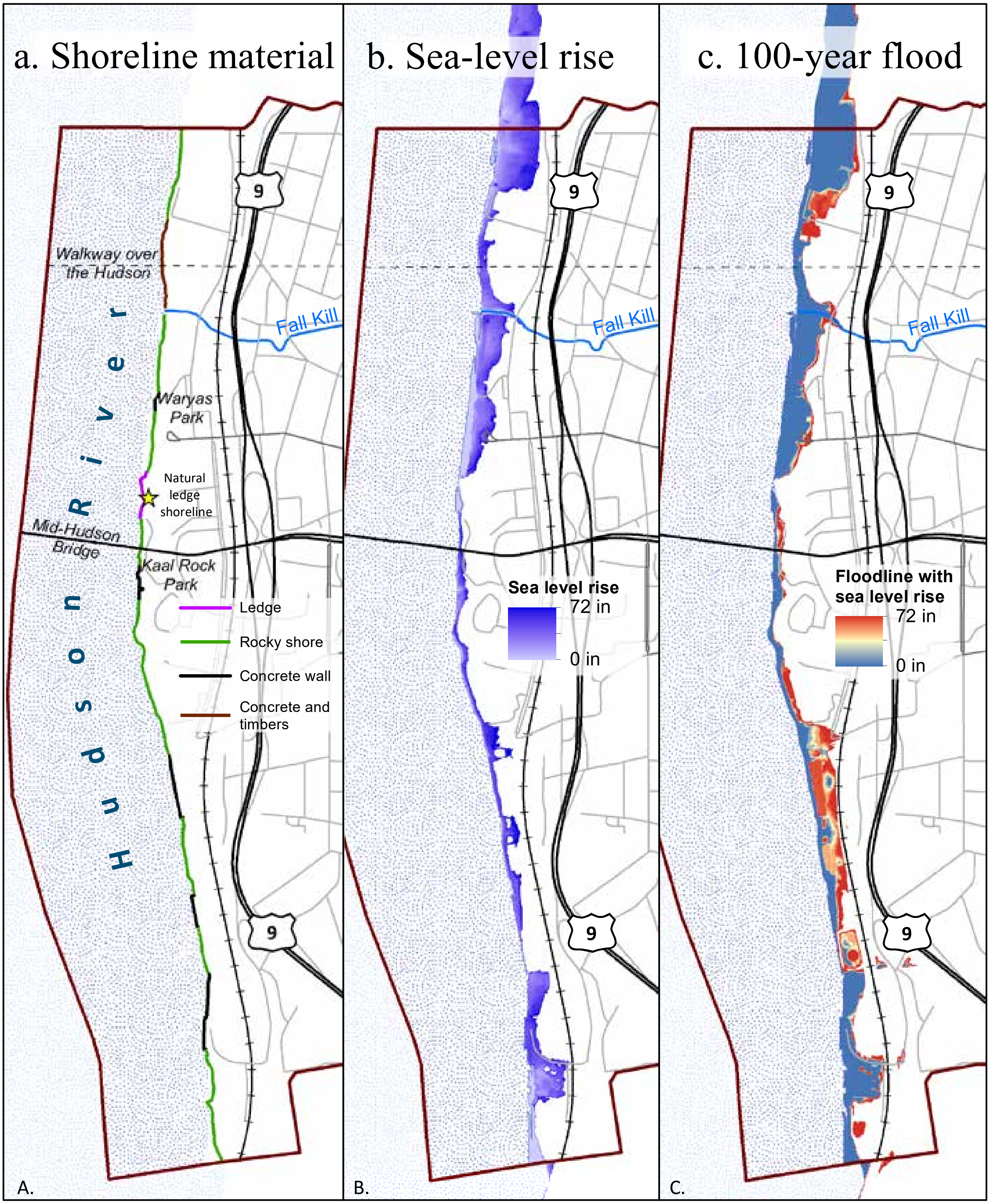


Figure 7. Shoreline material and models of sea level rise and floodlines through 2100 in the City of Poughkeepsie, Dutchess County, New York. "0 in" indicates present day sea levels and 100-year flood predictions.

Data Sources:
Sea level rise and flood model data from Scenic Hudson 2013 (https://www.scenichudson.org/slr/mapper). Shoreline material from Hudsonia field observations and 2013 orthoimagery. For road and stream data sources, see Figure 1. Map created by Hudsonia Ltd., Annandale, NY.

Sensitivities/Impacts

Human uses such as mining, railroads, and urban development have displaced large areas of natural shoreline up and down the Hudson River, and replaced it with constructed bulkheads, railroad ballast, and riprap. The habitats of remaining natural rocky shores are vulnerable to erosion and compaction of the shallow soils, loss of soil and vegetation from trampling, and disturbance of sensitive wildlife. Colonization by aggressive, non-native plants may displace native species from these rocky habitats.

Riprap on Hudson River shoreline. E. Heffernan © 2018

Sea level is projected to rise along the tidal Hudson by 1–5 inches in the 2020s, 5–12 inches in the 2050s, and 8–23 inches in the 2080s. Based on conservative projections of sea level rise (assuming low worldwide carbon emissions), the Hudson River flood levels of the magnitude that currently has a 10% chance of occurring in any given year (i.e., the "10-year flood") could be an annual flood event by the end of this century. The flood magnitude that may now have a 1% chance of occurring in any given year (the "100-year flood") may have 4% chance of occurring in any given year (a "25-year flood") by the end of the century. Furthermore, by 2020, the flood heights of the 1% probability flood are projected to be 4-8 inches higher than today's 1% flood, and 18-40 inches higher by 2100. These predictions are based on sea level rise projections alone, and do not take into account the increased frequency and severity of large storm events in this region. Also, if global carbon emissions are higher, and the melting of Greenland and Antarctic ice sheets continues to accelerate, then sea level rise could be as much as 37-55 inches by the 2080s, and the large floods could be considerably more frequent than outlined above (Horton et al. 2011).

Sea level rise threatens much of the developed areas along the Hudson River corridor. Scenic Hudson's Sea Level Rise mapper (http://scenichudson.org/slr/mapper) predicts that much of the Poughkeepsie Landing is at risk of inundation with a relatively small sea level increase (Figure 7b), and that most or all of the low-lying shore would be inundated by a 100-year flood at the current mean higher-high water (Figure 7c) (Scenic Hudson 2013). As some of the areas in this zone (24.5 ac, 70%) are largely undeveloped or at least have no buildings, the city may have opportunities to develop a more sustainable shoreline corridor that could serve many cultural, educational, and ecological purposes. These areas could also provide a pedestrian connection between the northern and southern parts of the city. The Hudson River is one of the great cultural and scenic assets in the City of Poughkeepsie, and enhancing the quality of the shoreline would present a rare opportunity to foster the city's place-based identity. (See the Conservation Priorities and Planning section for recommendations on protecting the habitat values of rocky shores and tidal wetlands.)

Tidal tributary mouth

Ecological Attributes

The term "tidal tributary mouth" refers to the tidal reach of a Hudson River tributary stream. This habitat occurs no farther upstream than the first topographic contour line (10 ft [3 m] elevation) or the first dam, whichever is lower. This portion of the stream is strongly influenced by the mixing of non-tidal and tidal waters. The substrate and water chemistry of these habitats are often very different from those of the non-tidal reaches of the tributary or the Hudson River.

In winter there is often intense ice scouring of the stream bed and shoreline. The plant and animal communities of these habitats are composed of freshwater species able to tolerate tidal fluctuations as well as stream flooding. (The Hudson River is typically freshwater at the City of Poughkeepsie, but may become slightly brackish during droughts when reduced freshwater input from the watershed allows the salt front to extend farther upriver than usual.)

Tidal tributary mouths tend to be sites of concentrated biological activity. Macroinvertebrates may be abundant and diverse in these habitats, which also serve as spawning sites for fish, and foraging sites for birds including osprey* and American bittern.* Several rare or uncommon plants such as lizard's tail, estuary beggar-ticks,* smooth bur-marigold,* and goldenclub,* and at least one rare snail (*Pomatiopsis lapidaria*) have been found in freshwater tidal tributary mouths of the Hudson.

Tidal mouth of Fall Kill. E. Heffernan © 2018

Occurrence in the City of Poughkeepsie

The mouth of the Fall Kill is tidal for approximately 105 ft (32 m). The edges of the tributary mouth were planted with woody vegetation and developed for recreation in the Poughkeepsie Landing Park. A gravel bar that extends out into the river serves as a foraging site for wading birds. The tidal reach of the Fall Kill is relatively short due to the steep nature of the shoreline, and the habitat values may be diminished due to the intensively-developed adjacent area.

Sensitivities/Impacts

Noise, water pollution, and mechanical disturbance from boat traffic can cause extreme disturbance to the plant and animal communities of tidal tributary mouths. Foot traffic on tributary banks can damage vegetation and increase susceptibility to bank erosion. Poor water quality in the tributary stream reduces the habitat quality of the tidal stream mouth. Unlike many other Hudson River tributaries, the Fall Kill has no dams near its mouth, but has two natural falls within 1400 ft (425 m) of the head of tide that pose significant barriers to upstream fish migration (Schmidt and Cooper 1996). For most fish species the falls are insurmountable, but American eel* passes them in small numbers (Stalzer et al. 2016). (See the Conservation Priorities and Planning section for recommendations on protecting the habitat values of tidal wetlands.)

Subtidal shallows

The subtidal shallows is the zone between the mean low water (MLW) elevation and approximately 6.5 ft (2 m) below mean low water. This zone supports beds of submerged aquatic vegetation, which are well-known for their importance to water quality, fish, and waterfowl. Large areas of subtidal bottom are bare of vascular vegetation or nearly so. Such areas may have been denuded by storms or ice and not yet recolonized, or may be unsuitable due to unstable substrate, adverse materials (e.g., cinder or organic matter), pollution, chronic ice scouring or wave and current stress, or animal activities. The shallows are nearly always flooded, although spring low tides and other exceptionally low tides may expose extensive areas just below mean low water.

Many fish reside in or enter subtidal habitats either as adults or at immature stages. Turtles use subtidal areas more than other tidal habitats, and these areas are important feeding areas for waterfowl (ducks, geese, and swans) and several species of gulls. Double-crested cormorant, great blue heron, American coot, common gallinule, and a few other water birds also use this habitat. Hudson River water-nymph* is an aquatic plant of subtidal shallows, tidal marshes, and intertidal zone endemic to the Hudson River estuary. Bald eagle and osprey forage in the shallows, and American bittern and least bittern forage in the edges of shallows at low tide. Regionally-rare species include map turtle, and several poorly-known fishes such as the northern hog sucker.

Occurrence in the City of Poughkeepsie

We mapped three areas of subtidal shallows in the City of Poughkeepsie, covering 3.5 ac (1.4 ha). The largest area runs parallel to the Victor C. Waryas Park Promenade (1.5 [0.6 ha]), a mixed-use park and business area. The habitat quality of the subtidal shallows here and elsewhere may be diminished due to their proximity to intensive human uses.

Sensitivities/Impacts

Subtidal shallows are especially sensitive to impacts from motorized boats and accumulated pollution. The boat launch at Waryas Park poses a potential hazard to the stability of the vegetation and substrate of the shallows. Restricting the launching of motorized boats or zone of propeller use might help reduce disturbance to the shallows zone.

Bald eagles hunt and roost along the Hudson River. Kathleen A.Schmidt © 2018

Fall Kill running through downtown Poughkeepsie. E. Heffernan © 2018

CONSERVATION PRIORITIES AND PLANNING

Most local land use decisions in the Hudson Valley are made on a site-by-site basis, without the benefit of good ecological information about the site or the surrounding lands. The loss of biological resources from any single development site may seem trivial, but the cumulative effects of decision-making solely on a site-by-site basis have been far-reaching. Regional impacts have included the disappearance of certain habitats from whole segments of the landscape, the fragmentation and degradation of many other habitats, the local and regional extinction of species, the depletion of overall biodiversity, and the degradation of the human-environment connection.

The best approach to conserving habitats, biodiversity, and urban greenspaces is from the perspective of whole landscapes. The City of Poughkeepsie habitat map illustrates the location and configuration of significant habitats throughout the city. The map, together with the information in this report, can be applied directly to land use and conservation planning and decision-making at multiple scales. Below we outline recommendations for: 1) developing general strategies for land conservation; 2) using the map to identify priorities for city-wide conservation planning; and 3) using the map as a resource for reviewing site-specific land use proposals.

General guidelines for habitat conservation

We hope that the Poughkeepsie habitat map and this report will help landowners understand how their land fits into the larger ecological landscape, and will inspire them to voluntarily adopt habitat protection measures. We also hope that the city will engage in proactive land use and conservation planning to ensure that future development is planned with a view to long-term protection and restoration of important biological resources, and expanded public access to greenspaces .

Habitat Envelopes and Potential Corridors

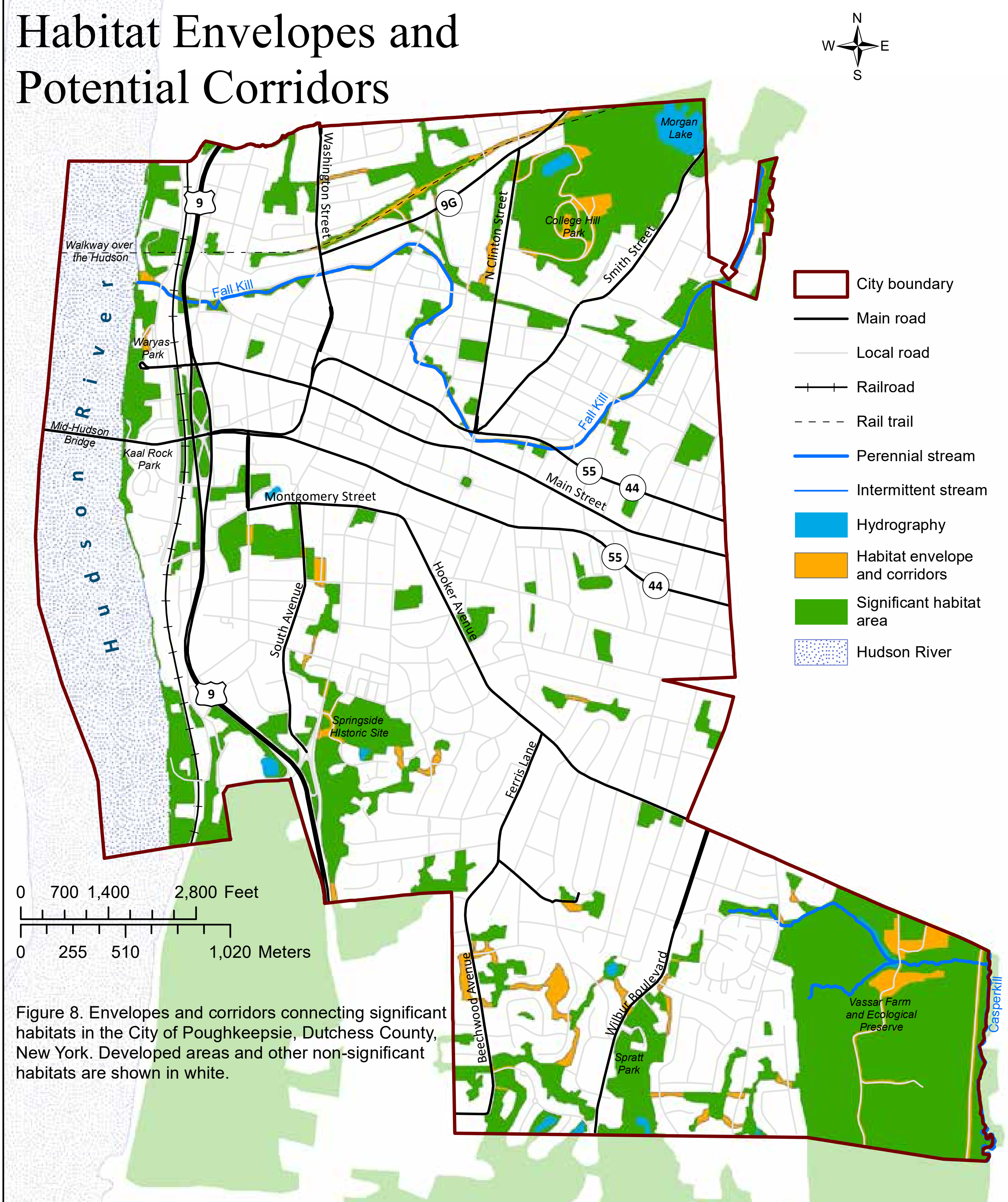


Figure 8. Envelopes and corridors connecting significant habitats in the City of Poughkeepsie, Dutchess County, New York. Developed areas and other non-significant habitats are shown in white.

Hudsonia Ltd.

Data Sources:
Habitats and envelopes were delineated from 2013 orthoimagery downloaded from NYS GIS Clearing house (https://gis.ny.gov/) and field observations. For road, stream and waterbody data sources see Figure 1. Map created by Hudsonia Ltd, Annandale, NY.

A variety of regulatory and non-regulatory means can be employed by a municipality to achieve its conservation goals, including volunteer conservation efforts by private landowners, master planning, zoning ordinances, tax incentives, land stewardship incentives, permit conditions, land acquisition, conservation easements, and public education. Section 4 of the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001) provides additional information about these and other conservation tools. Several publications from the Metropolitan Conservation Alliance, the Pace University Land Use Law Center, and the Environmental Law Institute describe some of the tools and techniques available to municipalities for conservation planning. For example, *Conservation Thresholds for Land-Use Planners* (Environmental Law Institute 2003) synthesizes information from the scientific literature to provide guidance to planners interested in establishing regulatory setbacks from sensitive habitats. The *Local Open Space Planning Guide* (NYSDEC and NYSDOS 2004) describes how to take advantage of laws, programs, technical assistance, and funding resources available to pursue open space conservation, and provides contact information for relevant organizations. *Revitalizing Hudson Riverfronts* (Eisenman et al. 2010) provides recommendations for communities along the Hudson River develop ecologically and culturally vibrant waterfront zones that are also resilient to sea level rise and other environmental change.

In addition to regulations and incentives designed to protect water resources, habitats, and other greenspaces, the city can also apply some general practices on a city-wide basis to foster biodiversity conservation. The examples listed below are adapted from the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001).

- **Protect large, contiguous, undeveloped tracts** wherever possible.
- **Protect high quality isolated habitat patches.** Relatively small, isolated habitats areas may function as refuges for uncommon plants and for animals that have small ranges or are well adapted to edge habitats and travel through developed areas. Such “islands” of habitat may protect certain plants or animals from predators, diseases, and other community processes that limit their ability to survive.
- **Plan landscapes with interconnected networks of undeveloped habitats**; preserve links and create new links between natural habitats on adjacent properties. Where possible, enhance the connective value of existing features such as streams and abandoned rail lines.

New construction along northern shore of Hudson River. E. Heffernan © 2018

- **Preserve natural disturbance processes** such as floods, seasonal drawdowns, and wind exposures wherever possible.
- **Restore and maintain broad buffer zones** of natural vegetation along streams, shores of water bodies and wetlands, and around the perimeters of other sensitive habitats.
- **Direct human uses toward the least sensitive areas and previously-disturbed areas**, and minimize alteration of natural features, including vegetation, soils, bedrock, and waterways.
- **Encourage development of altered land instead of unaltered land.** Promote redevelopment of brownfields and previously altered sites, "infill" development, and re-use of existing structures wherever possible.
- **Encourage and provide incentives for developers to consider environmental concerns early in the planning process**, and to incorporate ecological conservation principles into their choice of development sites, their site design, and their construction practices.
- **Minimize areas of impervious surfaces** (roads, parking lots, sidewalks, paved driveways, roof surfaces), and maximize onsite runoff retention and infiltration to the soils, to help groundwater recharge, protect surface water quality, and moderate flood flows.

- **Along the riverfront, establish land uses that are resilient to flooding and expand public access to the Hudson River shoreline.** Examples are picnic areas, walking trails, outdoor event spaces, and other uses that require few or no permanent structures, pavement, or materials that could impede floodwaters or pose hazards if flooded.
- **Restore degraded habitats wherever possible.**
- **Modify the urban matrix to provide more habitat elements.** For example, tree-lined streets, wooded hedgerows, butterfly gardens, and rain gardens. Use public education and incentives to encourage private landowners to provide additional habitat in their yards.
- **Promote the establishment of conservation agreements** on parcels of greatest apparent ecological value.

City-wide Conservation Planning

The City of Poughkeepsie habitat map illustrates the locations and sizes of habitat units, the juxtaposition of habitats in the landscape, and the degree of connectivity between habitats, all of which have important implications for local and regional biodiversity and ecosystems. Although intact habitats were the focus of this study, biodiversity conservation efforts in an urban landscape must also consider the potential for enhancement of developed areas for supporting the well-being of human residents.

We provide general recommendations for improving habitat characteristics for native plants and wildlife. We include some measures for protecting and enhancing habitats that alone are too small to map at the city scale (e.g., individual trees, wooded hedgerows, or backyard forests), but can still be important for some native species and for the human community (Figure 8). We also address habitat corridors, with a focus on opportunities for enhancing existing connections of natural corridors in intensively developed landscapes, and creating new ones.

The city-wide habitat map and this report provide a landscape perspective that can help the city establish conservation goals and priorities. Taking a landscape approach to land use planning is much more likely to yield sound conservation decisions than the typical parcel-by-parcel approach. The map and report are practical tools that can help with selecting areas for protection or restoration, and planning for new development where the ecological impacts will be minimized. The habitat map of the Town of Poughkeepsie, completed in 2008, can also be used for conservation planning across city-town boundaries.

Conservation Priorities in Poughkeepsie

Most of the land in the City of Poughkeepsie has been developed for residential, commercial, industrial, and transportation uses. Of the 3258 terrestrial acres in the city, 162 ac (5%) are in intensively managed parkland and recreation areas, and 496 ac (15.2%) are in undeveloped areas that are serving as ecologically significant habitat.

Urban greenspaces include small and large areas, ranging from street trees, green roofs, rain gardens, unpaved road verges, landscaped yards and gardens, community gardens, and parks. They can provide resident, temporary, and stepping-stone habitats for native plants and animals, but among their primary values are their services to the human populations of cities. Urban greenspaces offer well-documented physical benefits for people, including improved air quality, moderated air temperatures, mitigated wind speed, and reduced noise. The moderation of air temperatures can measurably reduce the costs of heating and cooling for residences and businesses.

Greenspaces invite increased physical activity, and their presence has been correlated with reduced stress, restored attention, and even reduced crime (Hladnik and Pirnat 2011, Jennings et al. 2012, Dinnie et al. 2013). Greenspaces benefit the social networks of their neighborhoods by increasing social encounters and a sense of community. They can provide space for recreation, social gatherings, community gardens, and environmental education. Greenspaces can contribute hugely to neighborhood beautification and foster a greater sense of well-being in people who live and work nearby. Greenspaces, both natural areas and intensively managed cultural areas, can be important to the development of place-based identity and social cohesion (Stedman 2002). Adaptive reuse and integration of non-public greenspaces can increase greenspace access in places of medium and high-density urban development. By increasing connectivity among disjunct cultural and natural spaces, the community identity can expand from a neighborhood to a city-wide view. For the benefits of greenspace to be felt by current residents, however, it is important that as greenspace access improves, the city take steps to ensure that the potential increased property values do not displace current residents (Wolch et al 2014) (Figure 6).

Below we highlight some of the habitats and habitat areas that may be the most significant from an ecological standpoint.

For conservation planning in suburban or rural settings, we typically recommend consideration of a substantial “conservation zone” around important habitats, to help accommodate the physical exchange of energy, nutrients, and organic materials, and the needs of wildlife moving within and among habitats. But these zones have less relevance and fewer practical applications in the urban setting, where habitat areas are mostly surrounded by pavement and buildings, and stormwater flow is more dependent on artificial channels and piped systems than on local topography.

Still, wherever undeveloped land remains along streams or adjacent to other important habitat areas, it can serve as a valuable buffer from human activities, pollution, and other disturbances. Also, maintenance of unbuilt areas anywhere—vacant lots to closely manicured lawns to unmanaged forests—will allow infiltration of rainwater and snowmelt to the soils, and thus reduce the water volumes that must be managed by the constructed stormwater systems in the city.

Many of the “conservation zone” areas (Figure 9) that we would ordinarily recommend around priority habitats substantially overlap with intensively developed areas. We have mapped the recommended conservation zone fully aware that these zones will be impossible to carry out in a developed urban setting (for example, protecting forest areas around a wetland when there is no remaining forest). Nonetheless, we show and discuss the full extent of the conservation zones because some conservation recommendations can still be followed in developed areas, and some parts of these zones can be considered for habitat restoration or installation of other conservation features.

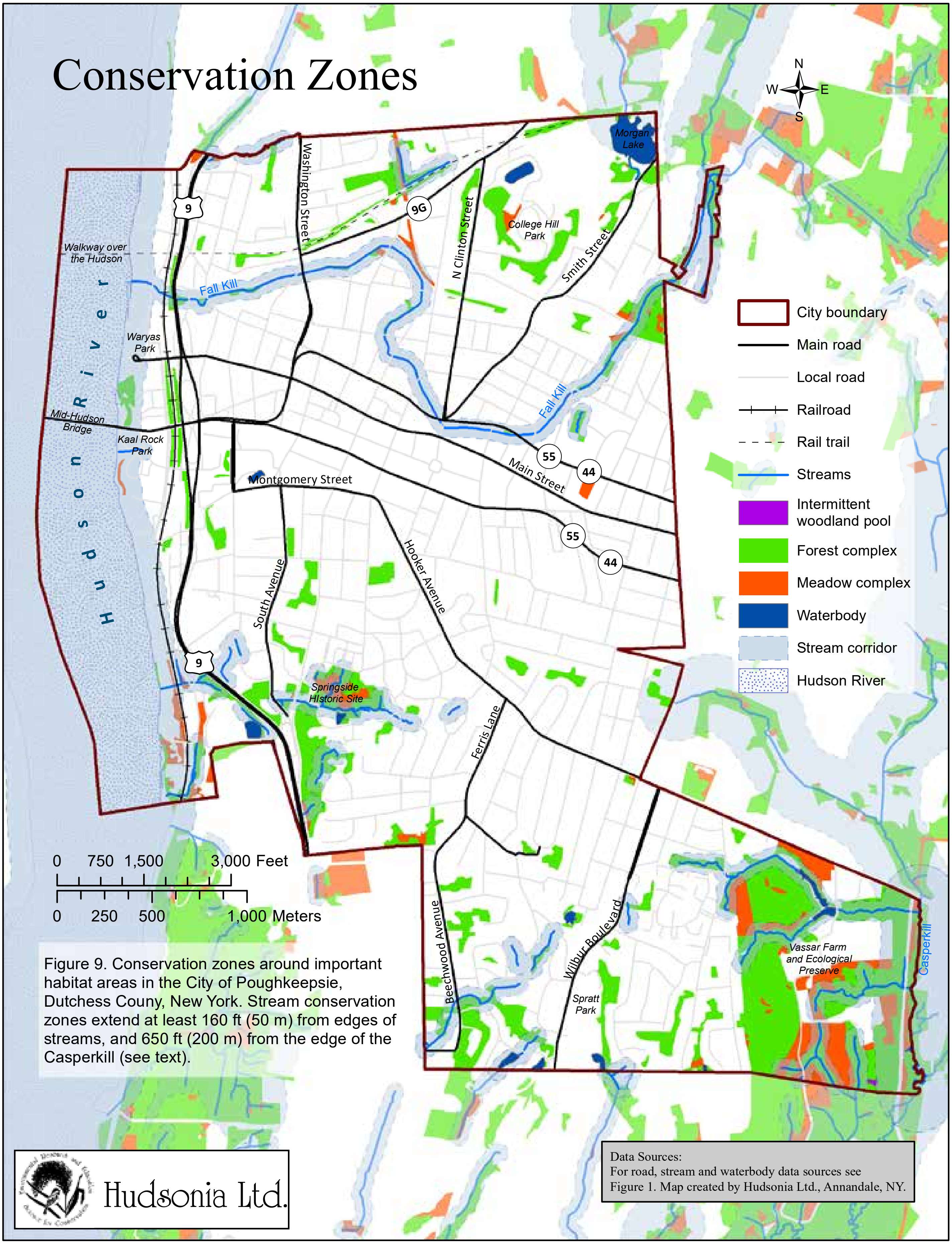


Figure 9. Conservation zones around important habitat areas in the City of Poughkeepsie, Dutchess Couny, New York. Stream conservation zones extend at least 160 ft (50 m) from edges of streams, and 650 ft (200 m) from the edge of the Casperkill (see text).

Data Sources:
For road, stream and waterbody data sources see Figure 1. Map created by Hudsonia Ltd., Annandale, NY.

Large Habitat Areas

The City of Poughkeepsie still contains several large habitat patches that may have high value for wildlife. Figure 5 illustrates the locations of contiguous habitat patches in the city, and Figure 8 shows the areas that could function as corridors. The habitat map (Figure 4) does not show the full size of habitat patches that extend beyond Poughkeepsie's boundary, but that is an important consideration in understanding the habitat value of these areas. The habitat maps for the City and the Town of Poughkeepsie will enable city officials and private landowners to plan strategically across civil boundaries to ensure that large, contiguous habitat areas are conserved where possible.

The Hudson River is the largest contiguous habitat in the city. View from Upper Landing Park.
E. Heffernan © 2018

Table 2. Priority habitats and conservation zones in the City of Poughkeepsie.

Priority Habitat	Representative Species or Group of Concern	Priority Conservation Zone	Rationale	References
Large contiguous forest	Forest interior-breeding birds, spotted turtle	Unfragmented areas with a high percent of forest cover and/or wetland complexes	Maximizes the occurrence and breeding success of species.	Robbins et al. 1989, Kluza et al. 2000, Joyal et al. 2001
Large meadow	grassland-breeding birds	Unfragmented patches greater than 10 ac (4 ha)	Required for successful breeding and maintenance of viable populations.	Vickery et al. 1994
Intermittent woodland pool	pool-breeding amphibians	750 ft (230 m) from pool	Encompasses non-breeding season foraging and refuge habitats and dispersal routes between pools.	Madison 1997, Semlitsch 1998, Calhoun and Klemens 2002
Fall Kill and intermittent streams	aquatic communities of streams	160 ft (50 m) from stream edge	Provides streamside habitats, helps to reduce and filter surface runoff, provides shading vegetation, and provides organic material that supports the food web and habitat structure of the stream.	Multiple sources cited in Environmental Law Institute 2003
Casperkill	aquatic communities of streams and wood turtle	650 ft (200m) from stream edge	Encompasses most of the critical habitat including hibernacula, nesting areas, spring basking sites, foraging habitat, and overland travel corridors.	Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997
Hudson River shoreline zone	Hudson River freshwater tidal communities	400 ft (120 m) from mean high water	Accommodates storm surges, and allows for inland migration of tidal habitats in response to sea level rise.	Eisenman et al. 2010

Forests and Trees

In general, forested areas with the highest ecological conservation value include large forest tracts, mature and relatively undisturbed forests, and those with a lower proportion of edge to interior habitat. The urban setting, however, magnifies the values of street trees, wooded hedgerows, and small forest groves wherever they occur.

The scattered small forest patches in the city are unlikely to support wildlife species that are sensitive to "edge effects" or need to travel significant distances overland between habitats to meet their dispersal or life history needs. Instead these patches are likely to have wildlife species that are well-adapted to small habitat fragments and the numerous hazards of urban life; for example, American robin, gray squirrel, raccoon, striped skunk, and less mobile animals such as soil invertebrates, ants, and ground beetles. Small forest patches may also be used as resting sites for migrating birds and summer roosts for bats.

The values of small forest patches for wildlife habitat, carbon storage, and water management will be enhanced by maintaining undisturbed, uncompacted soils, and downwood and other organic debris on the forest floor, standing snags, and structural diversity. Trees along streets and in yards and hedgerows can moderate local air temperatures, reduce costs for heating and cooling of buildings, reduce noise, provide welcome shade for pedestrians, and add comfort and beauty to the urban landscape.

Meadows

Meadows of any size can provide important habitat for diverse grasses and forbs, pollinating insects and other invertebrates, foraging wild turkey and songbirds, as well as small mammals and their predators (coyote, fox, raptors). Large, contiguous patches of meadow (i.e., 10-100+ ac [0.4 – 40+ ha]) can be especially valuable for grassland breeding birds. In Poughkeepsie, the largest meadow complex (34 ac [14 ha]) was on the Vassar Farm and Ecological Preserve—a network of oldfields, shrubland and active agricultural land that is part of a larger meadow complex extending south into the Town of Poughkeepsie. These meadow areas are known to have nesting eastern meadowlark, and could support bobolink, vesper sparrow, and many other kinds of wildlife.

Many of the plants and animals of meadows are highly susceptible to harm from human activities such as mowing or applying pesticides. But meadows that are left unmanaged, or mowed only infrequently, tend to develop diverse biological communities.

Intermittent woodland pools

We identified and mapped four intermittent woodland pools in the City of Poughkeepsie (Figure 4), but only the one at the Vassar Farm and Ecological Preserve was part of a relatively large area of intact habitat, and is thus likely to support populations of pool-breeding amphibians (wood frog, Jefferson salamander, spotted salamander, marbled salamander) (Figure 9). Maintaining habitat connections between the pool, upland forests, and nearby pools outside the city boundary will support the seasonal and longer-term migrations of these amphibians.

The small forest patch surrounding the three other pools is probably insufficient for the non-breeding season habitat, so persistent populations of pool-breeding amphibians are unlikely. Those pools may nonetheless support some of the aquatic invertebrates characteristic of vernal pools, and provide habitat and water sources for other wildlife.

Streams and Riparian Corridors

The Fall Kill and Casperkill are the major perennial streams in Poughkeepsie (Figure 9). The city's network of smaller perennial and intermittent streams is also important, not only to the organisms that depend directly on the streams but also to the larger ecosystem, including the Hudson River.

Water quality in large streams depends in large part on the water quality and quantity of the small, intermittent streams that feed them, as well as the overland runoff, ditches, and storm drains, if any, that run directly into the streams. To protect water quality and habitat in intermittent streams, we recommend that undisturbed soils and vegetation on adjoining lands be protected to at least 160 ft (50 m) on each side of the stream wherever possible. Intact vegetation and soils is this zone helps to filter sediment, nutrients, and contaminants from runoff, stabilizes stream banks, contributes organic material to the stream, regulates microclimates, and preserves other ecosystem processes (Saunders et al. 2002).

Much of the land bordering the Fall Kill in the city is intensively developed with buildings and pavements, and much of the overland runoff is captured by the stormwater system. But the 160-ft "conservation zone" can be used as a guide should opportunities arise to restore or protect streamside habitat areas. The Fall Kill and other streams throughout the city can be enhanced by simple actions such as planting trees, increasing nearby permeable surface cover, creating pocket parks, and ultimately developing streams to be aesthetic features of the neighborhoods they flow through.

The Casperkill runs through a less urbanized area just east of the Vassar Farm and Ecological Preserve, and has the potential to support wood turtles,* which use perennial streams for overwintering and at other times of the year, but also uses a variety of wetland and upland habitats during the warm months for basking, foraging, and nesting, sometimes moving long distances from the core stream habitat. To help protect the stream itself and the complex of nearby habitats that might be used by the turtles, we recommend considering a conservation zone of 650 ft (200 m) from the stream edge (Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997). Within that zone, the turtles can be adversely affected by stream alteration; removal of woody debris from stream beds; habitat fragmentation from culverts, bridges, roads, and other structures; the direct loss of wetland habitat; degraded water quality from siltation, pesticides, fertilizers, sewage, and toxic compounds; increased nest predation by human-subsidized predators; disturbance from human recreational activities; and road mortality of nesting females and other individuals migrating between habitats.

Hudson River Shoreline Zone

The "shoreline zone" in the City of Poughkeepsie includes the tidal shallows, the tidal tributary mouth of the Fall Kill, the rock riprap and native rocky shore, and the near-shore upland zone that is now or may soon be subject to tidal flooding and storm surges. Figure 7c shows the areas that are within the 100-year flood zone as currently mapped by FEMA (darkest blue areas in the third panel), and the predicted inland advance of that zone through the end of this century (Scenic Hudson 2013). Even at present-day sea levels, at least 26.3 ac (10.6 ha) above the sea wall are within the 100-year flood zone. This area includes 10.4 ac (4.2 ha) of land with buildings and pavement, 9.2 ac (3.7 ha) of unpaved "waste ground," and 6.7 ac (2.7 ha) of parkland and other greenspace. Of the 10.4 acres of paved, developed land within the current 100-year flood zone, new construction has begun for residential development. Notably, the 100-year flood zone was developed to represent the area that stands a 1% chance of being flooded in any given year, but can be more realistically interpreted as the area likely to flood in a major event. Increased precipitation intensity and volumes in storms have increased flood frequency and severity (Horton et al. 2011). The undeveloped waste ground areas present opportunities for restoring greenspaces that will accommodate future flooding.

Riprap has some potential habitat value for native plants and animals to the extent that it mimics some of the habitat characteristics of a natural rocky shore. Strayer et al. (2016) found that vegetation on rock riprap along the freshwater tidal reach of the Hudson River was diverse, included equal numbers of native and non-native species, and varied from sparse to dense. The reasons for the vegetation variability were not entirely explained by the factors measured in the study, but cover and composition were correlated with the age of the revetment, the size and roughness of rocks, and the degree of exposure to forces such as waves, currents, and ice. Strayer et al. suggest that denser and more diverse vegetation could be encouraged by designing riprap revetments with gentle slopes and finer material between the rocks, or perhaps adding coir mats to provide additional substrate. Plantings of desirable vegetation (and removing undesirables) could also help to hasten the development of a robust plant community.

The habitat values of the subtidal shallows and the tidal tributary mouth are immense for fish, waterfowl, and other wildlife. Minimizing disturbance to these areas from boat traffic will reduce pollution and encourage use by wildlife, and could increase bird watching along the river front.

Cultural Habitat Areas

The City of Poughkeepsie has many trail systems, parks, and athletic fields. The Walkway over the Hudson, a nationally-known pedestrian walkway, connects the Dutchess County Rail Trail to the Hudson Valley Rail Trail in Ulster County. The Walkway also connects northern Poughkeepsie to the Hudson River shoreline and Poughkeepsie Landing Park. A public-access waterfront trail planned for the One Dutchess development project will be connected to the Walkway and Waryas Park, and could ultimately connect northward to trails at Marist College and Quiet Cover Park in the Town of Poughkeepsie. Of the four trail systems within city limits (Dutchess County Rail Trail, Springside, Vassar Farm and Ecological Preserve, College Hill Park), all are independent and could benefit from connections between and among other areas.

Many parks in the city are smaller than 4 ac (1.6 ha), and the larger parks and open spaces are located on the periphery of the city (College Hill Park, Spratt Park, Poughkeepsie Landing, Springside, the Vassar Farm and Ecological Preserve), leaving the center of the city with smaller, pocket parks that are largely isolated from other greenspaces. Within many of these parks are intensively managed athletic fields; there are five public-access parks with athletic fields, and another three held by city schools and Vassar College. There are also two golf courses that are partially or entirely within the City of Poughkeepsie, at College Hill Park and at Spratt Park.

Rail trail in Poughkeepsie. E. Heffernan © 2018

Recommendations

Protecting and Restoring Habitats

We recommend that the remaining large blocks of habitat within the City of Poughkeepsie be considered priority areas for conservation, and that efforts be taken to fully protect these places wherever possible; these include 1) the area along the Fall Kill near the transfer station, Springside, and the Vassar Farm and Ecological Preserve. If new development in these areas cannot be avoided, it should be concentrated near the edges and near existing roads and other development so that as much habitat area as possible is preserved without fragmentation.

Some general guidelines for conservation of large habitat areas include the following:

- **Protect large, contiguous habitat areas** wherever possible, and avoid development in their interiors.
- **Maintain or restore habitat connections between large habitat areas.** This goal can sometimes be accomplished by protecting smaller forest patches that provide "stepping stone" connections between larger forest patches, or fitting roads with wildlife crossing structures (such as culverts or underpasses).
- **Maintain intact upland habitat connections between wetlands within wetland complexes.** These areas allow wildlife to move safely between wetland areas, and provide habitat for organisms with both wetland and upland requirements.

Forests

- **Protect patches of forest types that are less common in the city regardless of their size**. These patches include mature forests, natural conifer stands, forests with an unusual tree species composition, or forests that have other habitats (such as woodland pools) embedded in them.
- **Maintain the forest canopy and understory vegetation intact wherever possible**.
- **Maintain standing dead wood, downed wood, and organic debris, and prevent disturbance or compaction of the forest floor**.
- **Avoid leaving pitfall hazards** (such as soil test pits) that can unintentionally trap wildlife.

Meadows

For large meadows, where landowners have flexibility in their mowing and grazing practices, the following measures can reduce harm to nests and nestlings of grassland breeding birds. (In the City of Poughkeepsie, only the large meadows at Vassar Farm have potential to support these birds.)

- **Mowing after August 1** helps to ensure fledging of nestling birds; if mowing must occur before then, leave some unmowed strips or patches. Mowing even later (September or October) will allow fledging of second nests or of late-nesting birds.
- **Raising mower blades to six inches or more, using flushing bars, and avoiding night mowing** when birds are roosting all help to reduce bird mortality.

Other recommendations for meadow management for grassland birds are at https://www.massaudubon.org/content/download/19413/274073/file/Best-Management-Practices_Grasslands_2017_web.pdf

Meadow management at Vassar Farm and Ecological Preserve; meadows are mowed in late fall. E. Heffernan © 2018

In meadows of all sizes, to preserve nectar and pollen sources for butterflies, moths, wasps, and bees, postpone mowing until late October or November; late-season flowers such as goldenrods and asters can be especially important for late-flying insects when many other flowering plants have gone to seed. If mowing must occur before then, leave some substantial unmowed strips within and at the edges of meadows.

Intermittent woodland pools

To help protect pool-breeding amphibians and the habitat complexes they require, we recommend the following measures for the pool at Vassar Farm (adapted from Calhoun and Klemens 2002) extending 750 ft (230 m) into the critical terrestrial habitat zone:

- **Avoid locating roads, pitfall hazards, and other travel obstructionsor hazards** within the 750-ft zone. Pool-breeding salamanders and frogs are especially susceptible to mortality from vehicles, logging equipment, and pitfalls. Vehicle ruts and other artificial depressions that briefly hold water can act as "decoy habitats" that attract large numbers of pool-breeding amphibians, but the eggs laid in them rarely survive due to the short hydroperiod or the high sediment or pollutant loads.
- **Minimize use of heavy equipment** within the 750-ft zone of the surrounding forest, especially during the peak amphibian movement periods of spring and early summer. If equipment use during this period cannot be avoided, install temporary exclusion fencing to keep amphibians out of the active equipment-use areas.
- **Minimize soil compaction** within the 750-ft zone. Soil compaction from use of heavy equipment can destroy the habitat for invertebrates that pool-breeding amphibians rely on for food, and the small burrows and other forest floor microhabitats that they need for shelter.

Streams and Riparian Corridors

To help protect instream and riparian habitats that are used by numerous stream-associated wildlife species, we recommend the following measures:

- **Minimize impacts from new and existing stream crossings and roads**. Undersized bridges and undersized or suspended culverts may be undermined or washed out by large storms, and may constitute significant barriers to the upstream and downstream movement of aquatic organisms. If a poorly-designed or poorly-installed culvert completely blocks the passage of stream organisms, individuals can be cut off from habitats important to their life history needs. If new stream crossings must be constructed, we recommend that they be specifically designed and installed to accommodate large anticipated storm events and the passage of stream organisms. The following prescriptions can improve the connectivity of stream corridors (adapted from Singler and Graber 2005):

- Use bridges and open-bottomed arches instead of culverts, wherever possible.
- Use structures that span at least 1.2 times the full width of the stream so that one or both banks remain in a semi-natural state beneath the structure. This may promote the overland passage of turtles and other wildlife.
- Design the structure to be at least 4 ft (1.2 m) high and have an openness ratio of at least 0.5 (openness ratio = the cross-sectional area of the structure divided by its length). Higher openness ratio values mean that more light is able to penetrate into the interior of the crossing. Brighter conditions beneath a crossing may be more favorable for the passage of animals.
- Install the crossing in a manner that does not disturb the natural substrate of the stream. If the substrate must be disturbed, re-construct the substrate of natural materials and match the texture and composition of upstream and downstream substrates.
- If the stream bed must be disturbed during construction, design the final elevation and gradient of the structure bottom so as to maintain water depth and velocities at low flow that are comparable to those found in natural stream segments just upstream and downstream of the structure. Sharp drops in elevation at the inlet or outlet of the structure can be a physical barrier to aquatic animals.

Fall Kill less channelized with natural, rocky streambank. Walls remain and channelize high flows and limit animal access. E. Heffernan © 2018

- **Daylight streams** when opportunities arise**.** Daylighting increases stream health and improves nutrient processing and stream biodiversity (Neale and Moffet 2016).
- **Soften streambanks** wherever possible by removing rock or concrete walls (or allowing them to deteriorate) in places where the flooding stream will not threaten other infrastructure.
- **Plant streamside trees and shrubs** in open areas to create shade for the stream and habitat for riparian wildlife.
- **Create pocket parks and other streamside greenspaces** to add visual and recreational amenities to the urban landscape.
- **Use porous pavement and add rain gardens** and other vegetated catchment basins where practical within the riparian zone, to improve water infiltration to the soils, reduce surface runoff, and reduce contaminant, sediment, and thermal pollution of the stream.

Enhancement of Developed Areas

The wildlife of urban and suburban landscapes are mostly common species (e.g., pigeon, European starling, gray squirrel, raccoon) that are adapted to human-occupied environments, but less common species may also inhabit or travel through if nearby habitats are suitable. Bats and certain species of birds (including eastern screech owl, barn owl, and Cooper's hawk) will take advantage of individual trees, small groves, and structures in developed areas. Peregrine falcons (NYS Endangered) have been nesting on the Mid-Hudson Bridge and foraging in the City and Town of Poughkeepsie since 1996 (DeOrsey and Butler 2005), and Indiana bat* (NYS Endangered) and other bats might use trees in Poughkeepsie for maternity colonies and summer roosts (Zangla 2007).

There are many practices applicable to the city that would assist in the protection of species of conservation concern. Within the developed matrix, some small areas may serve as buffers to intact habitats, some may provide travel corridors for wildlife, and some may themselves provide habitat for certain species. Hudsonia did not map these small areas or isolated habitat features (such as individual trees, forested hedgerows, and backyard forests) as habitats in their own right due the mapping protocols at a city-wide scale (see Appendix A). We did, however, identify envelopes and corridors representing possible habitat connections through backyards and small greenspaces (Figure 8). The city-wide habitat map can help to focus habitat enhancements on locations where they will achieve the greatest returns for biodiversity conservation.

Following are some examples of conservation measures for developed areas (adapted in part from Adams and Dove 1989, and Adams 1994). There are many additional ways in which urban areas can be modified to reduce their negative environmental impacts and contribute positively to the natural environment (Beatley 2000). The costs of implementing these measures and their effectiveness at particular locations will vary. While some must be implemented by the city or other government entities, others can be practiced voluntarily by private landowners. The city can take a leading role in educating the general public about such actions and encouraging landowner participation.

Enhancing Habitat Characteristics

- **Preserve trees of a variety of species and age classes.** Trees are an important component of the habitat of many wildlife species, and some species of plants and animals can use wooded hedgerows as habitat corridors. Trees also provide services such as moderating local air temperatures, reducing wind velocities, controlling erosion, abating noise, and storing carbon.
    - Plant a variety of native tree species along streets and in hedgerows and yards, and reduce the use of salt on roads to minimize damage to the trees.
    - Allow natural regeneration of native trees where possible, to provide replacements for older trees and those that must be removed for safety reasons.
    - Allow dead trees (snags) to remain standing and fallen trees to decay in place where safety concerns allow. Standing snags provide good habitat for animals such as insects, woodpeckers, and bats; and downed wood provides both habitat and a source of nutrients for plants.
    - Preserve large trees wherever possible, and especially those with exfoliating bark that might serve as summer roost sites for bats.
- **Replace lawn areas with multi-layered landscapes.** Manicured lawns have little value for native biodiversity and lawn maintenance requires higher inputs of water and chemicals than other types of horticultural landscaping, such as wildflower meadows, perennial gardens, or ornamental woodlands. Lawns are commonly maintained with motorized lawn mowers and leaf blowers, which contribute to air and noise pollution. While the choice to maintain lawns in residential areas is often one of personal taste or safety, public education and landowner incentives can promote landscaping that

provides greater ecological services and higher quality resources for wildlife while reducing pollution in developed areas.

- **Design and manage constructed ponds (such as ornamental ponds and stormwater control ponds) for wildlife.**
  - Include irregular shorelines, gently sloped shores, and the capability to control water levels in the design of new ponds.
  - Encourage a combination of emergent vegetation and open water (i.e., interspersed shallow and deep areas).
  - Avoid the use of pesticides in ponds, and pesticides and fertilizers on the land that drains to ponds.
  - Maintain shoreline vegetation; do not mow to the pond edge.
  - Allow spontaneous recruitment of native aquatic animals instead of stocking with non-native fish.
- **Restore broad vegetated buffer zones along streams and tidal areas wherever possible.** Vegetated shorelines and floodplains serve to control erosion, moderate down-stream flooding, protect water quality, provide wildlife habitat, and enhance the habitat quality of the stream or pond. They also allow for natural movements of the stream channel over time, which improves the stream's capacity to dissipate the energy of water flow. Sea level rise and increasing frequency of extreme storm events magnifies the importance of an accommodating zone along the Hudson River and the tidal portion of the Fall Kill.
- **Maximize onsite infiltration of rainwater and snowmelt.** Impervious surfaces such as pavement and roofs alter hydrological patterns by preventing precipitation from infiltrating the soil, instead promoting rapid overland flow to ditches, streams, and ponds. This prevents the recharge of groundwater and filtration of pollutants by soil and vegetation, while increasing the likelihood of flooding, stream bank erosion, and surface water pollution (including sedimentation).
  - Encourage the use of permeable materials for driveways and parking lots in residential and commercial construction and renovation.
  - Construct stormwater retention ponds, wetlands, and rain gardens that allow infiltration of surface water to groundwater.
  - Follow stormwater Best Management Practices (BMP's) in areas of new construction. Examples of BMP's include preserving natural vegetation and installing and maintaining soil retention structures, check dams, sediment traps, and silt fences.
  - Encourage the collection of rainwater for use on gardens and lawns.

Minimizing Disturbance to Resident and Migratory Biota

- **Minimize the impacts of roads on wildlife.** One of the greatest, immediate threats to wildlife in urban and suburban areas is road mortality. A study to identify the roadways with the highest incidence of such mortality and the species most commonly crossing roads in the city could be used to direct the following measures to the places where they will be most effective.
  - Reduce speed limits and post wildlife crossing signs along roads in areas where wildlife are known to cross.
  - Encourage alternative modes of transportation, such as biking, to reduce speeds and reduce pollution.
  - Install structures for safe wildlife crossing, such as culverts, overpasses, underpasses, and modified roadside curbs. The USDA wildlife crossing toolkit is an online source of information on such structures (https://www.fs.fed.us/wildlifecrossings/).
  - Modify the immediate roadside areas to promote safer wildlife crossings. Factors to be considered include the location of barriers such as guardrails, and roadside vegetation (type and distance to the road's edge) (Barnum 2003, Clevenger et al 2003).
- **Minimize noise and light pollution.** High levels of noise and light in cities can be a deterrent to many kinds of wildlife. While noise and light are inevitable in urban environments, certain sources can be minimized. Below are examples of actions that can be implemented and/or enforced as local or city-wide light and noise ordinances.
  - Require that outdoor lights be directed downward (rather than outward or upward) to minimize the light pollution to offsite and overhead areas.
  - Require that lights in tall business buildings be turned off or dimmed in the evenings to minimize the disorienting effect that these lights can have on migrating birds.
  - Encourage the use of light technologies (such as low-pressure sodium lights) that minimize the attraction of flying insects, and prohibit the use of "bug-zappers."
- **Discourage human-subsidized predators and wildlife feeding.** Human-subsidized predators are species such as raccoon, opossum, striped skunk, and outdoor or feral cats, which thrive due to conditions created by humans. Human interference (such as feeding) with the habits and diets of wild animals not only impacts population dynamics, but can lead to nuisance behavior.
  - Do not intentionally feed wildlife.
  - Properly secure outdoor trash receptacles and compost bins.

- **Include biodiversity considerations in development planning.**
  - Plan for lower-disturbance human activities and developments adjacent to intact habitats.
  - Consider wildlife travel routes in placement of new developments and buildings.
- **Encourage building designs that reduce bird collisions and mortality.**

  Collision with glass is responsible for more bird deaths than any other known cause in the US. The American Bird Conservancy provides recommendations for façade materials that deter bird collisions, structural designs that reduce the chances of trapping birds, shielding and direction of outside lighting, design and management of indoor lighting, and landscaping to keep birds away from dangerous parts of a building (Sheppard 2011).

View south from the Walkway Over the Hudson to the Poughkeepsie shoreline.
E. Heffernan © 2018

Important considerations

The benefits of habitat conservation and urban greenspaces are mentioned above, but a paradox of urban greenspace should be addressed in urban planning. Access to greenspace is increasingly understood as an environmental justice issue, expanding the notion beyond direct health disadvantages, such as living downstream of a pollution source, to indirect health benefits, such as increased physical activity when living near a park (Jennings et al 2012). The paradox is that as neighborhoods have better access to high quality greenspaces (Figure 6), the properties are considered more desirable and property values increase (Wolch et al. 2014). While this benefits the city in some ways, the residents of these neighborhoods are often pushed out as their rents and property taxes rise beyond their economic means. The result is that the people who would most benefit from the greenspace, and for whom the greenspace was improved, are displaced and wealthier people move into the now more attractive neighborhood (Wolch et al 2014).

New York City has examples of both rampant gentrification from greening (e.g., the High Line), but also of neighborhoods that avoided the urban greenspace paradox by integrating grass-roots community activism with anti-gentrification strategies (Pearshall 2010, Curran and Hamilton 2012). Programs that encourage affordable housing, rent stabilization and home ownership incentives enable residents to stay in their neighborhood after environmental conditions have improved (Wolch et al 2014). However, communities and city planners must work together to avoid the paradox and design a strategy that works best for the city.

Example of mix-use of Hudson River shoreline: utility space, habitat space and public access space (foreground to background). E. Heffernan © 2018

Reviewing Site-specific Land Use Proposals

In addition to city-wide land use and conservation planning, the habitat map and report can provide ecological information about proposed development sites and the surrounding areas that might be affected by new land uses. We recommend that landowners, developers, and city agencies reviewing new land use proposals take the following steps to evaluate and mitigate the impact of the proposed land use change on habitats and water resources that may be present on and around the site:

1. **Consult the large format habitat map** and Figure 4 to see if the site in question is part of a large, contiguous block of habitat or a habitat connection, and which ecologically significant habitats, if any, are located on and near the site.
2. **Read the profiles of those habitats in this report**.
3. **Check to see if any of the habitats in the area of the proposal are described in the "Priority Habitats" section of this report**, either individually or as part of a habitat complex, and note the conservation issues and recommendations for each.
4. **Consider whether the proposed development project can be designed or modified to ensure that the habitats of greatest ecological concern, as well as the ecological connections between them, are maintained intact**. Examples of design modifications include but are not limited to:

    - Locating human activity areas as far as possible from the most sensitive areas.
    - Minimizing intrusions into large, contiguous habitat areas.
    - Minimizing intrusions into forested areas that are within 750 ft (230 m) of an intermittent woodland pool.
    - Channeling stormwater runoff from roofs, paved areas, or fertilized turf into detention basins or "rain gardens" instead of directly into ditches, streams, ponds, or wetlands; installing and maintaining oil-water separators where runoff leaves paved areas.
    - Minimizing the clearing of vegetation during construction, and restoring cleared areas with native plantings instead of lawn, wherever possible.

Because the habitat map has not been 100% field checked we emphasize that, at the site-specific scale, it should be used strictly as a general guide for land use planning and decision making. Onsite observations by professional biologists should be an integral part of the review process for any significant land use change in or near existing habitat areas.

CONCLUSION

The City of Poughkeepsie is an intensively developed urban landscape but still has areas of ecologically significant habitats, including some such as intermittent woodland pool, hardwood swamp, upland hardwood forest, exposed ledge, and tidal rocky shore, that may support rare, uncommon, or vulnerable plants and animals. Habitat areas at Vassar Farm and Ecological Preserve, Springside Historic Site, and the Fall Kill tidal mouth may be especially important to local and regional biodiversity. Backyard forest groves, wooded hedgerows, and street trees provide additional resident and stepping-stone habitats for plants and wildlife, provide ecological services that improve the urban environment, and help to maintain human connections to the natural world. The city's many areas of intensively managed parks and athletic fields ("cultural habitats") contribute much to the livability of the city. Adding street trees, streamside greenspaces, and pocket parks, especially in parts of the city where greenspaces are scarce, would further improve the natural and human environments of the cityscape.

The city boasts many natural features and has the potential to entwine natural and anthropogenic features together to increase the health of both. For example, the Vassar Farm and Ecological Preserve has the largest extent of uninterrupted habitat in the city, providing both people and wildlife refuge from the demands of city life. On the opposite end, the Fall Kill traverses the city, connecting people on the eastern side of the city back to the Hudson River. In between these features, backyard forests and pocket parks weave together both the anthropogenic and natural features of the city. However, the next step is to increase, enhance and manage these features to promote the health of the whole ecosystem, both natural and anthropogenic.

Twenty-nine percent of the Hudson River shoreline in the city has been hardened by vertical concrete or concrete-and-timber bulkheads, and much of the adjacent shore zone by pavement and buildings. This kind of shoreline restricts the development of tidal shallows and tidal wetlands, creates a barrier to wildlife movements between river and land, and inhibits the natural inland migration of tidal habitats with sea level rise. Sixty-six percent of the shoreline is of rock riprap which can provide some habitat value for plants and animals, depending on the slope and character of the rock fill. The remaining 522 feet (159 meters) of the shore is a steep ledge.

A zone of approximately 440 ft (134 m) width along the shoreline is within the 100-year flood zone designated by the Federal Emergency Management Agency. This means that the zone has a predicted 1% chance of being flooded in any given year, and a 26% chance of being flooded at least once over a thirty-year period. Because storms are predicted to continue increasing in severity and frequency over the coming decades, the chance of flooding and width of the flood zone may be even greater.

Approximately 44% of this flood-prone area is occupied by parks and other greenspaces that could accommodate flooding without incurring much damage to infrastructure, and without impeding flood flows except by the sea wall itself. Approximately 30% of this area is pavement and buildings, some of which could be damaged by flooding. And, approximately 26% is unpaved and substantially unvegetated land above the seawall that could be vulnerable to severe erosion. Fortunately, there are also two parks along the river that provide both permeable infrastructure in case of flood and recreation venues along the riverfront.

The habitat map provides a bird's-eye view of the landscape, illustrating the location and extent of existing habitat areas and their spatial relationships to each other. The habitat information can foster a better understanding the significant biological resources in the city, help the city plan for improving and expanding greenspaces to enhance the quality of life for Poughkeepsie residents and workers, and help local decision-makers focus limited resources for restoration and conservation where they will have the greatest impact.

We hope that the habitat map and this report will help landowners, developers, and city agencies consider the quality, character, and distribution of greenspaces throughout the city, and design effective measures to protect, restore, and expand the resources of greatest importance.

At the site-specific scale, we hope the map can be used as a resource for routine deliberations over development proposals and other proposed land use changes. The map and report provide an independent body of information for environmental reviews, and will help raise questions about important biological resources that might otherwise be overlooked. We strongly emphasize, however, that the map has not been exhaustively field checked and should therefore be used only as a source of general information. In an area proposed for development, for example, the habitat map can provide basic ecological information about the site and the surrounding lands, but the map should not be considered a substitute for site visits by qualified professionals. During site visits, the presence and boundaries of important habitats should be verified, changes that have occurred since our mapping should be ascertained, and the site should be assessed for additional ecological values. Detailed, up-to-date ecological information is essential to making informed decisions about specific development proposals. Because the natural landscape and patterns of human land use are dynamic, the city should consider refining and/or updating the habitat map over time.

Conservation of habitats is one of the best ways to protect biological resources and, in an urban setting, conservation and expansion of greenspaces is especially important to the well-being of residents and workers. We hope that the information contained in the habitat map and in this report will help the City of Poughkeepsie plan wisely for future development and take steps to protect natural resources. Incorporating this approach into planning and decision-making will help to integrate the needs of the human community with those of the natural communities, and protect the ecological patterns and processes that support the people of Poughkeepsie and the local ecosystems.

Tidal mouth of the Fall Kill viewed from Upper Landing Park.
E. Heffernan © 2018

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APPENDICES

A. Mapping Conventions

Mapping conventions used to draw boundaries between habitat types, and additional information on defining habitat types.

Crest and ledge. Because crest and ledge habitats constitute small areas in Poughkeepsie and are usually embedded within other habitat types (most commonly upland forest), they were depicted as a point location (a star) over other habitats. These habitats do not have distinct signatures on aerial photographs and were therefore mapped mostly based on field observations. The final overlay of crest and ledge habitats is therefore an approximation; we expect that there are additional bedrock exposures outside the mapped areas. The precise locations and boundaries of these habitats should be determined in the field as needed.

Cultural. We define cultural habitats as areas that are significantly altered and intensively managed (e.g., mowed), but are not otherwise developed with wide pavement or structures. These include golf courses, playing fields, cemeteries, and large lawns. On aerial photos it was sometimes difficult to distinguish extensive lawns from less intensively managed upland meadows, so in the absence of field verification some lawns may have erroneously been mapped as "upland meadow," and vice versa.

Developed areas. Habitat areas surrounded by or intruding into developed land were mapped only if at least one dimension exceeded 30 m (100 ft) in all directions. This area threshold was adjusted slightly to include the mapping of some areas slightly narrower but that were part of important habitat connection in heavily developed areas. Exceptions to this protocol were wetlands within developed areas, which we mapped (along with their immediately adjacent, non-cultural habitats) if they were identifiable on the aerial photographs or if we observed them in the field. Even though such wetlands may lack many of the habitat values of wetlands in more natural settings, they still may serve as important drought refuges for species of conservation concern. Lawns near buildings and roads were mapped as developed; large lawns not adjacent to buildings and roads, and adjacent to significant habitats were mapped as "cultural" habitats.

Intermittent woodland pools. Intermittent woodland pools are best identified in the spring when the pools are full of water and occupied by invertebrates and breeding amphibians. However, because the field work for this project occurred in late summer and fall, we relied on general physical features of the site to distinguish intermittent woodland pools from isolated swamps. We classified those wetlands with an open basin as intermittent woodland pools and those dominated by trees or shrubs as swamps, but they often serve similar ecological functions. Many intermittent woodland pools can also be mapped remotely since they have a distinct signature on aerial photographs, and are readily visible within areas of deciduous forest on photographs taken in a leaf-off season.

Constructed ponds. Most or all bodies of open water in Poughkeepsie were created by damming or excavation. All ponds were classified as "constructed pond".

Springs. Springs and seeps are difficult to identify by remote sensing. We mapped only the one we happened to see in the field. We expect there are others in the city that we did not map. The precise locations and boundaries of seeps and springs should be determined in the field on a site-by-site basis.

Streams. We created a stream map in our GIS that was based on field observations and interpretation of topographic maps and aerial photographs. We depicted streams as continuous where they flowed through ponds, impoundments, or large wetlands. We mapped the likely location of streams that are diverted underground in developed areas only when they re-surfaced at a distance of less than 200 meters (650 ft). We expect there were additional intermittent streams that we did not map, and we recommend these be added to the database as information becomes available. Because it was often difficult to distinguish between perennial and intermittent streams based on aerial photograph and map interpretation, these distinctions were made using our best judgment. Streams that were channelized or diverted by humans (i.e., ditches) were mapped when observed in the field or on aerial photos. Some larger perennial streams deposit sand or gravel bars, which we mapped upon observation and subsequent extrapolation. Gravel bars are considered part of the stream habitat, and discussed briefly in the report in the streams section. The location and size of such deposits can be highly variable from year to year.

Upland forests. We mapped just three general types of upland forests: hardwood, mixed, and conifer forest. Although these forests are extremely variable in their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other factors, we used these broad categories for practical reasons. Deciduous and coniferous trees are generally distinguishable in aerial photos taken in the spring, although dead conifers can be mistaken for deciduous trees. Different forest communities and ages are not easily distinguished on aerial photographs, however, and we could not consistently and accurately separate forests according to dominant tree species or size of overstory trees. Our "upland forest" types therefore include non-wetland forests of all ages, at all elevations, and of all species mixtures, including floodplain forests.

Upland meadows and upland shrubland. Upland meadows often have a substantial shrub component; the distinction between upland meadows and upland shrubland habitats is somewhat arbitrary. We defined upland shrubland habitats as those with widely distributed shrubs that accounted for more than 20% of the cover.

Wetlands. We mapped wetlands remotely using topographic maps, soils data, and aerial photographs. In the field, we identified wetlands primarily by the predominance of hydrophytes and easily visible indicators of surface hydrology (Environmental Laboratory 1987). We did not examine soil profiles. Along stream corridors and in other low-lying areas with somewhat poorly drained soils, it was often difficult to distinguish between upland forest and hardwood swamp without the benefit of onsite soil data. On the ground, these areas were characterized by moist, fine-textured soils with common upland trees in the canopy, often dense thickets of vines and shrubs (e.g., Japanese barberry, Bell's honeysuckles) in the understory, and facultative wetland and upland species of shrubs, forbs, and graminoids. In most cases, we mapped these areas as upland forest. Because we did not examine soil profiles in the field, all wetland boundaries on the habitat map should be treated as approximations, and should not be used for jurisdictional determinations. Wherever the actual locations of wetland boundaries are needed to determine jurisdictional limits, the boundaries must be identified in the field by a wetland scientist and mapped by a land surveyor. We attempted to map all wetlands in the city, including those that were isolated from other habitats by development.

B. Explanation of Rarity Ranks

Explanation of ranks of species of conservation concern listed in Appendix C and Appendix D. Explanations of New York State Ranks and New York Natural Heritage Program Ranks are from the New York Natural Heritage Program website, accessed in 2018 (https://www.dec.ny.gov/animals/29338.html).

NEW YORK STATE RANKS
Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

ANIMALS

E **Endangered Species**. Any species which meet one of the following criteria: 1) Any native species in imminent danger of extirpation; 2) Any species listed as endangered by the US Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Any species which meet one of the following criteria: 1) Any native species likely to become an endangered species within the foreseeable future in New York; 2) Any species listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC **Special Concern Species**. Those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

PLANTS

E **Endangered Species**. Listed species are those 1) with five or fewer extant sites, or 2) with fewer than 1,000 individuals, or 3) restricted to fewer than 4 USGS 7.5 minute map quadrangles, or 4) listed as endangered by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Listed species are those 1) with 6 to fewer than 20 extant sites, or 2) with 1,000 or fewer than 3000 individuals, or 3) restricted to not less than 4 or more than 7 USGS 7.5 minute map quadrangles, or 4) listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

R **Rare Specie**s. Listed species are those with 1) 20-35 extant sites, or 2) 3,000 to 5,000 individuals statewide.

NEW YORK NATURAL HERITAGE PROGRAM RANKS – ANIMALS AND PLANTS

S1 Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2 Typically 6-20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 Typically 21-100 occurrences, limited acreage, or miles of stream in New York State.

SH Historically known from New York State, but not seen in the past 15-20 years.

SNA A visitor to the state but not a regular occupant (such as a bird or insect migrating through the state), or a species that is predicted to occur in NY but that has not been found.

B,N These modifiers indicate when the breeding status of a migratory species is considered separately from individuals passing through or not breeding within New York State. B indicates the breeding status; N indicates the non-breeding status.

SPECIES OF GREATEST (AND POTENTIAL) CONSERVATION NEED (SGCN, SPCN) IN NEW YORK – ANIMALS

The lists of Species of Greatest Conservation Need were developed through a review of the status of 600 species of mammals, fish, birds, amphibians, reptiles, mollusks, crustaceans, and arthropods by a group of NYSDEC staff and species experts, with input from biodiversity scientists and and taxonomists.

Species of Greatest Conservation Need - High Priority
Species that are experiencing a population decline, or have identified threats that may put them in jeopardy, and are in need of timely management intervention, or they are likely to reach critical population levels in New York.

Species of Greatest Conservation Need
Species that are experiencing some level of population decline, have identified threats that may put them in jeopardy, and need conservation actions to maintain stable population levels or sustain recovery.

Species of Potential Conservation Need
Species whose status is poorly known, but there is an identified threat to the species or features of its life history that make it particularly vulnerable to threats. The species may be declining or begin to experience declines within the next ten years, and studies are needed to determine their actual status.

AUDUBON PRIORITY BIRD LIST

Audubon New York compiled a list Hudson Valley birds of special conservation concern. A species is included on the Hudson River Valley Priority Bird list if it is found in the Hudson Valley and on one of the following priority lists: NYS Endangered, Threatened, or Special Concern; Audubon Watchlist (2007); Partners In Flight (PIF, 2005) - Continental Concern, Regional Concern, Continental Stewardship, Regional Stewardship in any of the Bird Conservation Regions in the Hudson Valley (BCRs 13, 14, 28, and 30); North Atlantic Shorebird Plan - Highly Imperiled or Species of High Concern; Mid- Atlantic, New England, Maritime Waterbird Working Group - High Concern, Moderate Concern.

C. Status of Animals of Conservation Concern Mentioned in this Report

E = NYS Endangered; T = NYS Threatened; SC = NYS Special Concern; S1, S2, S3 = NYNHP active inventory ranks; SPCN = NYS Species of Potential Conservation Need; SGCN = NYS Species of Greatest Conservation Need; SGCN-HP = High Priority SGCN. For Hudson Valley Priority Birds (Audubon New York), the season they are found in the Hudson Valley are indicated by B = breeding; M = migration; W = winter. All ranks are explained in Appendix [B].

Species	NYS Rank	NYNHP Rank	SGCN/SPCN	Hudson Valley Priority Birds
VERTEBRATES				
Reptiles and Amphibians				
blue-spotted salamander	SC		SGCN-HP	—
four-toed salamander			SGCN-HP	—
Jefferson salamander	SC		SPCN	—
marbled salamander	SC	S3	SGCN	—
eastern box turtle	SC	S3		—
spotted turtle	SC	S3	SGCN-HP	—
map turtle		S3	SGCN	—
wood turtle	SC	S3	SGCN-HP	—
Blanding's turtle	T	S2S3	SGCN-HP	—
eastern racer			SGCN	—
eastern ratsnake			SGCN	—
northern copperhead		S3	SGCN	—
eastern hognose snake	SC	S3	SGCN-HP	—
Birds				
American bittern	SC		SGCN	B,M
least bittern	T	S3B, S1N	SGCN	B,M
American black duck		S3B, SNRN	SGCN-HP	
northern harrier	T	S3B, S3N	SGCN	B,M,W
osprey	SC			
sharp-shinned hawk	SC			B,M,W
Cooper's hawk	SC			B,M,W
red-shouldered hawk	SC		SGCN	B,M,W
broad-winged hawk				B,M
American kestrel			SGCN	B,M,W
common gallinule		S3S4		
king rail	T	S1B	SGCN-HP	
American woodcock			SGCN	B,M
barn owl		S1S2	SGCN-HP	
long-eared owl		S2S3B, SNRN	SGCN	
common nighthawk	SC	S2S3B	SGCN-HP	B,M

(continued)

C. Status of Animals (cont.)

Species	NYS Rank	NYNHP Rank	SGCN/SPCN	Hudson Valley Priority Birds
Birds (cont.)				
sedge wren	T	S3B	SGCN-HP	
marsh wren				B,M
wood thrush			SGCN	B,M
brown thrasher		S3S4B	SGCN-HP	B,M
blue-winged warbler			SGCN	B,M
golden-winged warbler	SC	S3B	SGCN-HP	B,M
black-throated green warbler				B,M
prairie warbler			SGCN	B,M
cerulean warbler	SC	S3?B	SGCN	B,M
black-and-white warbler				B,M
Canada warbler			SGCN-HP	B,M
scarlet tanager			SGCN	B,M
eastern towhee				B,M
field sparrow				B,M
savannah sparrow				B,M
clay-colored sparrow		S3S4B		
bobolink			SGCN-HP	B,M
eastern meadowlark			SGCN-HP	B,M
purple finch				B,M,W
yellow-breasted chat	SC	S2?B	SGCN-HP	B,M
Mammals				
small footed bat	SC	S1S3	SGCN	—
Indiana bat	E	S1	SGCN-HP	—
Fishes				
American eel		S2S3	SGCN-HP	—
brook trout			SGCN	—
INVERTEBRATES				
northern oak hairstreak		S2S4	SGCN-HP	—
dusted skipper		S2S3		—
gray petaltail	SC	S2	SGCN-HP	—
tiger spiketail		S1	SGCN-HP	—
Piedmont groundwater amphipod		SNR	SPCN	—

D. Common and Scientific Names of Plants Mentioned in this Report

Scientific names follow the nomenclature of Weldy et al. (2017). E = NYS Endangered; T = NYS Threatened; R = NYS Rare; S1, S2, S3 = NYNHP active inventory ranks. All ranks are explained in Appendix B.

Common Name	Scientific Name	NYS & NYNHP Ranks
agrimony, small-flowered	*Agrimonia parviflora*	R, S3
arum, arrow	*Peltandra virginica*	
arrowhead, broad-leaved	*Sagittaria latifolia*	
ash, green	*Fraxinus pennsylvanica*	
ash, white	*Fraxinus americana*	
aspen, quaking	*Populus tremuloides*	
azalea, swamp	*Rhododendron viscosum*	
barberry, Japanese	*Berberis vulgaris*	
beggar-ticks, estuary	*Bidens bidentoides*	R, S3
bergamot, wild	*Monarda fistulosa*	
berry, porcelain	*Ampelopsis glandulosa*	
birch, gray	*Betula populifolia*	
birch, river	*Betula nigra*	R, S3
bittersweet, oriental	*Celastrus orbiculatus*	
blackberry, northern	*Rubus allegheniensis*	
bladderwort	*Utricularia*	
blueberry, highbush	*Vaccinium corymbosum*	
bluejoint	*Calamagrostis canadensis*	
bluestem, little	*Schizachyrium scoparium* var. *scoparium*	
bur-marigold, smooth	*Bidens laevis*	T, S2
canary-grass, reed	*Phalaris arundinacea*	
cattail	*Typha*	
cedar, eastern red	*Juniperus virginiana* var. *virginiana*	
cherry, black	*Prunus serotina* var. *serotina*	
cliffbrake, purple	*Pellaea atropurpurea*	
cliffbrake, smooth	*Pellaea glabella* ssp. *glabella*	T, S2
corktree, Amur	*Phellodendron amurense*	
cottonwood, eastern	*Populus deltoides*	
dodder, buttonbush	*Cuscuta cephalanthi*	E, S1
dodder, field	*Cuscuta pentagona*	R, S3
dogwood, gray	*Cornus racemosa*	
dogwood, silky	*Cornus amomum* ssp. *amomum*	
duckweed, common	*Lemna minor*	
elm, American	*Ulmus americana*	

(continued)

D. Plant Names (cont.)

Common Name	Scientific Name	NYS & NYNHP Ranks
elm, slippery	*Ulmus rubra*	
false-mermaid	*Floerkea proserpinacoides*	
featherfoil	*Hottonia inflata*	T, S2
fern, cinnamon	*Osmundastrum cinnamomeum* var. *cinnamomeum*	
fern, marsh	*Thelypteris palustris* var. *pubescens*	
fern, sensitive	*Onoclea sensibilis*	
flag, blue	*Iris versicolor*	
garlic-mustard	*Alliaria petiolata*	
goldenclub	*Orontium aquaticum*	T, S2
goldenseal	*Hydrastis canadensis*	T, S2
hawthorn	*Crataegus*	
hemlock, eastern	*Tsuga canadensis*	
hickory, pignut	*Carya glabra*	
hickory, shagbark	*Carya ovata* var. *ovata*	
holly, winterberry	*Ilex verticillata*	
honeysuckle	*Lonicera*	
honeysuckle, Bell's	*Lonicera* × *bella*	
hornbeam, hop	*Carpinus caroliniana* ssp. *virginiana*	
knotweed, Japanese	*Reynoutria japonica* var. *japonica*	
knotweed, slender	*Polygonum tenue*	R, S3
locust, black	*Robinia pseudoacacia*	
loosestrife, purple	*Lythrum salicaria*	
mannagrass	*Glyceria*	
maple, Norway	*Acer platanoides*	
maple, red	*Acer rubrum*	
maple, sugar	*Acer saccharum*	
may-apple	*Podophyllum peltatum*	
meadowsweet	*Spiraea alba* var. *latifolia*	
monkey-flower, winged	*Mimulus alatus*	R, S3
oak, black	*Quercus velutina*	
oak, pin	*Quercus palustris*	
oak, red	*Quercus rubra*	
oak, swamp white	*Quercus bicolor*	
oak, white	*Quercus alba*	
pine, Scotch	*Pinus sylvestris*	
pine, white	*Pinus strobus*	
pinweed, slender	*Lechea tenuifolia*	T, S2
plantain, heartleaf	*Plantago cordata*	R, S3

(continued)

D. Plant Names (cont.)

Common Name	Scientific Name	NYS & NYNHP Ranks
pond-lily, yellow	*Nuphar advena* ssp. *advena*	
pond-lily, white	*Nymphaea odorata*	
pondweed	*Potamogeton*	
prickly-pear, eastern	*Opuntia humifusa*	
raspberry	*Rubus*	
rattlebox	*Crotalaria sagittalis*	E, S1
reed, common	*Phragmites australis*	
rose, multiflora	*Rosa multiflora*	
rush, soft	*Juncus effusus* ssp. *solutus*	
saxifrage, golden	*Chrysosplenium americanum*	
sedge, cattail	*Carex typhina*	E, S2
sedge, Davis'	*Carex davisii*	T, S2
sedge, tussock	*Carex stricta*	
skunk-cabbage	*Symplocarpus foetidus*	
spicebush	*Lindera benzoin*	
spruce, Norway	*Picea abies*	
starwort, terrestrial	*Callitriche terrestris*	T, S2S3
stiltgrass, Japanese	*Microstegium vimineum*	
sycamore, eastern	*Platanus occidentalis*	
tree-of-heaven	*Ailanthus altissima*	
violet	*Viola*	
water-nymph, Hudson River	*Najas muenscheri*	E, S2
wall-rue	*Asplenium ruta-muraria*	
watermilfoil	*Myriophyllum*	
water-chestnut	*Trapa natans*	
water-plantain	*Alisma triviale*	
weed, Joe-Pye	*Eutrochium maculatum*	
wisteria	*Wisteria*	
woolgrass	*Scirpus cyperinus*	

Emerald Ash Borer Management Recommendations for the City of Poughkeepsie

India Futterman, Vassar College ‘19 and Jennifer Rubbo, The Environmental Cooperative at the Vassar Barns; September 2017

This document is a project of the Environmental Cooperative at the Vassar Barns. The EAB survey and accompanying documents are part of a larger natural resources inventory for the City of the Poughkeepsie, funded in part by a grant from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation. This aspect of the project was advised and supported by the City of Poughkeepsie Shade Tree Commission.

Introduction

The emerald ash borer (EAB), *Agrilus planipennis* (Fig. 1) is an invasive beetle that arrived in the United States in wooden packing material shipped from Asia (Bauer and Duan 2017). The beetle targets ash trees, (*Fraxinus sp.)*, a native North American species often planted in urban areas as a street tree (USDA 2014). EAB was first encountered in the United States in 2002 in Detroit, Michigan and Windsor, Ontario (Poland and McCullough 2006), and was discovered in New York State in Cattaraugus County during the summer of 2009 (Whitmore 2011). Non-native, invasive organisms are often more likely to become established in cities due to the high commercial traffic in these areas (Poland and McCullough 2006). The beetle has traversed the country due to the movement of firewood, nursery trees, and other infested wood (Cappaert et al. 2005). As of 2014, Dutchess County is in the Quarantine Zone for New York State (NYS DEC 2014, see Fig. 2a), meaning that ash wood cannot be moved into or out of the area. The Mid-Hudson area in general is considered a “core” of EAB infestation (McDonnell 2013; see Fig. 2b). In response to the growing the growing threat of EAB in Dutchess County, the Vassar Farm and Ecological Preserve (VFEP) developed and implemented an EAB management plan in mid-2015. As of this year, EAB is firmly established among the City of Poughkeepsie’s ash population.

Fig. 1: The emerald ash borer
(Source: David Cappaert, Michigan State University, Bugwood.org)

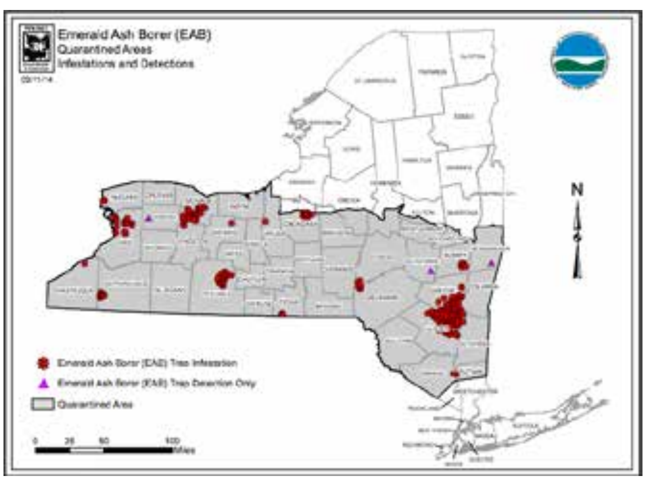

Fig. 2a: Quarantine Areas, Infestations, and Detections
(Source: NYS DEC)

1

Ash Trees in the City of Poughkeepsie

Street trees are a vital resource for cities. Through evapotranspiration and absorption into roots and soils, street trees absorb substantial amounts of rainfall and are thus beneficial in terms of stormwater management. Street trees also capture CO_2 and other airborne pollutants released with automobile emissions, improving air quality. Moreover, street trees help cool urban heat islands by shading pavement and other surfaces. Many city trees provide important habitat for urban species, and groups of street trees can serve as wildlife corridors, especially for birds (Mullaney et al. 2014). Street trees also help improve aesthetics, increase property values, and strengthen communities (Burden 2006). In 1978, the City of Poughkeepsie Shade Tree Commission was established to oversee the planting and care of the City's trees (City of Poughkeepsie 2017). For the past 38 years, the City has retained its status as a Tree City USA, recognized for its excellence in urban forestry planning and management (Arbor Day Foundation 2017). Street trees are therefore particularly meaningful to the City of Poughkeepsie.

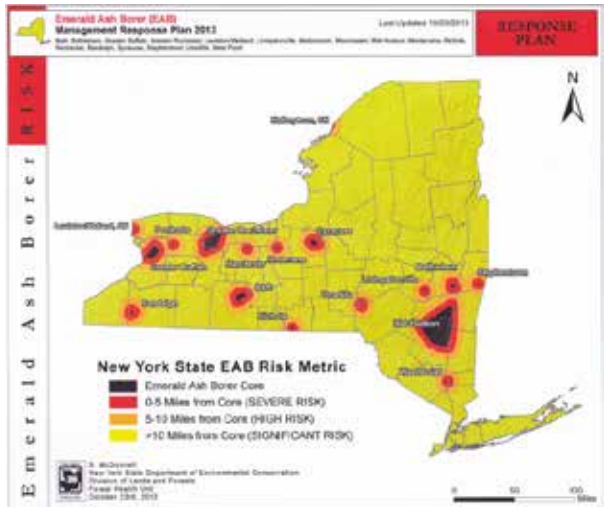

Fig. 2b: EAB Infestation Cores, NYS
(Source: S. McDonnell, NYS DEC)

Poughkeepsie's street trees are diverse, with 84 species comprising a population of 6,987 individuals (Urban Forestry, LLC 2006). Of those street trees, 405 (5.8%) are either white or green ash trees. Green ash (*Fraxinus pennsylvanica*) is much more common in the City than white ash (*Fraxinus americana*). Ash is an excellent street tree, as it tolerates a relatively wide range of soil pHs (Cornell University 2017), which tend to fluctuate in urban environments. Ash is identified by its compound leaves, opposite branching pattern, and diamond-shaped bark (The Tree Doctor 2017).

Fig. 3: EAB adult (above) and larva (below)
(Source: David Cappaert, Michigan State University, Bugwood.org)

EAB Biology

Life Cycle

The adult emerald ash borer measures 10-20mm in length and 4mm wide (Cornell Cooperative Extension 2012). Adult borers lay their eggs in the crevices of the ash's diamond-shaped bark at least 1.4 m above the ground in a newly infested tree (Kovacs et al. 2010). Larvae hatch about two weeks after eggs are laid (Poland

2

et al. 2006). Larvae are white, with several bell-shaped segments comprising a body up to 38 mm in length (see Fig. 2; Cornell Cooperative Extension 2012). Upon hatching, the larvae proceed to tunnel into the vascular system of the tree, excavating telltale S-shaped galleries (Fig. 3) in their wake (de Groot et al 2006). Larval activity effectively girdles the tree over time, inhibiting the transport of water and nutrients (Sadof et al 2017). Larvae mature within the tree and bore their way out as adults in the spring through distinct D-shaped holes (Fig. 4; de Groot et al 2006). Adult beetles then feed on ash leaves prior to mating and dispersal (Poland et al. 2006). Borers are most active on warm, cloudless, windless days (USDA–APHIS 2008).

Fig. 4: S-shaped gallery, City of Poughkeepsie

Fig. 5: D-shaped exit holes and vertical bark splitting, City of Poughkeepsie

Population Dynamics

Burr and McCullough (2014) describe the spread of EAB as a "wave". During an EAB infestation insect density starts out low then steadily increases. As ash trees decline, the beetle population grows exponentially until the ash population is entirely infested. After all or most of the ash trees die the beetle moves on to another healthy population.

Effects on Ash Trees

EAB infestation usually commences towards the top of the tree and progresses downwards over time (Cappaert 2005); therefore symptoms in the initial stage of infestation are not easily seen. Thus, by the time D-shaped holes and/or S-shaped galleries are visible at eye-level, the infestation is likely already too well-established in the tree for treatment to be viable. Other symptoms of ash tree stress are epicormic branching, vertical bark splitting, blonding due to woodpecker activity, and crown dieback (de Groot et al 2006).

Natural Predators

EAB has several natural predators in its native ranges of China and the Russian Far East (Bauer and Duan 2017; Haack et al. 2015), though ash trees in those regions appear to be resistant to EAB (Rebek et al. 2008). However, parasitic wasps and other natural predators of EAB are not native to the U.S., and ash trees here have no defenses against the invasive beetle. Woodpeckers are an important native species that feed on EAB (Cappaert 2005), but their predation is not enough to sufficiently curb the spread of infestation (Lindell et al. 2008). Parasitoid wasps have been imported and released in forest stands of ash with moderate rates of success at EAB population control. For instance, Duan and colleagues (2017) observed a 36-85% larval parasitism rate by *Ooibus agrili* among ash saplings. However, parasitism rates declined with increasing tree size. Rates of success varied among parasitoid species as well (Duan et al. 2017). See *EAB Treatment and Tree Management* section for further information regarding parasitoid wasp release.

Fig. 6a: Ash tree displaying symptoms of EAB infestation (crown dieback, epicormic branching), City of Poughkeepsie

Fig. 6b: Ash tree killed by EAB infestation, City of Poughkeepsie

Ash Tree Assessment

In late 2015, the City of Poughkeepsie Shade Tree Commission met with the VFEP to discuss the potential implementation of an EAB management plan similar to that of the VFEP in the City of Poughkeepsie. EAB presence was confirmed on the VFEP in March of 2017. Distinct signs of EAB infestation, such as extensive dieback and blonding, were also observed among scattered street trees in the City by residents and passersby. In response to the clear threat to Poughkeepsie's ash trees, the Environmental Cooperative at the Vassar Barns conducted a survey of the City's street ash trees to assess the extent of the infestation within city limits. This survey informed the recommendations listed in this document.

Working with data from a 2006 street tree inventory, tree points were plotted on a map (Fig. 7) in ArcGIS using address geocoding. Ash tree points were then extracted from the larger data set and plotted on a separate map. Using the ArcGIS Collector app, tree points were ground-truthed in the field for location accuracy. Tree condition was also updated in the database using the Collector app. The following symptoms were noted as signs of tree stress, potentially indicating EAB presence (see Fig. 6a): epicormic branching (shoots sprouting from base of tree trunk), crown dieback, vertical bark splitting, and blonding and woodpecker activity.

D-shaped exit holes and S-shaped galleries underneath bark were considered definitive signs of EAB activity. Trees that only displayed stress symptoms (i.e., not D-shaped holes or S-shaped galleries) were deemed “symptomatic” and are indicated on the map by yellow tree points. Trees that displayed either D-shaped holes or S-shaped galleries (and/or any of the above stress symptoms) were deemed infested with EAB and are denoted on the map by red tree points. “Asymptomatic” trees are defined as trees exhibiting neither stress symptoms nor signs of EAB; in other words, apparently healthy. These trees are displayed on the map as green tree points. Trees originally included in the 2006 report but which had since been removed were not included on the map.

Results

The results of our survey indicate that EAB is well-established among the street ash tree population in the City of Poughkeepsie. 8.4% of City ash trees are definitively infested with EAB, while over half (58.8%) of City ash display symptoms of stress to varying degrees, potentially due to EAB infestation. Regardless of whether these stress symptoms are due to EAB or not, trees in stressed conditions are much more vulnerable to infestation than non-stressed trees, putting the majority of the City’s ash trees at high risk. Only about one third of Poughkeepsie city trees appear to be asymptomatic for EAB infestation at the moment. Infested trees are scattered throughout the city, which means that EAB infestation cannot be contained to one particular core location and will likely spread to all or most ash trees in the City within the next year or two.

EAB Treatment and Tree Management

Biocontrol

While biocontrol efforts have been implemented with some success in forest stands of ash, parasitoid wasp release is not suitable for urban environments such as the City of Poughkeepsie. The release method for many species of parasitoid wasps involves attaching a plastic container to ash tree trunks (USDA–APHIS 2016), and these containers are at risk of being disturbed in urban areas with high traffic. Additionally, parasitoid wasp dispersal is limited, in some cases less than 1 km (Duan et al 2011), posing a major obstacle for dispersal in cities where ash trees are irregularly scattered over a large area.

Pesticide Treatment

The suitability of pesticide treatment varies depending on the extent and severity of infestation. In uninfested localities within 10-15 miles of a known EAB infestation, insecticide treatment of ash trees may be an effective and worthwhile investment (Herms et al. 2014). Insecticide treatment may also be effective in the early stages of EAB infestation, as ash trees can withstand and recover from minor EAB damage (Poland et al. 2006). Various cost analyses have shown that early insecticide treatment of ash trees is often less expensive than the removal and replacement of infested trees (Sadof et al. 2017; Herms et al. 2014). However, EAB is often difficult to detect in ash populations until it is too late to treat. For example, trees with greater than 50% crown dieback are already too heavily damaged to respond to insecticide treatment (Spears et al. 2014). Insecticide treatment is a multi-year procedure that may be detrimental to non-target organisms depending on the active ingredient applied. Listed below in Table 1 are the most commonly applied EAB insecticides and their potential side effects.

Table 1: EAB Insecticide Options

Insecticide Active Ingredient	Application Method	Benefits	Drawbacks
Imidacloprid	Trunk injection, trunk spray, soil drench	Designated by EPA as reduced-risk*, low toxicity to mammals*, breaks down rapidly in water in the presence of sunlight, not highly toxic to woodpeckers*	Harmful/fatal to honey bees at certain concentrations*, does not break down readily in water without sunlight (can persist in groundwater)*, provides only 1 year of EAB control**
Dinotefuran	Trunk spray, soil drench	Designated by EPA as reduced-risk*, breaks down rapidly in water in the presence of sunlight*, not highly toxic to woodpeckers*	Does not break down readily in water without sunlight (can persist in groundwater)*, provides only 1 year of EAB control**
Emamectin benzoate (TREE-äge)	Trunk injection (annual)	Designated by EPA as reduced-risk*, not highly toxic to woodpeckers*, provides higher/longer lasting protection against EAB**, found to be the most effective EAB insecticide treatment**	Can be harmful to non-target aquatic and terrestrial organisms (highly toxic to pollinators at certain concentrations) ⁑
Azadirachtin (TreeAzin)	Trunk injection	Botanically derived✲ , protection against EAB for 1-2 years*, not found toxic to bees, breaks down rapidly in water∗	Not toxic to EAB adults (but increases larval mortality, which limits adult emergence)*

*Hahn, J., Herms, D.A., McCullough, D.G. 2011. Frequently Asked Questions Regarding Potential Side Effects of Systemic Insecticides Used to Control Emerald Ash Borer. North Central IPM Center Bulletin. 2nd edition. 16 pp.
**Poland, T., McCullough, D., Ciaramitaro, T., Cappaert, D., Anulewicz, A. 2016. Evaluation of Systemic Insecticides to Control Emerald Ash Borer. USDA Forest Service Northern Research Station; [accessed 2017 Aug]. https://www.nrs.fs.fed.us/disturbance/invasive_species/eab/control_management/systemic_insecticides/
⁑ Durkin, P.R. Emamectin benzoate: Human Health and Ecological Risk Assessment, Final Report. 2010. USDA Forest Service, Southern Region; [accessed 2017 Aug]. https://www.fs.fed.us/foresthealth/pesticide/pdfs/052-23-03b_Emamectin-benzoate.pdf
✲ Cranshaw, W. 2014. Control Options for Emerald Ash Borer in Colorado. Colorado State University Extension; [accessed 2017 Aug]. http://bspm.agsci.colostate.edu/files/2014/02/EAB-control-options-February-11.pdf
∗ Pesticide Information Profile: Azadirachtin. 1995. Extension Toxicology Network; [accessed 2017 Aug]. http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/azadirachtin-ext.html

Because EAB symptoms are already highly visible throughout the City of Poughkeepsie, attempting to “save” the City’s ash by treating all or most of them with insecticides is not a viable option. Instead, we recommend that a few (5 or 6) choice ash trees be treated, while the City’s remaining ash are removed and replaced in a phased process. Each ash tree provides specific benefits based on its size, health, and location, and these factors should all be taken into account when choosing ash trees to treat. Ash trees chosen for treatment should be young but mature, seed-bearing, and healthy. Smaller ashes are also more likely to respond to systemic insecticide than ash trees with larger DBH measurements. Treatment is a multi-year process and can only be administered by certified professionals. Healthy ash trees that contribute significantly to the landscape aesthetics of public areas such as schools and churches, and which do not grow in close proximity to power lines or other utilities, are good candidates for insecticide treatment. The cost of insecticide treatment varies with the size of the tree, the number of trees being treated, and the type of insecticide used.

Phased Removal and Replacement

The majority of remaining ash trees should ultimately be removed and replaced in phases. Tree removal is a costly, time consuming, and labor-intensive process that requires thorough communication between City municipality workers and tree specialists. However, removal is the safest and most realistic EAB treatment option for the City of Poughkeepsie considering the extent of EAB damage - dead and/or dying trees have the potential to fall and damage homes and cars or injure passersby if not removed promptly. Trees that are clearly EAB-infested (red points) should be removed first and replaced with appropriate species (see below for list of recommended street tree species). Trees with the most severe symptoms of stress should be addressed next by close monitoring on a monthly basis for definite signs of EAB infestation. These should be removed and replaced in subsequent years following the first round of removal of the most severely EAB-damaged trees. All other street ash trees should continue to be monitored and removed and replaced as necessary based on the severity of damage, which is likely to worsen in the next few years.

In terms of replacement species, maximum urban forest diversity should be a goal in order to prevent future damage from other species-specific pests. Cornell Cooperative Extension describes a “10-20-30 Rule”, wherein they recommend that an urban forest should not consist of more than 10% of one species, 20% of one genus, and 30% of one family (Hargrave et al. 2010). Other criteria to be considered are tree height, canopy shape, growth rate, and whether a tree produces fruit (Cornell Cooperative Extension 2011). The following species have been selected from a list of recommendations by George Profous, Senior Forester with the New York State Department of Environmental Conservation, for street ash tree replacement. These trees are generally tolerant of changes in soil pH, moisture, and salt levels, and most are relatively small (<30 ft. in height). Information on each species was taken from Cornell University’s Woody Plants Database (2017). Options include:

- American smoketree - *Cotinus obovatus*
- Hackberry - *Celtis occidentalis*
- European Hornbeam - *Carpinus betulus* ('Fastigata' cultivar)
- American Hornbeam - *Carpinus caroliniana*
- Eastern Redbud - *Cercis canadensis*
- Black Locust - *Robinia pseudoacacia* ('Globe' cultivar)
- Common Honeylocust - *Gleditsia triacanthos* ('Imperial' cultivar)
- Japanese Tree Lilac - *Syringa reticulata* ('Summer Snow', 'Ivory Silk' cultivars)
- Hybrid Elm - *Ulmus 'Frontier'* (resistant to Elm Yellows, Dutch Elm Disease, and Elm Leaf Beetle)

Tree removal is a highly visible procedure and may confuse or concern residents who have ash trees on their blocks. For this reason, it is imperative that City of Poughkeepsie residents be informed of tree removal prior to its occurrence, through email, paper mailing, and/or other forms of announcement. Besides public, street ash trees, the City of Poughkeepsie is also home to many ash trees on private land. The treatment and removal of these private trees is outside of the City's jurisdiction and is solely the responsibility of homeowners. However, informational pamphlets and other materials, as well as public educational outreach events, can increase awareness of EAB among City residents and help inform decisions about treating privately owned ash trees.

After ash trees are cut down, ash wood can be used for lumber, firewood, or wood chip for landscaping (Coon 2007). However, EAB-infested lumber cannot be moved out of quarantine areas (see Fig. 2a).

EAB presence is widespread across the entire city of Poughkeepsie. It is too late to save most of the City's street ash trees with pesticide treatment, and the issue of removal and replacement must still be addressed promptly. Street trees are extremely ecologically, financially, and aesthetically valuable resources for urban areas, and the loss of the City's ash trees will be particularly detrimental. City municipal workers and residents alike should approach the EAB issue through active dialogues and careful monitoring of city ash trees. While treatment, removal, and replacement decisions are ultimately those for the City of Poughkeepsie municipality to make, this document serves as a recommendation for future actions concerning EAB infestation.

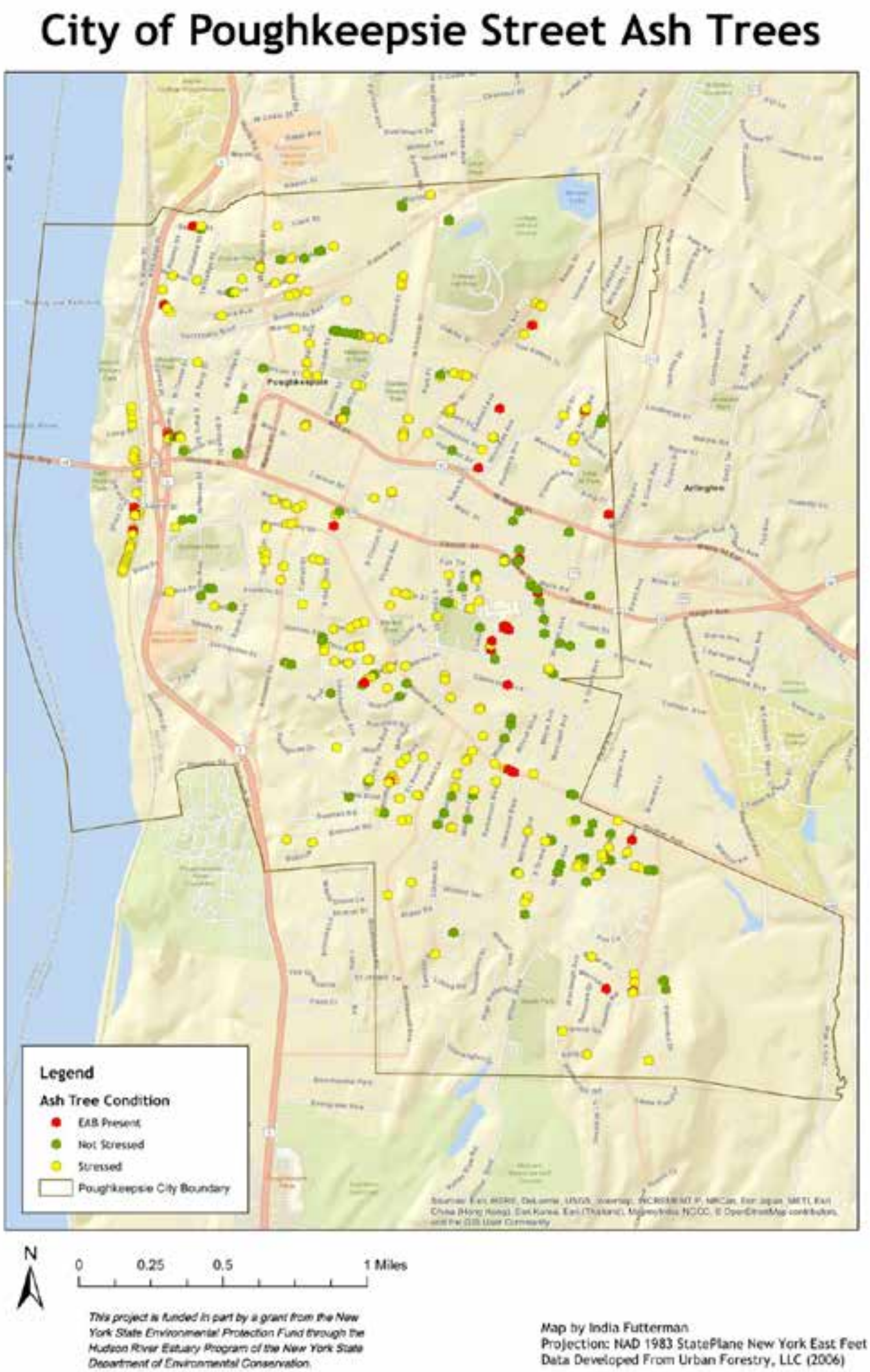

Fig. 7: City of Poughkeepsie Ash Tree Survey Map

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College Hill Park Invasive Species Survey

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Introduction

College Hill Park is located in the Northeast corner of the City of Poughkeepsie. It is one of the largest city-owned parks, and, at 386 feet above sea level, also the highest point in Poughkeepsie. The park is notable as a local historic landmark. The Guilford Dudley Memorial located at the top of the hill was built in the 1930s as part of the Works Progress Administration (Musso, 2015), and was placed on the National Register of Historic Places in 1982 (Wahlberg, 2016). On the Eastern slope of the hill, the Clarence Lown Memorial Garden was originally created in 1931 as a tribute to Lown, a Poughkeepsie resident and influential rock garden designer (Wahlberg, 2013). The garden was added to the Local Register of Historic Places in 2014 (Wahlberg, 2016). In 2015 the Revive College Hill Park Coalition began its revitalization of the overgrown garden, and installed a pollinator garden within a portion of the rock garden within. The Revive College Hill Park Coalition maintains this garden with the help of volunteers and the City Department of Public Works and plans to continue restoration of the rock garden in the near future. Abutting the park is the College Hill Golf Course, and to the Northeast is Morgan Lake. The park also contains a playground on its Western border by the North Clinton Street entrance, as well as a baseball field on the other side of the park near Smith Street. In 2017 College Hill Park was added to the Local Register of Historic Places.

Fig. 1.1 College Hill Park Dudley Memorial, photo by Camelia Manring.

While much of the Park is mowed lawn, there are remnants of forests. Much of the forested area has been invaded by a variety of invasive species ranging from vines to trees. For the purposes of this study, invasive species are defined as “non-native species that have been introduced to an area outside of its native range and causes economic or environmental harm or harm to human health” (National Invasive Species Information Center, 2016). The goals of this study were to not only assess the presence of invasive species at the park but to identify and locate “emerging” invasives, defined as species just starting to become established in localized parts of Poughkeepsie (Invasive Species Categorization for the Lower Hudson). This survey was conducted to facilitate and inform a future management plan for College Hill Park

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which will help to preserve and restore some of the park's history, beauty, and its general ecological health.

Methods

This survey was completed over the course of two days (July 26-27, 2018). The data was collected at College Hill Park using an iPad with a Bad Elf GPS Lightning Connector. The iPad was preloaded with a survey of the park using the application, Survey 123 (ESRI 2018).

The points to be surveyed were determined by overlaying a 50-meter grid on an aerial image of College Hill Park. Any points located entirely within mowed lawn, water features, or points in inaccessible locations of the park due to construction, were removed. The remainder of the points were surveyed for predetermined common and emerging invasive species (Table 2.1).

The following information was recorded at each survey point: observers, date, plot number (assigned chronologically based on order of completion), common invasives, emerging invasives, site photo (taken facing North), additional comments, and the GPS coordinates for the plot center. Figure 2.1 illustrates the layout of the Survey 123 application throughout the process of data collection.

Table 2.1 Emerging and Common Invasives for CHP Survey (Finley, 2018) (New York iMapInvasives, n.d.)

EMERGING INVASIVES

Common Name	Scientific Name
Amur Corktree	*Phellodendron amurense*
Black Alder	*Alnus glutinosa*
Black Swallow-wort	*Cynanchum louiseae*
Border Privet	*Ligustrum obtusifolium*
Castor Aralia	*Kalopanax septemlobus*
Chinese Privet	*Ligustrum sinese*
Chocolate Vine	*Akebia quinata*
Climbing Spindle Tree	*Euonymus fortune*
Common Star-of-Bethlehem	*Ornithogalum umbellatum*
Cup Plant	*Silphium perfoliatum*
Dog-Strangling Vine	*Cynanchum rossicum*
Giant Hogweed	*Heracleum mantegazzianum*
Hardy Kiwi	*Actinidia arguta*
Japanese Angelica Tree	*Aria elata*
Japanese Hop	*Humulus japonicas*

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Japanese Knotweed	*Fallopia japonica*
Japanese Virgin's Bower	*Clematis terniflora*
Japanese Wisteria	*Wisteria floribunda*
Jetbead	*Rhodotypos scandens*
Kudzu	*Pueraria montana*
Large Gray Willow	*Salix atroinerea*
Linden Viburnum	*Viburnum dilatatum*
Mile-a-Minute	*Persicaria perfoliata*
Oriental Photinia	*Photinia villosa*
Perennial False-Brome	*Brachypodium sylvaticum*
Russian Olive	*Elaeagnus angustifolia*
Sapphire Berry	*Symplocos paniculata*
Siberian Elm	*Ulmus pumila*
Siebold's Viburnum	*Viburnum sieboldii*
Smooth Buckthorn	*Rhamnus frangula*
St. Andrew's Cross	*Hypericum hypericoides*
Sticky Sage	*Salvia glutinosa*
Sweet Cherry	*Prunus avium*
Sycamore Maple	*Acer pseudoplatanus*
Wild Parsnip	*Pastinaca sativa*

COMMON INVASIVES

Common Name	Scientific Name
Amur honeysuckle	*Lonicera maackii*
Buckthorn	*Rhamnus cathartica*
Cow Vetch	*Vicia cracca*
Crown Vetch	*Securigera varia*
Japanese barberry	*Berberis thunbergii*
Japanese stiltgrass	*Microstegium vimineum*
Morrow's honeysuckle	*Lonicera morrowii*
Mugwort	*Artemisia vulgaris*
Norway Maple	*Acer platanoides*
Multiflora rose	*Rosa multiflora*
Oriental bittersweet	*Celastrus orbiculatus*
Porcelain berry	*Ampelopsis brevipedunculata*
Toringo crabapple	*Malus sieboldii*
Tree of Heaven	*Ailanthus altissima*

(Finley, List of emerging and common invasive species for the Vassar Farm and Ecological Preserve, 2018), (New York iMapInvasives, n.d.)

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The following protocol was completed at each survey point (Finley & VanCamp, 2018):

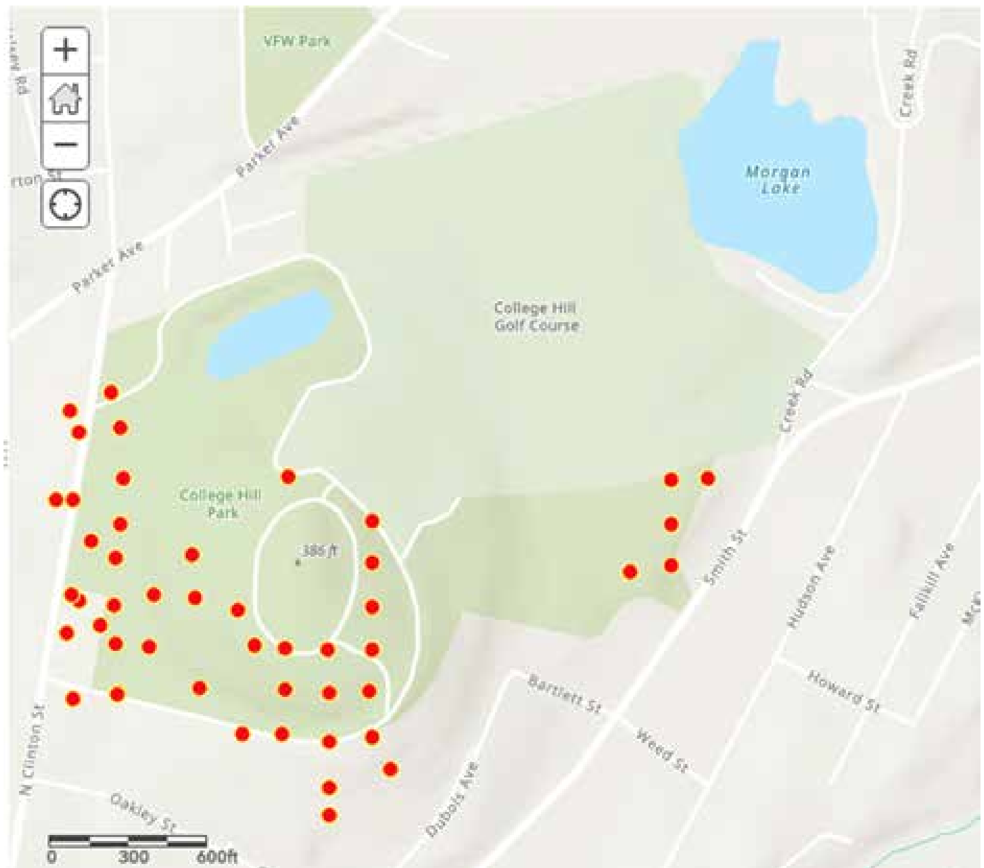
1. Using ArcMap, a 50-meter grid was placed over the forested areas on College Hill Park. Survey points are located at the center point of each grid.
2. The survey points and the survey form were loaded into the application, Survey 123. The survey was conducted using the Survey 123 app on iPads that have a Bad Elf GPS receiver added for increased accuracy.
3. The Survey 123 application was used to navigate survey points, and when the survey point is reached, the GPS coordinates are saved in the Survey 123 application.
4. At each survey point, a circle with a 5-meter radius was measured out.
5. Within this five-meter radius, observations of all nine common invasive plant species were made. An observation includes clicking the appropriate cover class (0.1-25%, 25-50%, 50-75%, 75-100%) and taking a site photograph to the North. The default category was “not present”.
6. The names of the observers, the plot number, and any additional comments are also entered into the observation.

Fig. 2.1 Survey 123 layout

7. Within this five meter radius, observations of all emerging invasive plant species were made. An observation included measuring the patch size (in square meters) or number of individuals, and a photograph of the plant.
8. From each observed instance of an emerging plant species, the radius of the circle was increased by five meters. If another emerging invasive was found in this new area, the survey radius was expanded by an additional five meters. This process was continued until a distance of 25 meters away from the center of the circle was reached.
9. Each survey point entry also included the following information:
    a. Date and time;
    b. Names of observers;
    c. GPS coordinates;
    d. Additional observations; and
    e. Photo of survey point facing North.
10. Opportunistic sampling of emerging invasives occurred if encountered when traveling between points. If encountered, an entry was made in the Survey 123 app. An

observation included measuring the patch size (in square meters) or number of individuals and a photograph of the plant.

After the data was collected on Survey 123, it was uploaded to ArcGIS Online. The ArcGIS Online version is available at https://arcg.is/1LK8vW, and a copy is included below in Figure 2.3. It is important to note that the actual surveyed points are not exactly aligned with the overlaid 50-meter grid. This is due to the inconsistency within the Bad Elf GPS and due to the physical impossibility of accessing the exact plot center at some of the plots.



5

Fig. 2.3 Surveyed points at College Hill Park

III: Results

There were a total of 48 plots surveyed. Eight of the 48 plots surveyed had no invasives, and of those eight plots, five were majority mowed lawn and one was a wetland. Therefore, two forested plots sampled did not have invasives present. Based on this survey, the three most abundant common invasives at College Hill Park are Oriental bittersweet, Norway maple, and tree of heaven. Oriental Bittersweet was present in 25 plots, and on average it covered 30% of the plot in which it was found. Norway maple was present in 21 plots and, on average, covered 52.94% of the plot in which it was found. Tree of heaven was found in 13 plots and, on average covered 25% of the plot in which it was found. The chart below shows the frequency and distribution of all surveyed common invasives at College Hill Park. In the chart, the plants were sorted from highest abundance to lowest abundance, which is based on the number of plots where a species was observed. The rankings of the most frequently occurring invasive were based on abundance rather than average percent cover because it facilitates an understanding of the distribution of the invasive species in the park, which ultimately is more useful in the management of invasive species.

Species Name	Abundance (# of plots)	Average Percent Cover
Oriental Bittersweet	25	30%
Norway Maple	21	52.94%
Tree of Heaven	13	24%
Porcelain Berry	12	N/A*
Multiflora Rose	12	25%
Buckthorn	11	27.27%
Toringo Crabapple	8	25%

6

Amur Honeysuckle	3	33.33%
Cow Vetch	3	<25%
Crown Vetch	3	<25%
Japanese Barberry	2	37.5%
Japanese Stiltgrass	2	<25%
Mugwort	1	<25%

*Observers recorded data on Porcelain Berry location and percent cover, yet ESRI Software failed to record Porcelain Berry percent cover observations in Survey 123. Although the percent cover data for Porcelain Berry is not available, the locations of Porcelain Berry were retained by Survey 123 and ESRI software, which is still useful to understand the occurrences of the invasive vine. Porcelain Berry found in plots #5, 9, 10, 14, 15, 20, 22, 23, 27, 28, 29, and 30.

Emerging invasives at College Hill Park occur less frequently than common invasives, and the only two emerging invasives found were black swallow-wort and Japanese knotweed. Japanese knotweed was found in seven plots, and in those plots its patch size ranges from as small as 1 square meter to as large as 30 square meters, and the average patch size is 15.5 square meters. All of the occurrences of Japanese knotweed were found near sites of human disturbances such as a newly added fence or near/on dumping grounds.

While a significant amount of Japanese knotweed was found in the park, black swallow-wort is much less abundant than Japanese knotweed, and it was only found in one plot. In the plot where the black swallow-wort was found, the patch size was four square meters. However, just like Japanese knotweed, black swallow-wort was discovered near a site of human disturbance, as it was growing on a fence adjacent to the North Clinton Street entrance.

The map below (Figure 3.1) depicts the spatial distribution and frequency of occurrence of the three most abundant common invasives and the two emerging invasives found at College Hill Park. The series of inset maps was created using ArcGIS. It includes one inset map with the GPS coordinates of all the surveyed points, one map of black swallow-wort patch sizes and locations, one map of Japanese knotweed patch sizes and locations, and it includes maps of the three most abundant common invasives and their locations and percent covers (Norway maple, tree of heaven, and oriental bittersweet).

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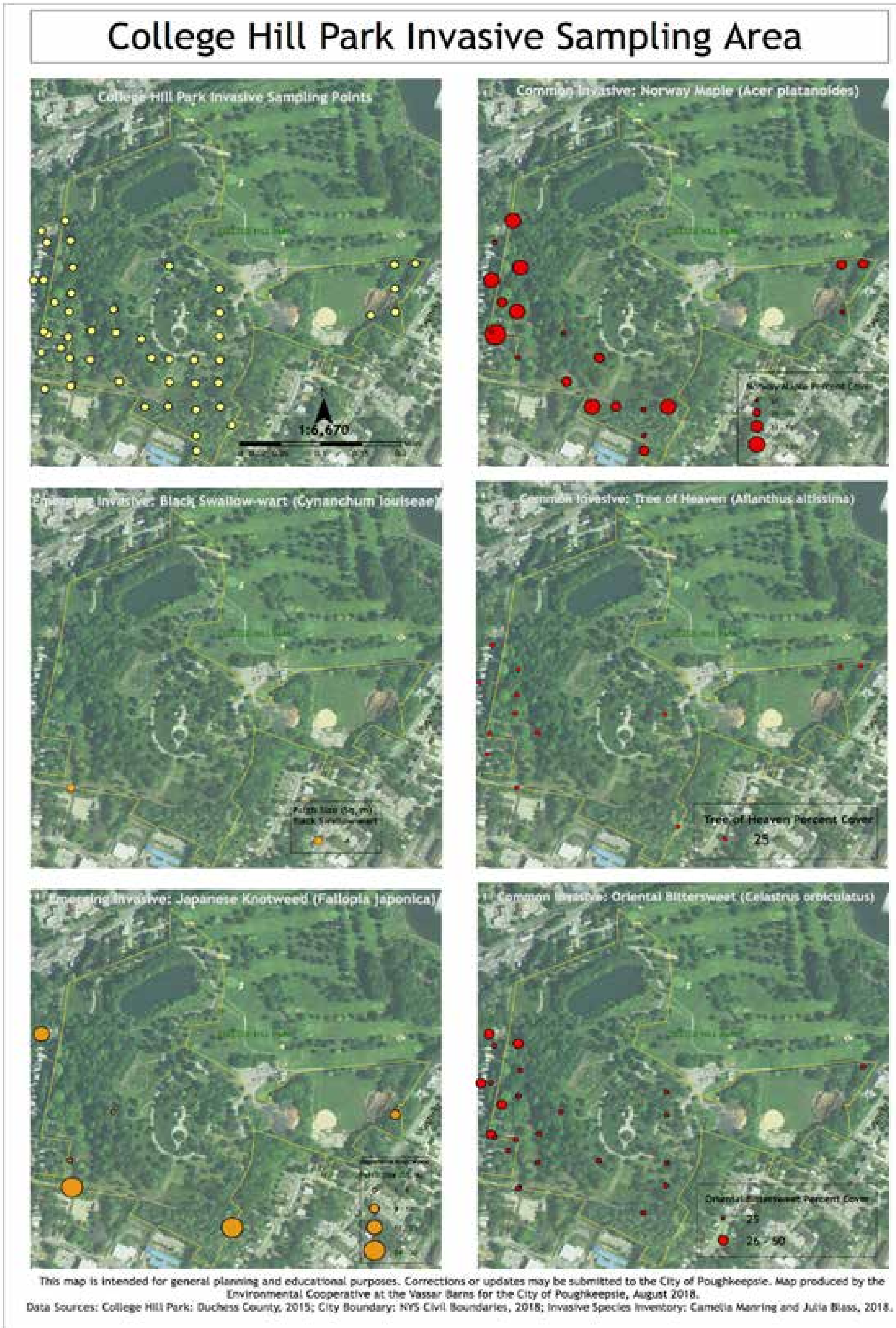

9 Fig. 3.1 Inset maps of College Hill Park, common and emerging invasives.

Additionally, it is also important to note that of the five points surveyed in the eastern-most edge of the park, the three southern-most points in that group (Object ID 44-46) were found to be in undocumented wetlands. Based on examination of 2016 aerial photos as well as existing wetlands data, it seems that this particular wetland has not been noted in existing data sets for the City. Additional on-site surveys will be needed in order to determine the exact extent, health, and permanence of the wetland.

IV: Discussion

The results of this survey indicate that the park is dominated by invasive species. Only a few plots contained no invasive species, and these plots were either mostly, or entirely, mowed grass or wetlands. The most prolific invasive species in the park were porcelain berry, oriental bittersweet, Norway maple, and tree of heaven. Two emerging invasive species were identified: Japanese knotweed and black swallow-wort. The one occurrence recorded of black swallow-wort is in a plot where both of these species were found together, but patches of Japanese knotweed were found in many different areas of the park, both around the edges and in the middle away from the road and surrounding houses.

It is important to note that in 2016 and 2017, based on the iMapInvasives database (imapinvasives.org), Kudzu (*Pueraria montana*) was found at College Hill Park. This survey did not find the plant but it is important to be aware that the plant may be established on the park property[1].

College Hill Park has been identified as a significant habitat area in the City of Poughkeepsie, containing a variety of habitats including upland forests and shrubland (Heffernan & Stevens, 2018). As a large tract of open space, the park is providing important ecosystem services such as stormwater abatement, pollution filtration, urban heat island amelioration, habitats, and recreational opportunities (Bolund and Hunhammar, 1999). Management focused on invasives at College Hill Park should include 1) eradicating the emerging invasives identified in this study and focusing on common invasives in specific areas of the park 2) protecting large mature shade trees, and 3) replacing trees that are in decline, especially Ash trees that will be affected by the Emerald Ash Borer.

- [1] From the iMapInvasives database: Kudzu (2016 & 2017) – Records from Dutchess CCE and Trillium ISM (Private Company) – “College Hill Park Lot S of 7 Reservoir Rd. College Hill Park Exit Road, near North Clinton Street. Along exit road, less than 1/10 mile from Parker Ave. Plants growing on a fence right behind some houses and then 50 feet later up among some trees.” TREATMENT STATUS – UNKNOWN.

Emerging invasives pose a threat to the health of ecosystems at College Hill Park. They are primarily found along the borders of the park and isolated patches. Removing and managing these species before they further invade the park is possible. Additionally, the plots where emerging invasives were found are somewhat isolated and not close to each other. Both Japanese knotweed and black swallow-wort are generally still on the fringes of the park and were only found in a combined total of seven plots. The management of these species at College Hill is attainable and should be a priority.

Efforts to remove common invasives may seem daunting but can be considered on a microscale within the park. There are currently several specific areas within the park where general management of invasives should be prioritized. These are the Clarence Lown Memorial Garden, the pollinator meadow on the west slope of the Victorian Reservoir that will be planted in spring of 2019, the area surrounding the Dudley Shelter at the top of the hill and the adjacent memorial, and landscaping that will be planted around the newly installed water tanks.

Mature trees that provide shade are extremely important when considering the management of invasives, especially invasive vines such as oriental bittersweet and porcelain berry. These two invasives (and many others identified at the park) thrive in areas where there is a lot of light. Vines such as oriental bittersweet climb into the canopy of trees. This extra weight at the top of the tree makes the tree more susceptible to windthrow, breakage, and tree death. Gaps caused by broken or fallen trees create light gaps that allow the spread of more invasives. There are many large, old trees at College Hill Park. As these trees begin to decline due to natural factors as well as insect pests such as the Emerald Ash Borer, it is important that the City of Poughkeepsie replants the park with more trees. Management of shade trees at College Hill Park in an important step in managing for invasive species. Trees that are currently invaded with vines can be saved, and protocols exist for the proper cutting and treatment of vines (Gover, 2013). A tree inventory within the park is a needed first step to properly plan for the maintenance and replanting of trees within the park.

V. Conclusion

College Hill Park is one of the largest open spaces in the City of Poughkeepsie and has the potential to be a biodiversity hotspot. Within its boundaries, there are lawns, meadows, shrubland, forests and aquatic habitats. Invasive species decrease biodiversity by out-competing native species and creating monocultures of only a few species. Along with a decrease in biodiversity comes a decrease in the ecosystems ability to function in ways that support healthy communities and resilience to global changes (Heffernan & Stevens, 2018). Managing invasive species in the park is an important way to minimize the loss of biodiversity.

Long term impacts of invasive species eradication have been shown to create a more complex forest structure with an increase in the recruitment of native trees (Johnson & Handel, 2016). Focusing on emerging invasives and priority areas is a manageable strategy for beginning this effort at College Hill Park.

VI. Additional Resources

NYS Department of Environmental Conservation - Rapid Response and Control Grant Program. This program provides funding for projects that target the eradication of both terrestrial and aquatic invasive species. A potential opportunity to receive this funding may exist at college Hill park. https://www.dec.ny.gov/pubs/110383.html

NYS Department of Environmental Conservation – Partnerships for Regional Invasive Species Management (PRISM). Regional partnerships that focus on disseminating information and managing invasive species. https://www.dec.ny.gov/animals/47433.html.

Penn State College of Agricultural Sciences, Wildland Weed Management – Outreach Publications. A compilation of fact sheets focused on the specific control recommendations for many common invasive species. https://plantscience.psu.edu/research/labs/weed-ecology/research/wildland-weed-management/publications.

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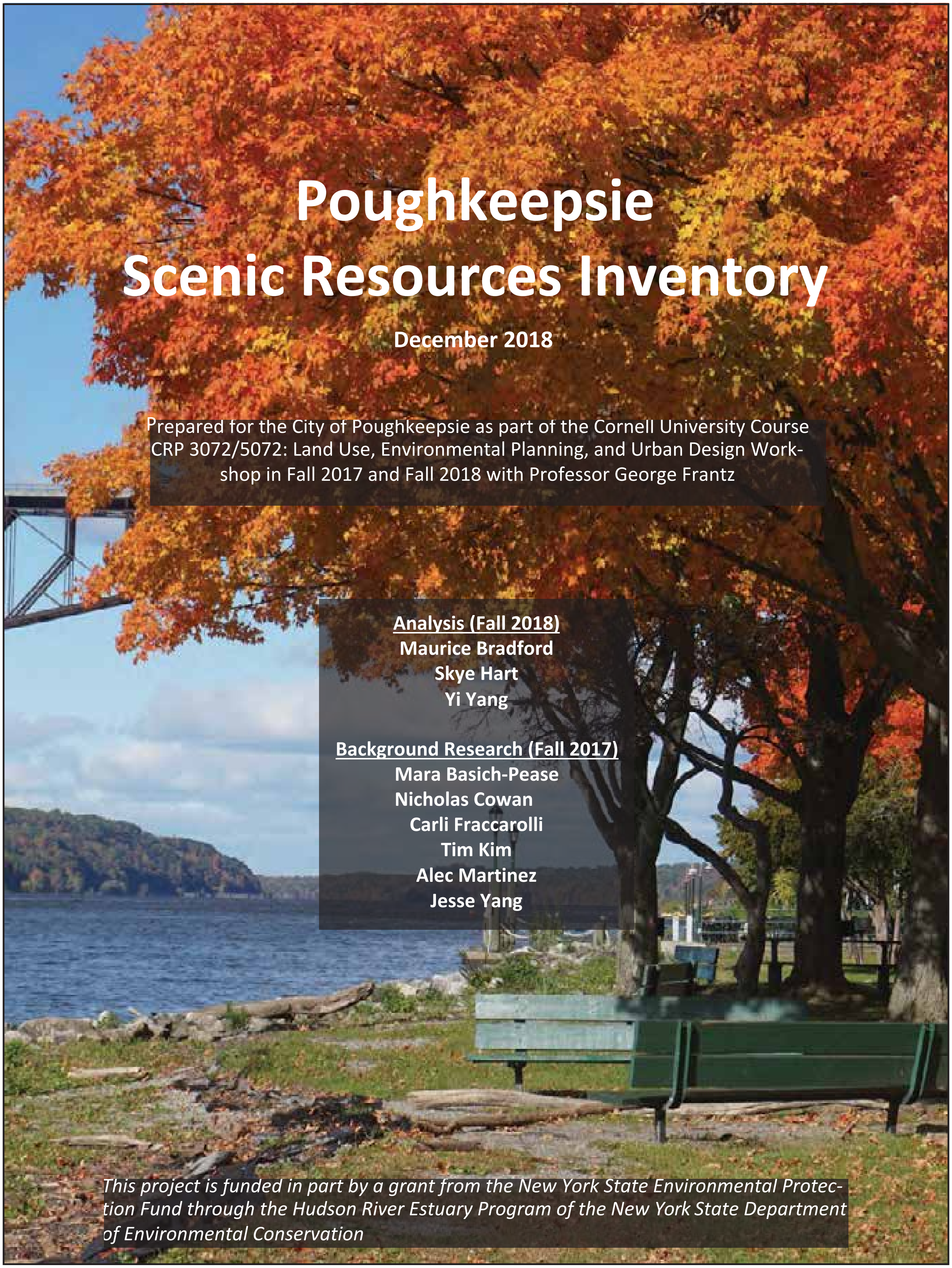

Poughkeepsie Scenic Resources Inventory

December 2018

Prepared for the City of Poughkeepsie as part of the Cornell University Course CRP 3072/5072: Land Use, Environmental Planning, and Urban Design Workshop in Fall 2017 and Fall 2018 with Professor George Frantz

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Table of Contents

INTRODUCTION

This report identifies potential scenic resources in the City of Poughkeepsie. Based on each parcel's unique circumstances, they can be highlighted as community assets, better maintained, and/or protected from development or change. Several site visits, a public survey conducted in fall 2017, and GIS data analysis served as the contextual framework in which the project was conducted.

Due to time, data, and constraints in gaining access to some properties, there may be issues with the identifications and recommendations made in this inventory. That being acknowledged, the project surveyed Poughkeepsie for scenic resources, which are public assets of visual or aesthetic contribution. These potential resources were identified and scored based on whether they possess environmental, historic, recreational, and cultural qualities.

DEMOGRAPHICS[1]

The City of Poughkeepsie, a relatively dense urban area, lies on the western shore of the Hudson River, about seventy-five miles north of New York City in the mid-Hudson Valley. Covering 5.14 square miles, it is one of two cities within

Dutchess County, and it is surrounded by the larger town of Poughkeepsie.

[1] U.S. Census Bureau. "City of Poughkeepsie."

Population

As of 2017, the U.S. Census Bureau estimates the City of Poughkeepsie's population at just over 30,000 people. Poughkeepsie's population grew rapidly from 1900-1950 but peaked around 1950 with 41,000 residents. Between the 1950s and the 1980s, the City's population declined, likely due to a series of factors including the forces of deindustrialization. Poughkeepsie's population has been consistently near 30,000 since that decline.

Year	Population	Percentage Change
1860	14,726	27.9%
1900	24,029	8.2%
1950	41,023	1.3%
1960	38,330	-6.6%
1980	29,757	-7.1%
2000	29,871	3.6%
2010	32,736	9.6%
2016*	30,267	-7.5%

* Census Bureau 2016 estimated population.

Housing & Education

Around 80 percent of residents have obtained at least a high school diploma, while 23% have obtained a college degree. The employment sector for Poughkeepsie residents is dominated by educational services, health care, and social assistance, bolstered by the presence of three higher education institutions in the city or larger town: Vassar College, Marist College, and Dutchess Community College. In total, these colleges add a student population of 19,253 during instruction. Further, because of these colleges, the rate of renting is much higher. Of the 13,984 total households, the percentage of owner-occupied housing was around 35 percent. From 2012-2016, the median value of owner-occupied housing units was $193,100, while the median gross rent from the same time period was $1,033.

Income Levels

Compared with the Town of Poughkeepsie and New York State, the City of Poughkeepsie's median household income is significantly lower. While the Town of Poughkeepsie averaged a median income of $71,584 from 2012-2016 and New York State averaged a median income of $60,850 in those years, the City of Poughkeepsie averaged a median income of $39,067.

Land Use

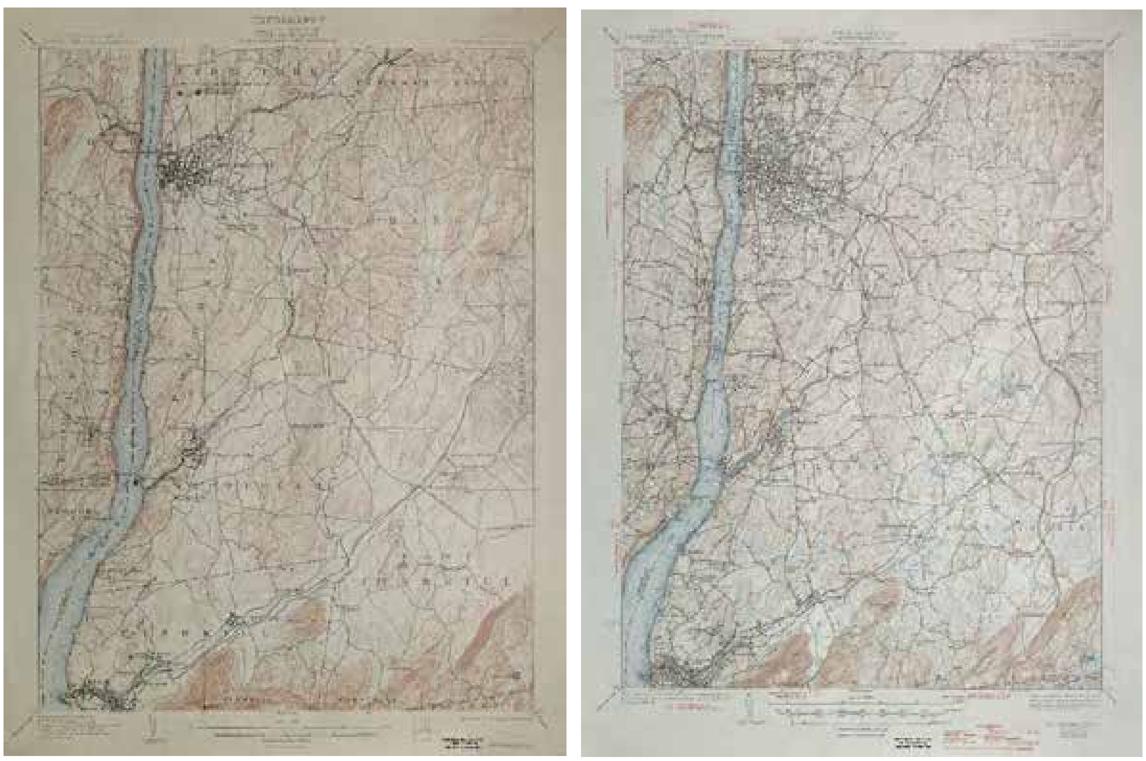
Land use trends have evolved along with the development of industry. While the city currently retains a density of 5,890 persons per square mile, the density has fluctuated from around 4,500 persons per square mile in 1900, peaking in 1950 closer to 8,000, and settling back down to densities between 5,800 and 6,400. The changing densities also align to the

zoning outlined within the historic comprehensive plans, expanded upon in the section titled "Prior Planning Initiatives."

BRIEF HISTORY

Poughkeepsie is located on the homelands of the Wappinger, a community that is part of the Lenape Nation. Demographics, settlement patterns, and land use practices changed when British and Dutch settlers colonized the area in the late 17th century.[2] The colonizers chose to settle in what is currently Poughkeepsie because of its strategic location between two existing major cities, Albany and New York. This, along with Poughkeepsie's closeness with the river, made it a sensible stop for traders between the two cities.[3] The town was "officially" founded in 1687 when a few settlers were issued a land patent by the governor of the colony of New York.[4]

The maps below from 1903 and 1943, respectively, show the region as it developed over the years. The growth of the City of Poughkeepsie is especially prominent. Technological advancements



1903 Poughkeepsie Topography Map (Left) &1943 Poughkeepsie Topography Map (Right)

[2] Diaz, Michael. "A Short History of Poughkeepsie's Upper Landing." *Poughkeepsie Upper Landing Park*. Chapter 1: Native Americans, the Dutch, and the English. Web. Accessed 8 Oct. 2017.

[3] Palaia, Joe. "History of Poughkeepsie." *The Hudson River Valley Institute*. McManus Library, Marist College. Web. Accessed 8 Oct. 2017.

[4] Diaz, Michael. "A Short History of Poughkeepsie's Upper Landing."

like the Hudson River Railroad, which opened in 1851, and the automobile much later, solidified Poughkeepsie's trader economy and helped turn it into a suburb of New York City.[5]

However, the establishment of major universities like Vassar College and Marist College, and the later location of IBM in the town helped transform the demographic of Poughkeepsie to be a more educated and independent city.

PAST AND PRESENT PLANNING INITIATIVES

The City of Poughkeepsie has released multiple city plans, stormwater management programs, and waterfront redevelopment initiatives over the past 20 years.

Comprehensive Plans

In 1998, The Chazen Companies and Rapport, Meyers, Whitbeck, Shaw, and Rodenhausen, LLP, published the City of Poughkeepsie Comprehensive Plan that proposed strategies for policy and capital improvements and established a program for development of the city.[6] In 2007, the County of Dutchess and the City of Poughkeepsie, along with Saccardi & Schiff, Inc., released the 2008-2012 Consolidated Plan.[7] This plan set forth both housing and community development needs in one document and established priorities and strategies for meeting identified needs, consistent with available funding sources. Finally, in 2012, Dutchess County and the City of Poughkeepsie released the 2013-2017 Consolidated Plan, which is a comprehensive document promoting a coordinated approach to housing and community needs, and fostering the coordination of all programs funded by the U.S. Department of Housing and Urban Development (HUD).[8] These plans, along with the other plans that follow, outline the history and vision for the future of the City of Poughkeepsie.

Other Plans Related to the Project

1) Poughkeepsie Waterfront Redevelopment Strategy (2015): The Waterfront Redevelopment Strategy is a comprehensive action plan for revitalizing the Hud-

[5] Palaia, Joe. "History of Poughkeepsie."
[6] The Chazen Companies, and Rapport, Meyers, Whitbeck, Shaw, and Rodenhausen, LLP. "City of Poughkeepsie Comprehensive Plan." Nov. 1998.
[7] Dutchess County, et al. "County of Dutchess & City of Poughkeepsie 2008-2012 Consolidated Plan." July 2007.
[8] Molinaro, Marcus J., et al. "2013-2017 Dutchess County and City of Poughkeepsie Consolidated Plan ." July 2015.

son River waterfront with a focus on its connectivity to the city of Poughkeepsie.[9] Goal statements include: "(i) Build a continuous Greenway Trail along the riverfront; (ii) Knit together surrounding City plans, projects, and neighborhoods; and (iii) Create a high-quality waterfront park and regional destination center between Main Street, the Railroad Station, and Walkway Elevator." As these scenic resources inventory (SRI) catalogues scenic resources within the city, it is impossible to ignore the prominence of the Hudson River waterfront as both a macro- and micro- landscape.

2) Poughkeepsie City Center Revitalization (PCCRP) Plan (2014): The PCCRP works to enhance the existing functions of Poughkeepsie's City Center, increasing walkability while preserving the historic main street, government offices, and mixed use zoning.[10] The Plan works to "generate planning concepts and implementation strategies to help reassert Poughkeepsie as the economic and cultural center of the Hudson Valley," relevant to scenic resources as a cultural asset. Further, as the Plan addresses "enduring concerns about building vacancy, crime, public safety, open space, and underutilization of land," it works parallel to the enhancement of open space within the most central district of the city.

3) The Poughkeepsie Innovation District (PID) Plan (2018): The PID is a plan to revitalize the core commercial section of downtown Poughkeepsie and transform it into an economic center that features an artistic/historical, attractive, and pedestrian-friendly design. Currently, the area is in economic decline, which contributes to the persistence of unemployment in the city, causes an increase in vacant and abandoned properties, and explains the city's problem of great urban poverty. The plan hopes to solve such issues, as well as several others, by stimulating a creative economy through public and private funding that enhances the local historic and art features; reduces automobile dependency to assert an eco-friendly and pedestrian-oriented character; enhances diversity and inclusivity with mixed-income housing; and repurposes vacant buildings to support Poughkeepsie's applied art industries.[11] With these

[9] City of Poughkeepsie Common Council, et al. "Poughkeepsie Waterfront Redevelopment Strategy." May 2015.
[10] Kevin Dwarka LLC. "Poughkeepsie City Center Revitalization Plan." Mar. 2014.

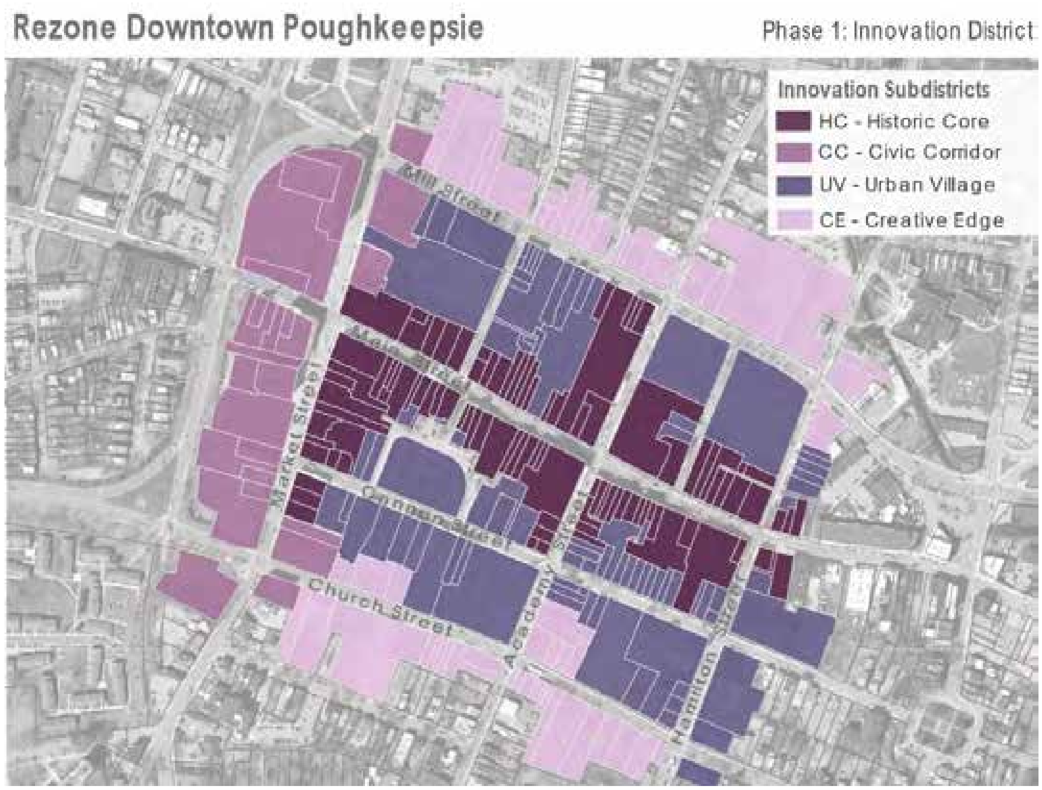
[11] Kevin Dwarka LLC. "Poughkeepsie Innovation District." Nov. 2017.

program elements in mind, the plan aims to channel economic growth back into Poughkeepsie's Central Business District (CBD), which would increase its tax base. This would help provide the funding necessary to afford to eliminate the City's social and economic problems.

EXISTING REGULATORY STRUCTURE

Existing Zoning Categories

Based on the Dutchess County Department of Planning and Development's "City of Poughkeepsie Zoning Map" (2015), the City of Poughkeepsie has 25 different zoning districts, listed below.[12] Many of these districts have been in place since zoning laws began in Poughkeepsie and reflect land use patterns established during the 1930s through the 1960s.



Proposed District Concept

C-1, NEIGHBORHOOD COMMERCIAL

C-2, RESEARCH AND DEVELOPMENT

C-2A, MAIN STREET COMMERCIAL

C-3, GENERAL COMMERCIAL

[12] Dutchess County Department of Planning and Development. "City of Poughkeepsie Zoning Map." Dec. 2015.

H-M, HOSPITAL MEDICAL

I-1, LIGHT INDUSTRIAL

I-2, GENERAL INDUSTRIAL

O-R, OFFICE RESIDENTIAL

PRD, PLANNED RESIDENTIAL DEVELOPMENT

R-1, LOW-DENSITY RESIDENCE

R-2, MEDIUM LOW-DENSITY RESIDENTIAL

R-2A, CENTRAL LOW DENSITY

R-3, MEDIUM-DENSITY RESIDENCE

R-3A, CENTRAL MEDIUM DENSITY RESIDENTIAL

R-4, MEDIUM HIGH-DENSITY RESIDENTIAL

R-4A, CENTRAL URBAN DENSITY RESIDENTIAL

R-5, HIGH-DENSITY RESIDENCE DISTRICT

R-6, URBAN DENSITY RESIDENCE

R-D, RESEARCH & DEVELOPMENT

T, TRANSPORTATION CENTER

W, WATERFRONT

WTOD, WATERFRONT TRANSIT ORIENTED DEVELOPMENT

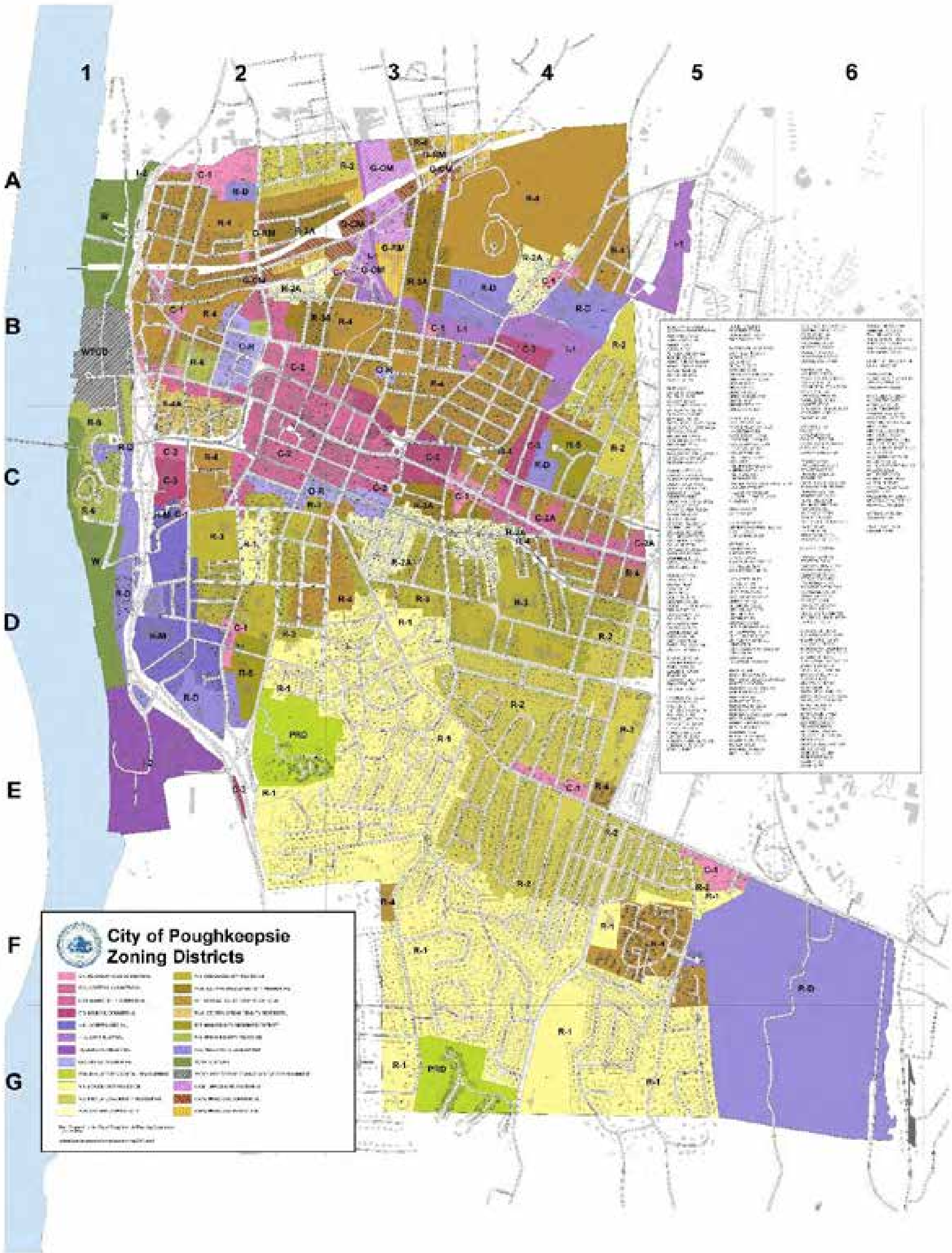
G-OM, WALKWAY-GATEWAY OFFICE MANUFACTURING

G-CM, WALKWAY-GATEWAY MIXED-USE COMMERCIAL

G-R M, WALKWAY-GATEWAY MIXED-USE RESIDENTIAL

In general, low-density residential districts are located at the outskirts of the City to the south, with higher density residential districts and commercial districts located closer to Main Street, the arterials, and Route 9. Limited neighborhood commercial districts dot the city and serve local retail needs but are scarce to none in the south and southwest parts of the city. Industrial zones are located at the northern and southern end of the waterfront, and along the Conrail spur in the Cottage Street business area, remnants of a time when industry relied upon major waterways and railroads for transportation of goods.[13]

[13] The Chazen Companies, and Rapport, Meyers, Whitbeck, Shaw, and Rodenhausen, LLP. “City of Poughkeepsie Comprehensive Plan.”



The map shows the most recent zoning districts for the City of Poughkeepsie.

The City of Poughkeepsie most recently adopted the new Walkway-Gateway district (G-OM, G-CM, and G-RM) to expand mixed-use land cover including retail, residential, and restaurants. This is to encourage other land uses in an area that is currently primarily industrial.[14]

LAND USE DISTRICTS

Much of the existing land use in the City of Poughkeepsie can be found in the zoning map above.

Not included in the zoning map are existing historical and cultural resources. Added to the National Register of Historic Places in 1976, the Poughkeepsie Train Station was built in 1850 and has since served as a hub for commuters traveling into New York City. The Bardavon 1869 Opera House, currently serving as a performing arts center, is also listed on the National Register of Historic Places. The theater, located in downtown Poughkeepsie, was built in 1868 and has hosted bands, famous public figures such as Andrew Carnegie, and Broadway test productions. Finally, the Poughkeepsie Underwear Factory, a 22,000-square-foot property on N. Cherry Street, is a historic site that was visually appealing to a few of the 2017 survey respondents. This 143-year-old building is now business space, a home to the Mid-Hudson Heritage Center, and a space used for activities and after school programs related to the arts. All historical sites included in our models can be found in Table 1 of the appendix.

Other cultural and historic sites mentioned by the 2017 survey respondents include Adriance Memorial Library, Schatzi's Pub, Changepoint Church, and the Poughkeepsie Civic Center.

EXISTING ECOLOGICAL RESOURCES AND OPEN SPACE

The City of Poughkeepsie sits on the banks of the Hudson River, which has fueled settlement and economic development for centuries. This river provides critical habitat for endangered animals and supports a diversity of life. The Hudson River is the largest body of water within the City of Poughkeepsie, but there are also some small ponds and lakes such as those in College Hill Park, as well as rivers and streams that run through the city.

Fall Kill creek flows through Poughkeepsie's Northside neighborhood. A major stream in the city, this creek offers recreation, sightseeing, and connectivity throughout the city. However, the creek is polluted and is featured on the New York State Priority Waterbodies List as a "Class C" stream, meaning it is safe for fishing but not for swimming. Significant problems in the creek include high fecal coliform counts, high

[14] Clarke, John. "Converting Conventional Zoning to Form-Based Codes." Plan On It: A Dutchess County Planning Federation eNewsletter. Nov. 2013. Web. Accessed 17 Dec. 2017.

contaminant and nutrient levels (nitrate, phosphate, sulfate, heavy metals, and hydrocarbons), high temperatures due to a sparse tree canopy, and deficient oxygen levels.[15]

The City of Poughkeepsie has multiple parks within city boundaries, notably Kaal Rock, Waryas, and College Hill Parks. Waryas and Kaal Rock Parks are located along the riverfront, while College Hill Park is located in the northeastern corner of the city. Many of our survey respondents (Table 2) stated that they enjoyed spending time in these and other parks and green spaces within the city.

Waryas Park consists of 9 acres of green space at the foot of Main Street along the Hudson River. Highlights of the park include a three-part whale sculpture with contributed mosaic tiles, picnic tables, outdoor grills, a pavilion, a children's playground, public restrooms, a boat launch, a dock, and a nearby restaurant. Close to Waryas Park with similar attractions is Kaal Rock Park, also along the riverfront.

College Hill Park, one of our survey sites, is one of the largest open spaces in the City of Poughkeepsie. It also has an intriguing past. Once home to the Collegiate School on College Hill (the park's namesake) and later a hotel, the land is now a public park with a monument to commemorate its history as the site of a college during the 19th century.

Finally, the Vassar Farm is one of few open spaces in the City of Poughkeepsie. Situated on 527.5 acres, this land was once a working farm providing milk, pork, and vegetables to the college dining halls until 1957. Now, the farm

[15] Hudson River Sloop Clearwater, Inc, and Fall Kill Watershed Committee. "A User's Guide to the Fall Kill Creek." 2012.

serves as an ecological preserve for study and research, and currently provides wooded trails, open meadows, sports fields, and space for several organizations.

SURVEYS

Over the weekend of October 14, 2017, students traveled to Poughkeepsie and surveyed residents in three locations: College Hill Park, along Main Street, and along the waterfront. They asked each respondent the following four questions:

1. Where do you go to relax and enjoy the scenery in Poughkeepsie?
2. Where are the best views in Poughkeepsie?
3. What places would you tell a tourist to go visit in Poughkeepsie?
4. What do you value about living in Poughkeepsie?

These questions, along with a brief collection of demographic data about each survey respondent (age, gender, and where they live), gave the Fall 2017 team a starting point to determine what scenic resources were valued in Poughkeepsie.

With approximately 60 responses, we made a list of each response to our survey and quantified how many times a location was mentioned. Overall, the top responses were the waterfront, the Walkway over the Hudson, and College Hill and Waryas Parks. These responses informed the sites that the 2018 team chose to visit prior to starting their GIS analysis. Each of the top sites/areas from the survey are either highlighted via the GIS analysis or discussed for their potential of being better developed into a scenic resource.

The fourth question of the survey, although not a factor within our methodology, is a very interesting insight into the way in which community members view their city. Being that this is an open-ended and subjective question, the answers varied. However, we were able to group many of the responses together and found that the most valued aspects of Poughkeepsie included: a sense of community (17 responses), a peaceful/safe atmosphere (14 responses), a sense of home (7 responses), its walkability (6 responses), its diversity (5 responses), and most importantly to this report, its scenic qualities (13 responses).

METHODOLOGY

ArcGIS Version 10.6.1 was used to develop a scenic resource identification methodology for Poughkeepsie, New York, and a parcel prioritization method was used to illustrate the areas suggested for protection or emphasis as scenic resources. Essentially, this is a suitability analysis for which we developed a non-weighted linear combination model where parcels received points for possessing environmental, historic, recreational, and cultural qualities. The only weighted category was the "parcel size" characteristic.

We believe that scenic resources are not just natural but can also be cultural and/or historic resources. This is significant to Poughkeepsie because it has a rich historic character. Thus, we developed a single GIS Model that follows the criteria below, which considers more than just the environmental qualities typically studied in an SRI. Using these criteria, we were able to identify parcels that we consider scenic. Parcels that are highly scenic meet multiple scoring characteristics. Please see the maps in the appendix to visualize which parcels received points for each scored characteristic.

<u>Scored Characteristics by Parcel</u>

- Parcels within historic districts identified by the Walkway Over the Hudson State Historic Park Greater Walkway Experience
- Parcels along Fall Kill
- Parcels within Poughkeepsie Innovation District (PID)
- Parcels with Hudson River Frontage
- Parcel size
- Parcels containing wetlands
- Parcels containing trails
- Parcels containing historic sites (protected or unprotected)
- Parcels containing historic sites protected by the City of Poughkeepsie Historic District and Landmark Preservation Commission (HDLPC)
- Parcels within protected historic districts identified by the HDLPC

To ensure objectivity, each scored characteristic is valued at (1) with the exception of the "parcel size" characteristic, which values the largest parcel at (1) and all other parcels as a ratio of their actual acreage to the actual acreage of the largest parcel. Thus, no parcel can receive more than 1 point for the size characteristic. Parcels' scores are determined by summing the points received for possessing the characteristics listed above. For example, the parcel with the highest score (Upper Landing Park with 5.010583 points) received 1 point for containing a park, 1 point for containing a historic site (protected or unprotected), 1 point for containing a protected historic site, 1 point for being along a trail, 1 point for river frontage, and 0.010583 points for its size ratio. Please refer to Table 3 in the appendix to see each parcel's score.

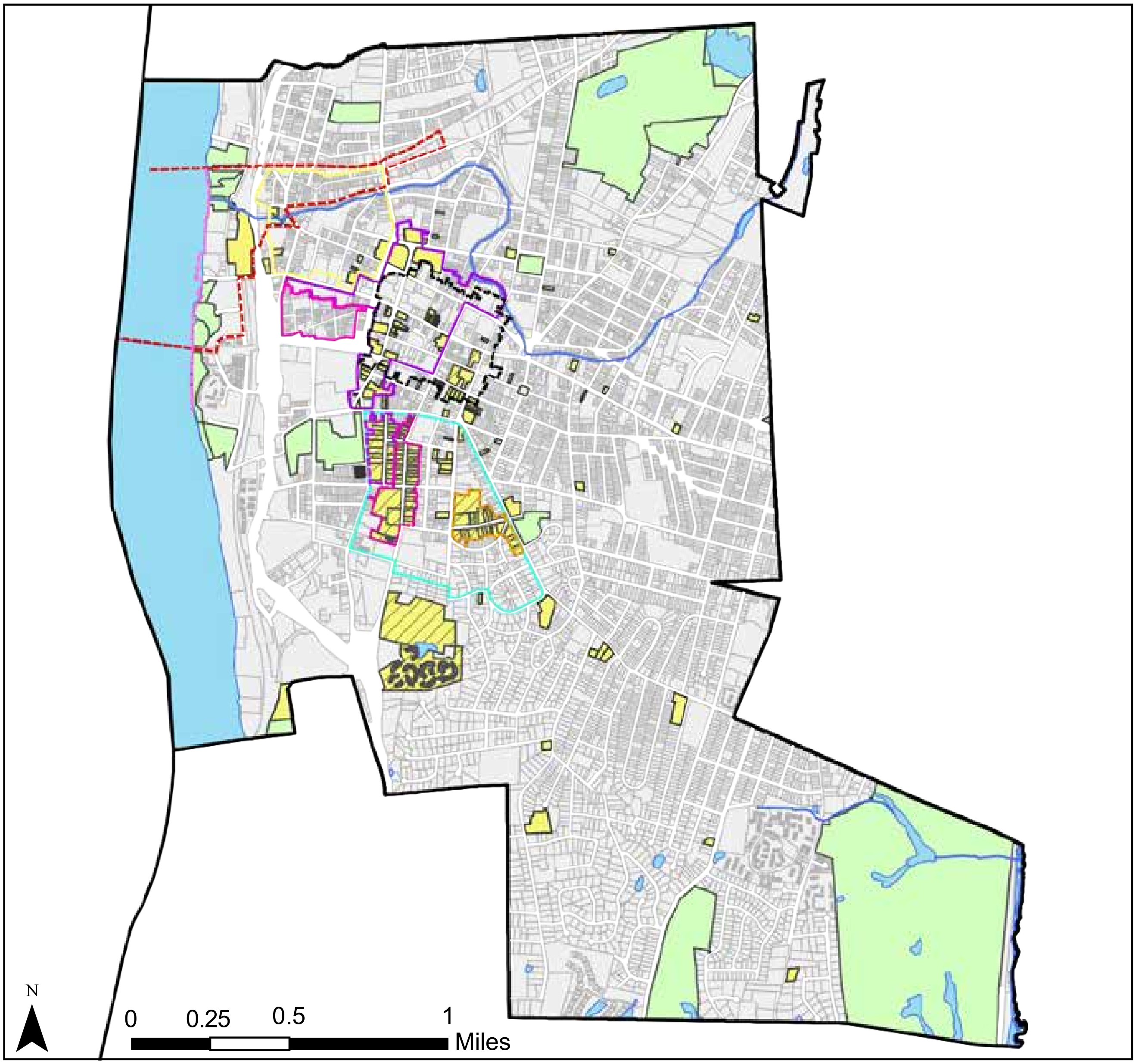
It is important to note that these weights and analyses are preliminary. As we are not Poughkeepsie residents, we recognize that we do not have an omniscient perspective of the city. Instead, our goal is to develop a methodology that is easily understood and replicable, so it can be built upon and improved in later adaptations.

Model Setup

We first identified significant scenic areas through "ground-truthing." As a result, we were able to identify Fall Kill, College Hill Park, Upper Landing Park, the Walkway Over the Hudson, the Children's Museum, Vassar Farm, Main Street, and Dongan Park as major resources or potential major resources. Although these sites and their respective parcels did not receive an extra point for being pre-identified significant sites, they did inform us of potential development opportunities that can give select parcels a more scenic character. This will be further discussed in our Recommendations section. They also helped us confirm whether our scoring reflected our experiences in Poughkeepsie; for example, if these areas scored very low, that may indicate a problem with the model.

From our time in Poughkeepsie we were able to conclude that a scenic resource inventory for the city would be more reliant on historic and cultural sites rather than natural resources. This is because most of the city has a rich historic character, and sites in Poughkeepsie with significant natural characteristics are already protected as parks. Thus, we were able to focus on the scenic characteristics of the built urban environment rather than on the natural ones. Moving forward, we were able to make more informed decisions regarding scoring criteria when constructing our GIS Model. A map of existing the existing resources that we identified is on the following page.

Overview of Existing Resources



Trails

Poughkeepsie Waterfront Trail

Walkway Loop Trail

Resources

Park

Protected Historic Parcel

Historic Parcel

Districts

Little Italy Historic District

Southside Historic District

Union Street Historic District

Downtown

Poughkeepsie Innovation District

Protected Historical Districts

Academy Street Historic District

Dwight Street-Hooker Avenue Historic District

Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018

RESULTS

Based on the scored characteristics, the maps on the next five pages were created.

The top-scoring parcels are:

1. **Upper Landing Park, including the Hoffman House and Reynolds House**
   - Score: 5.0105

2. **The Mid-Hudson Children's Museum**
   - Score: 4.0068

3. **Dongan Place**
   - Score: 4.0042

4. **Springside Porter's Lodge (Matthew Vassar Estate)** (two parcels)
   - Scores: 3.0815, 3.0555

5. **Poughkeepsie Train Station**
   - Score: 3.0313
   Please note that this parcel was clipped to only encompass the area where the train station building is and not where the tracks run. This changed the parcel's score for the "parcel size" characteristic.

6. **Walkway Over the Hudson State Historic Park** (first parcel in Poughkeepsie next to the Hudson River)
   - Score: 3.0290

7. **Kaal Rock Park** (three parcels)
   - Scores: 3.0244, 3.0141, 3.0063

8. **Forested parcels from the southern corner of Academy Street and Franklin Street to the parcel adjacent to 154 Academy Street** (three parcels)
   - Scores: 3.0169, 3.0068, 3.0059

9. **Forested parcels on South Hamilton Street north of Dwight Street, including New Horizons Resources, Inc.** (two parcels)
   - Scores: 3.0138, 3.0050

10. **331 Mill Street**
    - Score: 3.0084

11. **28 Garfield Place**
    - Score: 3.0060

12. **Parcel along Fall Kill beginning at Dongan Place**
    - Score: 3.0048

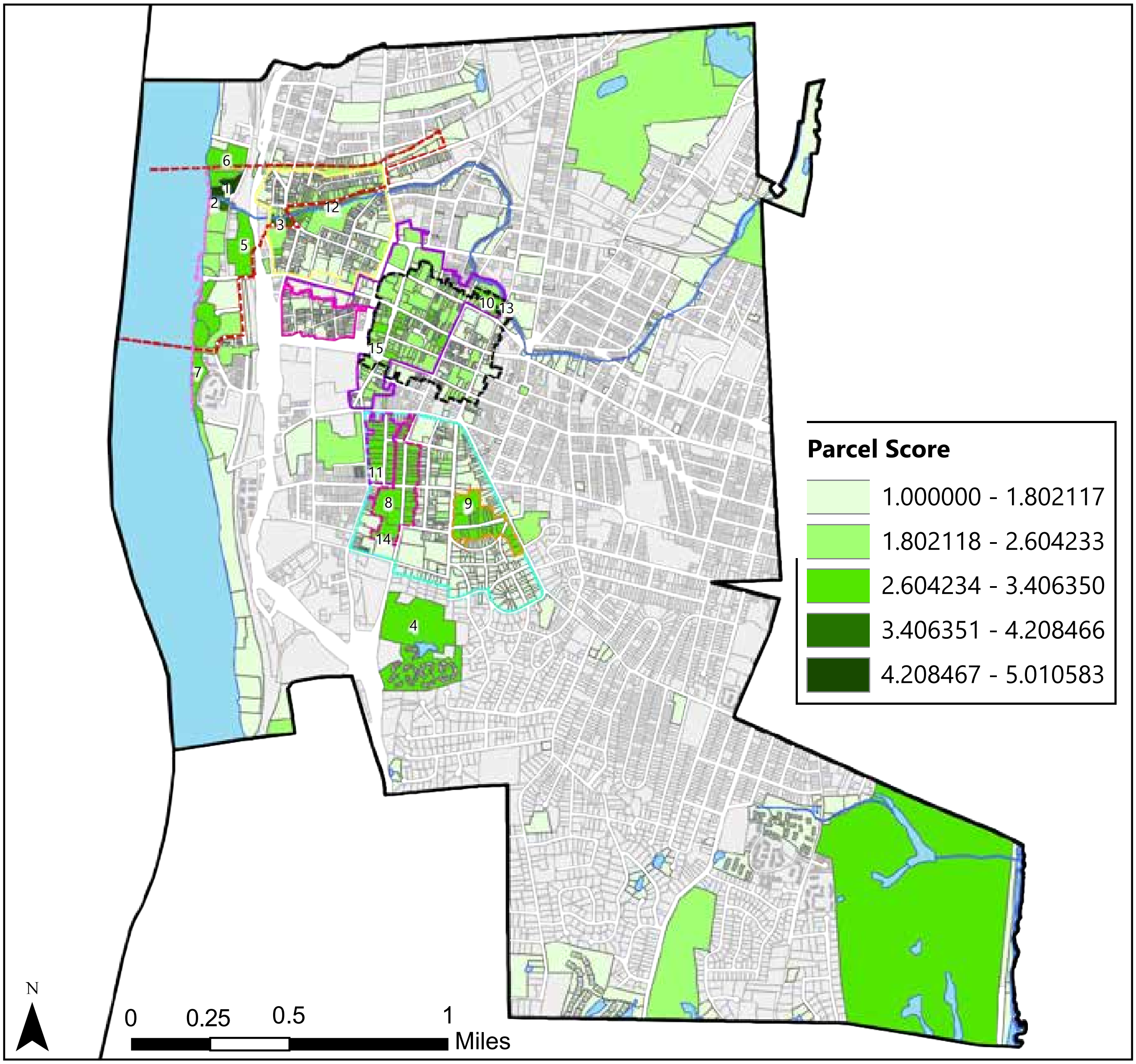
13. **341 Mill Street**
    - Score: 3.0045

14. **154 Academy Street**
    - Score: 3.0044

15. **Old Young Men's Christian Association (YMCA) on Market Street**
    - Score: 3.0040

Other high-scoring named properties include the Luckey, Platt, and Company Department Store building (3.0033 points) and the Seventh Day Adventist Spanish Church on Market Street (3.0023 points).

Potentially Scenic Parcels



Trails

- Poughkeepsie Waterfront Trail
- Walkway Loop Trail

Districts

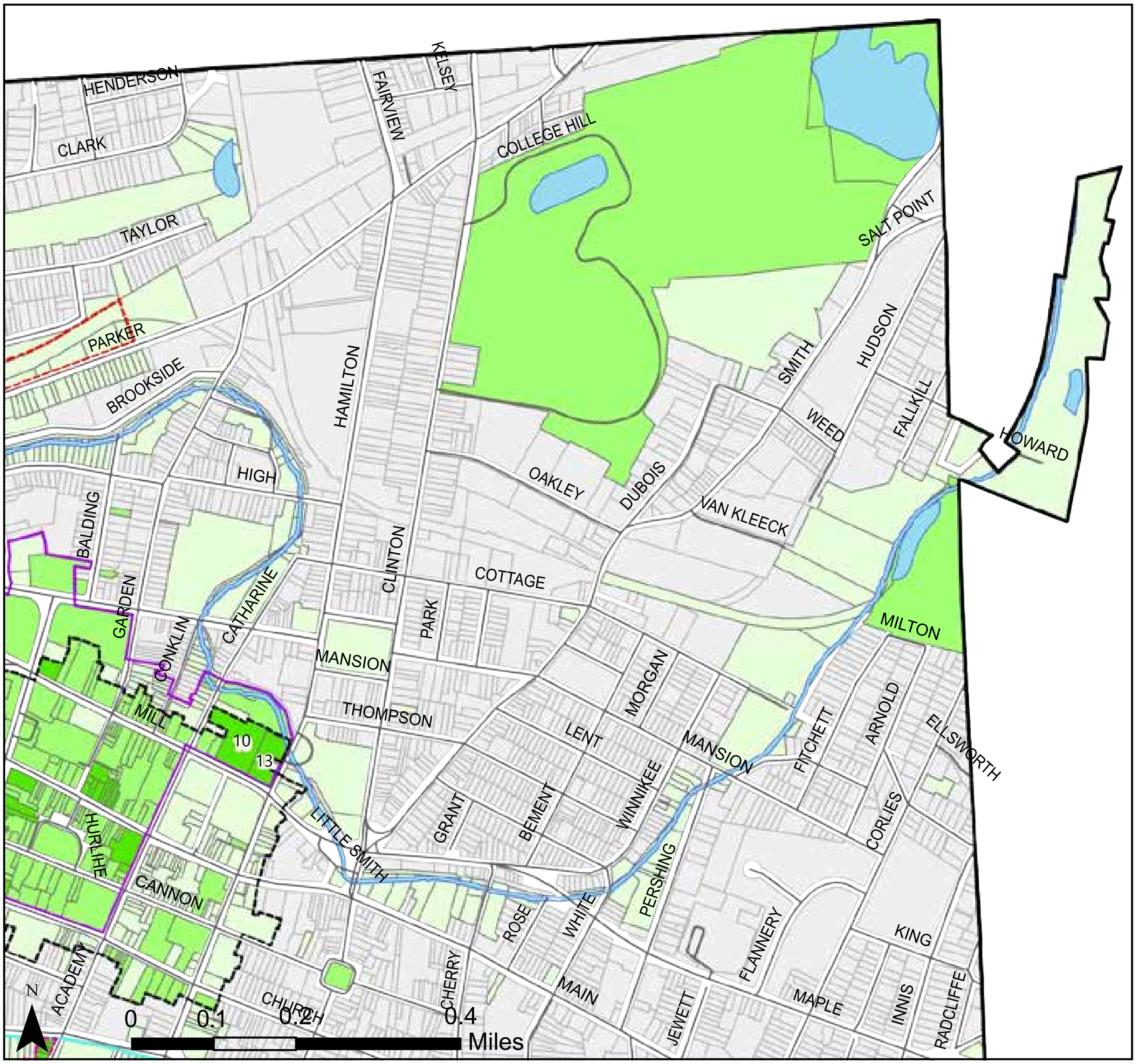
- Little Italy Historic District
- Southside Historic District
- Union Street Historic District
- Downtown
- Poughkeepsie Innovation District

Protected Historical Districts

- Academy Street Historic District
- Dwight Street-Hooker Avenue Historic District
- Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018

Potentially Scenic Parcels (Northeast)



Trails

Poughkeepsie Waterfront Trail

Walkway Loop Trail

Parcel Score

1.000000 - 1.802117

1.802118 - 2.604233

2.604234 - 3.406350

3.406351 - 4.208466

4.208467 - 5.010583

Districts

Little Italy Historic District

Southside Historic District

Union Street Historic District

Downtown

Poughkeepsie Innovation District

Protected Historical Districts

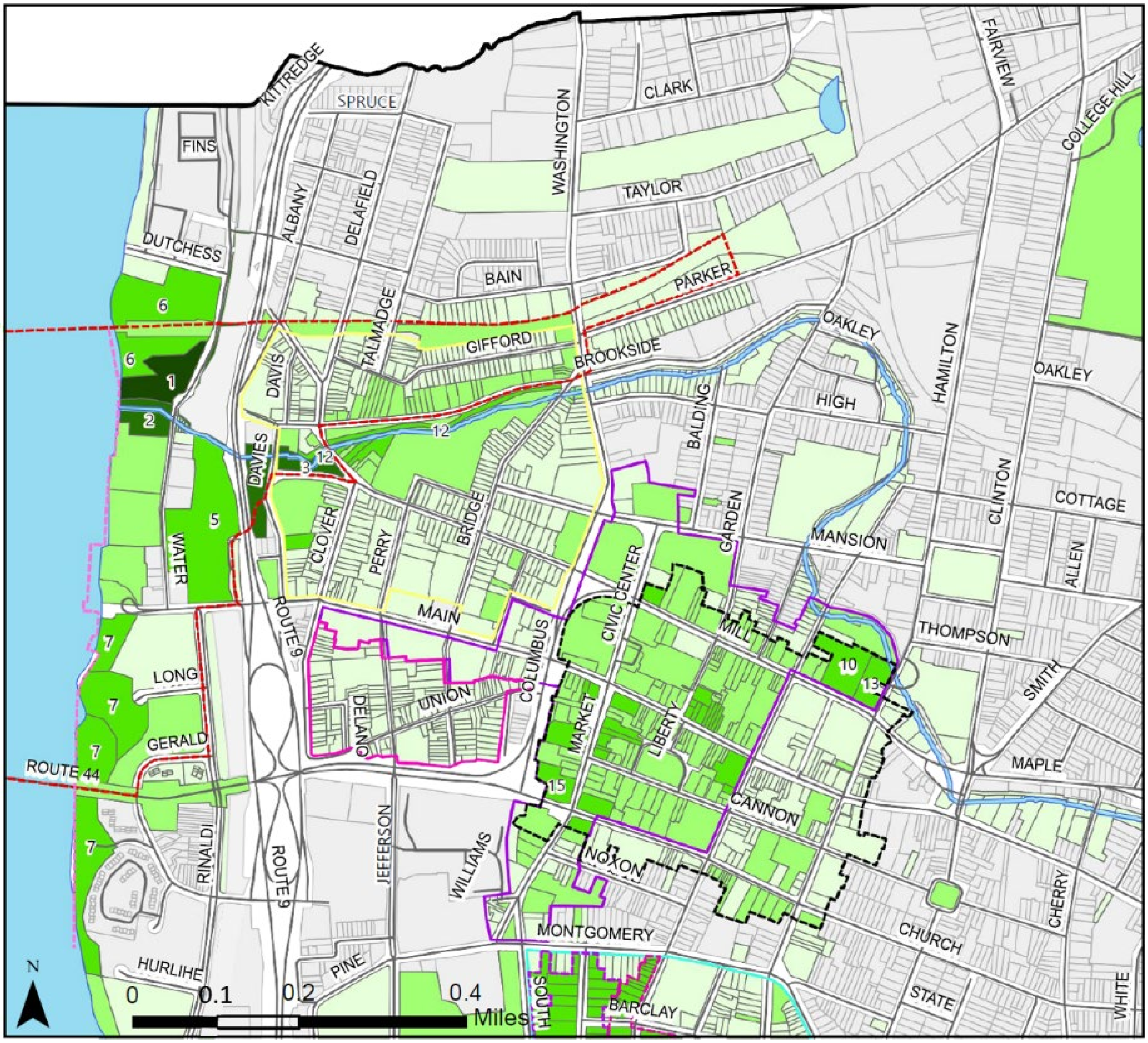
Academy Street Historic District

Dwight Street-Hooker Avenue Historic District

Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018

Potentially Scenic Parcels (Northwest)



Trails

Poughkeepsie Waterfront Trail

Walkway Loop Trail

Parcel Score

- 1.000000 - 1.802117
- 1.802118 - 2.604233
- 2.604234 - 3.406350
- 3.406351 - 4.208466
- 4.208467 - 5.010583

Districts

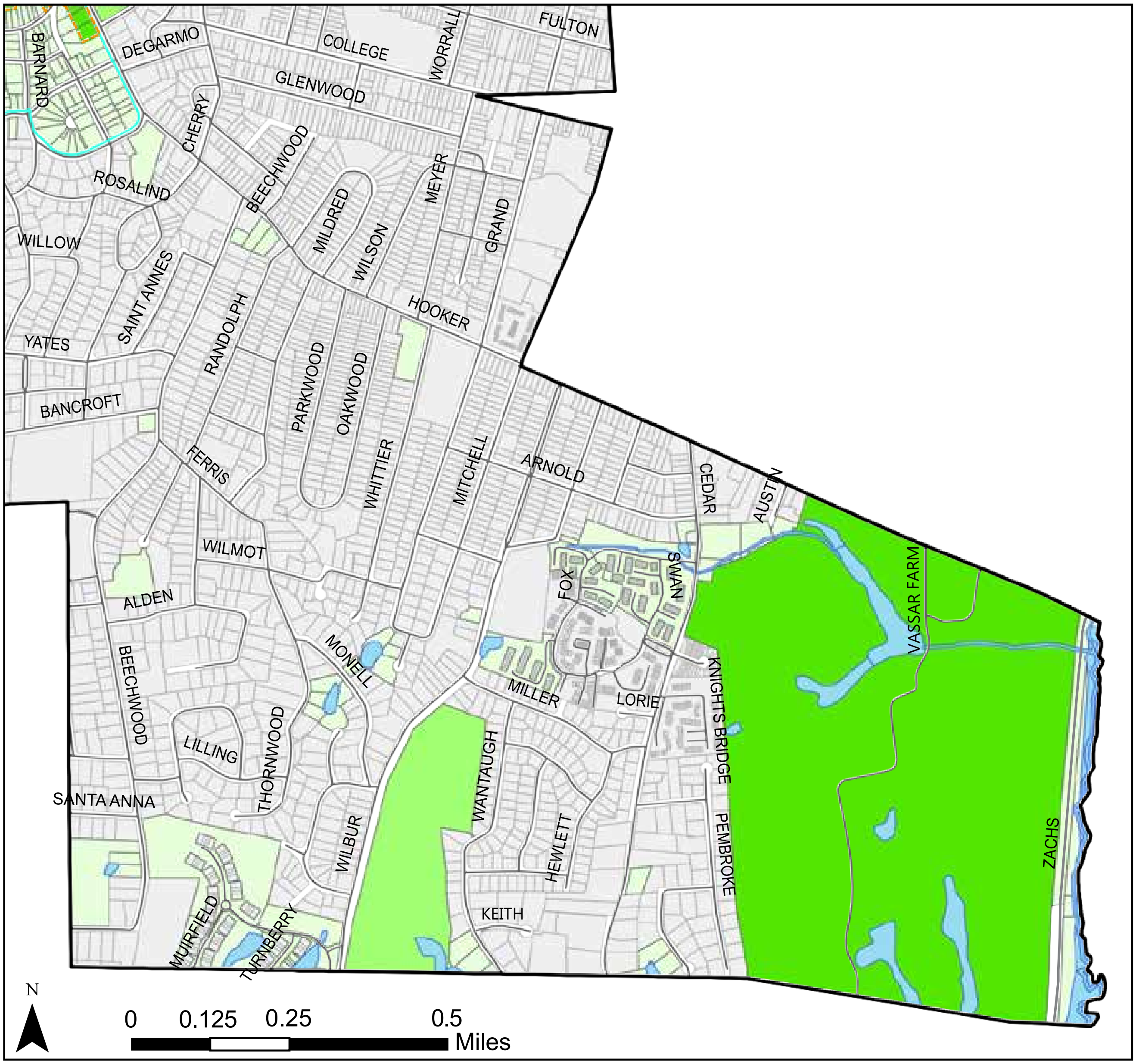
- Little Italy Historic District
- Southside Historic District
- Union Street Historic District
- Downtown
- Poughkeepsie Innovation District

Protected Historical Districts

- Academy Street Historic District
- Dwight Street-Hooker Avenue Historic District
- Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018

Potentially Scenic Parcels (Southeast)



Trails

Poughkeepsie Waterfront Trail

Walkway Loop Trail

Parcel Score

1.000000 - 1.802117

1.802118 - 2.604233

2.604234 - 3.406350

3.406351 - 4.208466

4.208467 - 5.010583

Districts

Little Italy Historic District

Southside Historic District

Union Street Historic District

Downtown

Poughkeepsie Innovation District

Protected Historical Districts

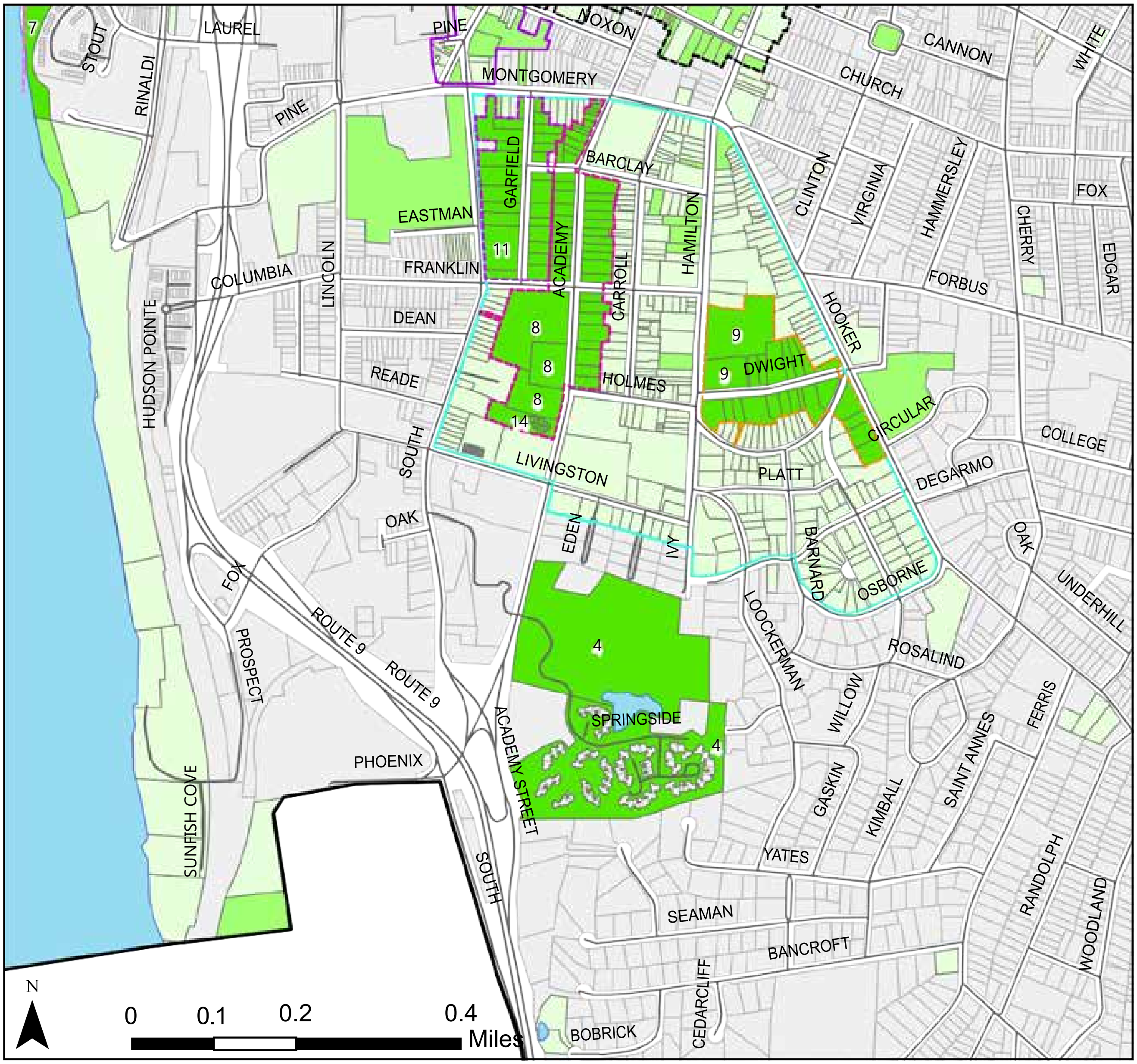
Academy Street Historic District

Dwight Street-Hooker Avenue Historic District

Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018

Potentially Scenic Parcels (Southwest)



Trails

Poughkeepsie Waterfront Trail

Walkway Loop Trail

Parcel Score

1.000000 - 1.802117

1.802118 - 2.604233

2.604234 - 3.406350

3.406351 - 4.208466

4.208467 - 5.010583

Districts

Little Italy Historic District

Southside Historic District

Union Street Historic District

Downtown

Poughkeepsie Innovation District

Protected Historical Districts

Academy Street Historic District

Dwight Street-Hooker Avenue Historic District

Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018

DISCUSSION AND SUGGESTIONS

The parcels that scored the highest suggest that Poughkeepsie has a wealth of scenic resources; however, some of them are not currently emphasized as local assets. The section below discusses the parcels' significance or potential significance if emphasized or developed.

Riverfront Value

Upper Landing Park (including the Hoffman House and Reynolds House), the Mid-Hudson Children's Museum, the Walkway Over the Hudson State Historic Park, and Kaal Rock Park all scored highly. This reflects the value of the Hudson River as a scenic resource. Poughkeepsie has already done a good job of emphasizing the river by creating viewpoints and waterfront access. These sites could be emphasized as valuable community assets by implementing programming in the parks such as beautification volunteer work to encourage community members to visit and take care of the areas.

Fall Kill Redevelopment

Based on our SRI, Fall Kill is an ideal scenic asset that has potential for future development. One consideration is to redevelop select portions into community parks. This would improve its scenic value as well as that of surrounding areas. Additionally, these park developments can simultaneously help manage stormwater, such as through rain gardens, permeable pavement, flood control gates, or slope designs that increase stormwater holding capacity.

A successful exemplary project of this sort is the Boneyard Creek (see picture below), which is located in Champaign, central Illinois. The creek is a 3.3-mile-long waterway that flows through the

Boneyard Creek at North Campus on University of Illinois city of Urbana-Champaign and connects with two larger water channels: The Salt Fork Vermilion River and the Wabash River. Today, Boneyard Creek has been transformed into a highly channelized and engineered creek that drains through much of the town, including the central business district and the University of Illinois campus town area. The improvement of the creek not only enhances its stormwater-holding capacity and ecological functions, but it also provides new recreational spaces for the surrounding community.

Based on the treatment of the Boneyard Creek, we recognized an opportunity to excavate the potential of Fall Kill for new community development and environmental restoration. According to our analysis, there are a few areas along Fall Kill that scored highly in our SRI that deserve investment. From our analysis, these are 331 Mill Street, 341 Mill Street, Dongan Park, and the parcel along Fall Kill beginning at Dongan Place. Instead of hiding the waterways with overgrown vegetation, these areas can be cleared and developed into public areas like Boneyard Creek where people can relax and gather. 331 and 341 Mill Street are located within the PID, which means that these parcels' future uses are being reconsidered. The City could look into including design criteria for parcels in the PID that lie along Fall Kill.

Additionally, these new developments will have a simultaneous use as stormwater retention areas, which will reduce flooding along Fall Kill. This is important because Fall Kill is identified as an at-risk area by the FEMA Digital Flood Insurance Rate Map (DFIRM) (Parcel Access Map).

Fall Kill Around Neighborhood

Installing urban parks along Fall Kill in the innovation district and historic districts of downtown Poughkeepsie would help attract tourists and statewide investment which is vital to the city's

revitalization plan. Thus, investment in maintaining and developing the city's scenic resources is imperative as it will help enable future growth for Poughkeepsie.

keepsie residents in the Fall 2017 survey. The Hudson River Valley Greenway has awarded the City of Poughkeepsie $75,000 for improvements and a trail connection in the area.[16] These funds could be used to clear some of the trees that block the natural viewshed atop the hill so that the scenic views can be enjoyed to their full potential.

College Hill Park

College Hill Park Revitalization

Another major scenic asset that we identified on our site visit was College Hill Park, which was also commonly mentioned as an important asset my Pough-

[16] City of Poughkeepsie, "City Receives $75,000 Grant for Improvements to College Hill Park," City of Poughkeepsie Press Releases, September 14, 2018, http://cityofpoughkeepsie.com/archives/7370.

The project could also be an opportunity to reach out to leaders of the Hudson Valley AmeriCorps Program, a program dedicated to recognizing, preserving, and interpreting the nationally significant historical, cultural, and natural resources of New York's Hudson Valley.[17] By doing so, improvements to the park can be made by regional professionals and students, who also engage local residents in their work.

Treatment of Forested Areas in Neighborhoods

Both the Academy Street Historic District and the Dwight Street-Hooker Avenue Historic District are neighborhoods containing large, forested parcels. These areas scored highly because they are large parcels located within protected historic districts. As they are, these forested areas have scenic value. However, forests can be perceived negatively as the cover they provide can be ideal for illegal behavior. These forests could potentially be managed so that they can become neighborhood assets. For example, the City of Poughkeepsie could design parks in these forests that make the areas more inviting. The Hudson Valley Americorps Program could help with environmental analysis and implementation of the plans.

Academy Street Forest. Image from Google Street View

[17] Hudson Valley AmeriCorps Program, "Hudson Valley Corps," The Student Conservation Association, 2018, https://www.thesca.org/serve/program/hudson-valley-corps.

South Hamilton Street Forest. Image from Google Street View

Before proceeding with changing the current character of the forests, it is important to survey neighborhood residents about whether they would like to see a change to the forests in the first place. If not, that might suggest that these areas are already seen as scenic resources. If residents would like to see changes, the next steps would be evaluating whether the land is suitable for development into a park or other community resource and determining who the current landowners are.

Emphasis on Historic Sites

Poughkeepsie is rich in historic character, and many historic sites scored highly in our analysis. These top-scoring parcels are Hoffman House and Reynolds House in Upper Landing Park; Springside Porter's Lodge (Matthew Vassar Estate); the Poughkeepsie Train Station; the Walkway Over the Hudson State Historic Park; 28 Garfield Place; 154 Academy Street; and the old YMCA on Market Street.

Hoffman House located within Upper Landing Park

Reynolds House located within Upper Landing Park

Springside Porter's Lodge (Matthew Vassar Estate). Image from the Springside Historic Designed Landscape Historic Site website.

The Poughkeepsie Train Station.
(Image from the Harlem Line blog.)

28 Garfield Place. Image from Google Street View.

The Old YMCA on Market Street. Image from Wikipedia.

154 Academy Street Image from online resources

VIEW FOM THE WALKWAY OVER THE HUDSON

The City of Poughkeepsie could develop a tourism site that emphasizes its historic assets. For example, it could emphasize the protected historic districts and suggest specific parcels such as 28 Garfield Place and 154 Academy Street for visitors to see. Self-guided scenic historic walking/driving routes could be suggested on this website as well. With enough emphasis placed on the scenic value of Poughkeepsie's historic resources, which tend to be sited near each other, perhaps in the future tourists will visit Poughkeepsie for historic Poughkeepsie tour groups.

Conversion of U.S. Route 9 into a Scenic Byway

Based on on-the-ground experience and not GIS analysis, we suggest that the portion of U.S. Route 9 that runs through Poughkeepsie could be redeveloped into a scenic byway. Currently, there are trees and foliage that grow on each side of the route as well as in some medians; however, they are not maintained to retain a scenic character that drivers would like to view. Tree branches are overgrown, shrubbery is sparse, and green development is inconsistent along the way. To improve the scenic character of Route 9, the City could invest in managing the green areas to improve its aesthetic quality, or it could investigate the availability of federal funds for maintaining a national route. Doing so would create a more visually pleasing Route 9 that can be added to Poughkeepsie's SRI.

DISCUSSION AND CONCLUSION

The final map displaying parcels' scores is an important part of our methodology as they help visualize the areas within Poughkeepsie that are critical scenic resources and what areas may be prioritized for protection. Using GIS helps to highlight parcels and areas that have scenic value but otherwise may be overlooked based on a community survey. For example, this methodology awards one point to parcels along Fall Kill. This was not one of the areas mentioned by community members as being scenic or a place they go to relax. In fact, many areas of the creek are poorly maintained or ignored entirely. Within this report, we wish not to propose specific parcels for the city to acquire, but rather we suggest that much can be done to better celebrate existing city assets. Relatively simple choices as daylighting the creek and clearing vegetation around its perimeter so as to create small pocket parks or making Kaal Rock a safe and easily accessible scenic resource, can have a profound effect on the scenic qualities of the city as a whole by expanding access and visibility of existing resources.

Limitations

It is extremely important to mention that this is a very analytical report based almost entirely on GIS models and maps. This alone has major limitations and consequences. First and foremost, not all data that could be used in a model like this is digitized and available for such results. Adding onto this, we are not Poughkeepsie residents, and one weekend in the City and a month or so conducting research is not enough to truly know the ins and outs of Poughkeepsie.

Due to our limited familiarity with the City and limited opportunities to ground-truth, the following were characteristics that we would have liked to have considered but could not:

- Parcels that are along identified major scenic resources that view the resource.
- Parcels that can clearly view the parkland across the river. There may be viewsheds that we were unable to locate.
- Parcels in areas identified as significant by community members.

On a smaller scale, this project was also limited by a few factors including dataset availability, dataset quality, and human error. For example, some datasets such as land use may have been helpful, but a readily usable and accurate dataset was difficult to find, especially given the time constraints of the project. Having more details in the parcel dataset (such as ownership and street numbers) may have also helped, especially when it comes to the accuracy of the data that our team entered into the parcel dataset. When working with maps, there is a strong chance of human error in the creation of the datasets. It is important to acknowledge the limitations of using GIS for a project of this type, especially when it is being used by people who are relatively unfamiliar with the area and therefore cannot ground-truth or use their lived experiences to improve the model.

Future Work

The parcel-based GIS dataset generated by the 2018 team should be a useful starting point for the City of Poughkeepsie as it identifies parcels with characteristics that are potentially scenic. The City could alter this dataset by adding more categories to the scoring, such as community opinion, and/or by altering the weights of the scores to better reflect their interests in scenic resource programming.

VIEW FOM THE WALKWAY OVER THE HUDSON

ACKNOWLEDGMENTS

We would like to extend a warm thank you to the following people for their assistance with this project:

- Professor George Frantz (Cornell University), for introducing us to the concept of scenic resources; taking the time to drive both the 2017 and 2018 teams twice to Poughkeepsie, once to survey and once to conduct their final presentations; and helping to guide both teams with this project.
- Andrew Meyer (Hudson River Estuary Program) and Jennifer Rubbo (Vassar College), for helping the Fall 2017 set up important meetings including their presentation and providing them with advice throughout.
- Peter Barnard (Scenic Hudson), and everyone else who showed up to the Fall 2017 final presentation and provided extremely helpful feedback on their methodology and models.
- Joe Heggenstaller (Dutchess County Office of Central and Information Services), for providing us with multiple GIS files that were integral to the GIS analysis.
- Dylan Tuttle (Dutchess County Department of Planning and Development; Cornell University MRP '17), for meeting with the Fall 2018 for lunch during our trip to Poughkeepsie and providing us with valuable insight from living in the City.

APPENDIX

SECTION 1: Details on GIS Analysis Set-Up

- Identified significant areas through field study. The comprehensiveness of our field study was limited due to time constraints.
- Used historic map survey and national register of historic places to identify parcels containing historic sites.
- Identified parcels containing parks and trails
- Identified protected historic districts from Historic District and Landmark Preservation Commission
- Identified historic/significant districts from the Walkway Over the Hudson State Historic Park's Greater Walkway Experience
- Identified all parcels along Fall Kill
- Identified parcels within Poughkeepsie Innovation District (PID Plan)
- Identified Parcels with Hudson River Frontage
- Calculated Parcel size ratio based on largest parcel
- Identified Parcels with Wetlands (Federal Wetlands Survey)

Based on GIS files, no Bird Conservation Areas (data from Audubon Society), DEC Conservation Lands (data from the NYS GIS Clearinghouse), DEC Points of Interest (data from the NYS GIS Clearinghouse), DEC trails, agricultural districts (data from CUGIR), or Critical Environmental Areas (data from CUGIR) are located within the City of Poughkeepsie.

SECTION 2: Tables

TABLE 1: Historic Sites

Historic Site	Protected?
Amrita Club	No
Bardavon Opera House	No
Barrett House (Dutchess County Art Association)	No
Boughton/Haight House (Schoonmaker Chapel)	No
Building at 73 Mansion Street	**Yes**
Cedarcliff Gatehouse	No
Charles Morschauser House	No
Church - Yesst Presby - Redeemed Christian Fellow	No
Church Building	No
Church of the Holy Comforter	**Yes**
Church Street Row	No
City Hall	No
Clark House	No
Clinton House	No
Corlies-Hart-Ritter House / S Hamilton St Row	No
County Court House	No
Dixon House	No
Eastman Park	No
Eastman Terrace	No
Ethal House	No
Farmers and Manufacturers Bank or Opera	No
FR Bain House	No

Historic Site	Protected?
Freer House	No
Glebe House	No
Gregory House	No
Grey Hook	No
Harlow Row (Brick Row)	No
Harlow Row + Soldiers Memorial Fountain	No
Hasbrouck House (Evelyn Samuels Memorial Building)	No
Hershkind House	No
Historic church - First Baptist Church	No
Innis Dye Works	No
Italian Center	No
Lady Washington Hose Company	No
Library	No
Luckey Platt and Company Department Store	No
Mader House	No
Main Mall Row	No
Market Street Row	No
Moore House	No
Mulrein House	No
Niagara Engine House	No
NYS Armory - Seventh Day Adventist Spanish Church	No
OH Booth Hose Company	No
Old Young Men's Christian Association	No
One Civic Center Plaza	No
Pelton Mill - now apartments	No

Historic Site	Protected?
Phillips House	No
Post-Williams House	No
Poughkeepsie Almshouse and City Infirmary	No
Poughkeepsie Journal Building	No
Poughkeepsie Meeting House	No
Poughkeepsie Railroad Station	No
Poughkeepsie Rural Cemetery	No
Poughkeepsie Savings Bank	No
Poughkeepsie Trust Company	No
Poughkeepsie Underwear Factory (Central Press)	No
Reformed Dutch Church	No
Reynolds House	No
Sague House	No
Second Baptist Church	No
South Hamilton Street Row	No
Springside Porter's Lodge/Matthew Vassar Estate	**Yes**
St Pauls Episcopal Church	No
Thompson House	No
Travis House	No
Upper Landing Park: Hoffman House and Reynolds House	**Yes**
US Post Office	No
Vassar Home for Aged Men	No
Vassar Institute	No
Vassar-Warner Row	No

TABLE 2: Survey Response Summary Data

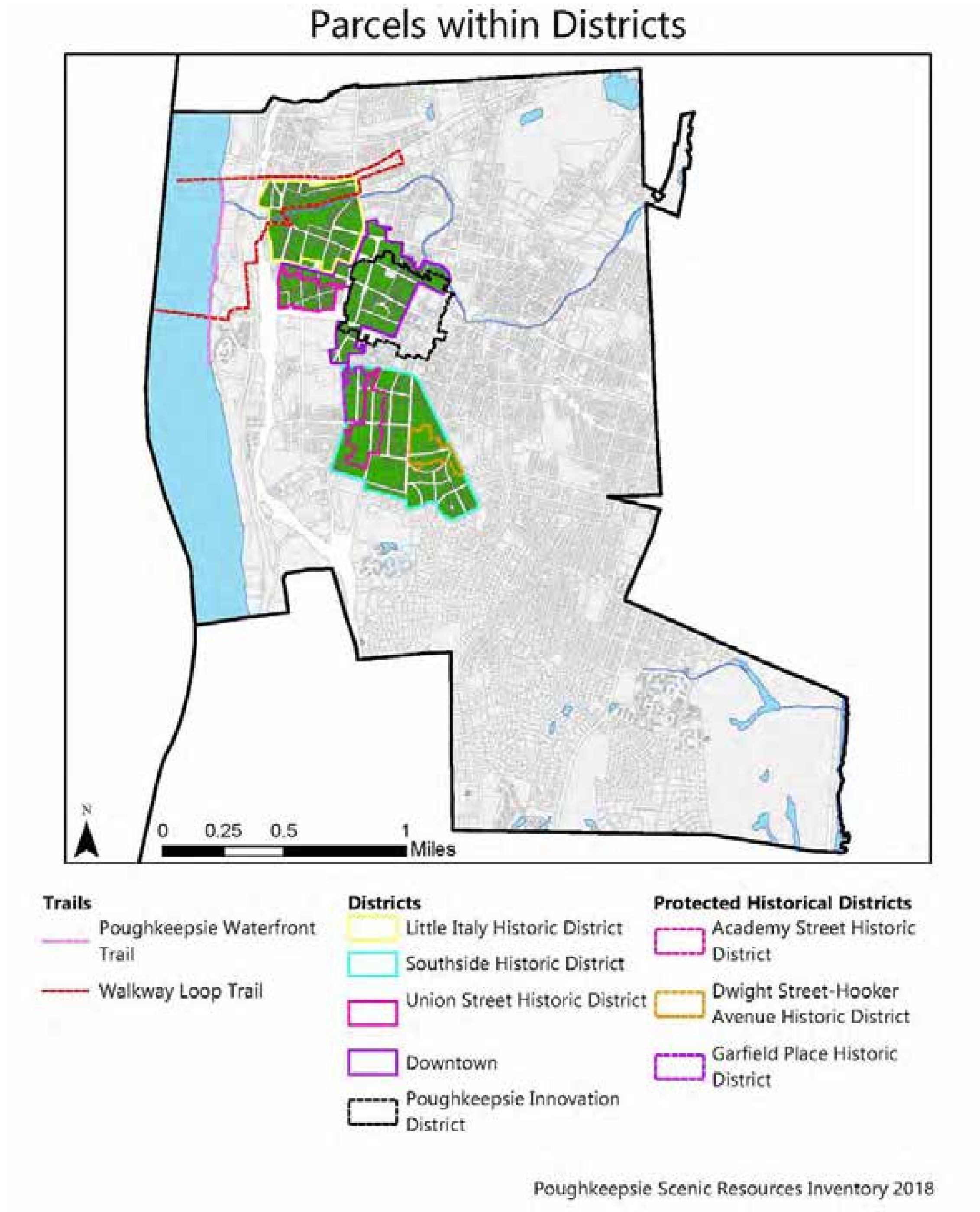
Response	Question 1 Sum	Question 2 Sum	Question 3 Sum	Total
Walkway	12	27	30	69
Riverfront	19	15	11	45
Marist & Marist Boathouse	2	1	1	4
Train Station	1	2	1	4
Rail Trail			1	4
Restaurants			4	4
Library		3		3
Bardavon			3	3
Museum			3	3
Morse Estate	1		1	2
Quiet Cove	2			2
Pirate Canoe		2		2
Civic Center	1		1	2
Bowdoin Park	1		1	2
Shadows on the Hudson		2		2
Pizza Place by the Train Station			2	2
Memorial	1			1
Bear Park	1			1
St. Peter's Cemetery	1			1
Samuel Moss		1		1
King Street Park	1			1
Clinton Park	1			1

Response	Question 1 Sum	Question 2 Sum	Question 3 Sum	Total
Pleasant Valley	1			1
Arlington Middle School		1		1
Wappinger Creek Greenway	1			1
Regional Hospital		1		1
Kaal Rock		1		1
Derby			1	1
Culinary Institute			1	1
Hyde Park			1	1
Churches			1	1
River Station			1	1

TABLE 3: Scoring Information for the Top 15 Sites

Rank	Site Name	Hudson River Frontage	Fall Kill Frontage	Within District	Trail Frontage	Innovation District (PID)	Wetlands	Historic	Historic & Protected	In Protected Historic District	Park	Total Score
1	Upper Landing Park (with historic buildings)	1	0	0	1	0	0	1	1	0	1	5.0106
2	Mid-Hudson Childrens Museum/Mouth of Fall Kill	1	1	0	1	0	0	0	0	0	1	4.0068
3	Dongan Place	0	1	1	1	0	0	0	0	0	1	4.0042
4	Springside Porter's Lodge/Matthew Vassar Estate	0	0	0	0	0	1	1	1	0	0	3.0815
4	Springside Porter's Lodge/Matthew Vassar Estate	0	0	0	0	0	1	1	1	0	0	3.0555
5	Poughkeepsie Railroad Station	0	1	0	1	0	0	1	0	0	0	3.0313
6	Walkway Over The Hudson S.H.P.	1	0	0	1	0	0	0	0	0	1	3.0290
7	Kaal Rock Park	1	0	0	1	0	0	0	0	0	1	3.0244
8	Academy Street Forest	0	0	1	0	0	0	0	1	1	0	3.0169
7	Kaal Rock Park	1	0	0	1	0	0	0	0	0	1	3.0141
9	South Hamilton Street Forest	0	0	1	0	0	0	0	1	1	0	3.0138
10	331 Mill Street	0	1	1	0	1	0	0	0	0	0	3.0084
8	Academy Street Forest	0	0	1	0	0	0	0	1	1	0	3.0068
7	Kaal Rock Park	1	0	0	1	0	0	0	0	0	1	3.0063
11	28 Garfield Place	0	0	1	0	0	0	0	1	1	0	3.0060
8	Academy Street Forest	0	0	1	0	0	0	0	1	1	0	3.0059
9	South Hamilton Street Forest	0	0	1	0	0	0	0	1	1	0	3.0050
12	Along Fall Kill beginning at Dongan Place	0	1	1	1	0	0	0	0	0	0	3.0048
13	341 Mill Street	0	1	1	0	1	0	0	0	0	0	3.0045
14	154 Academy Street	0	0	1	0	0	0	0	1	1	0	3.0044
15	Old Young Mens Christian Association	0	0	1	0	1	0	1	0	0	0	3.0040

SECTION 3: Additional Maps



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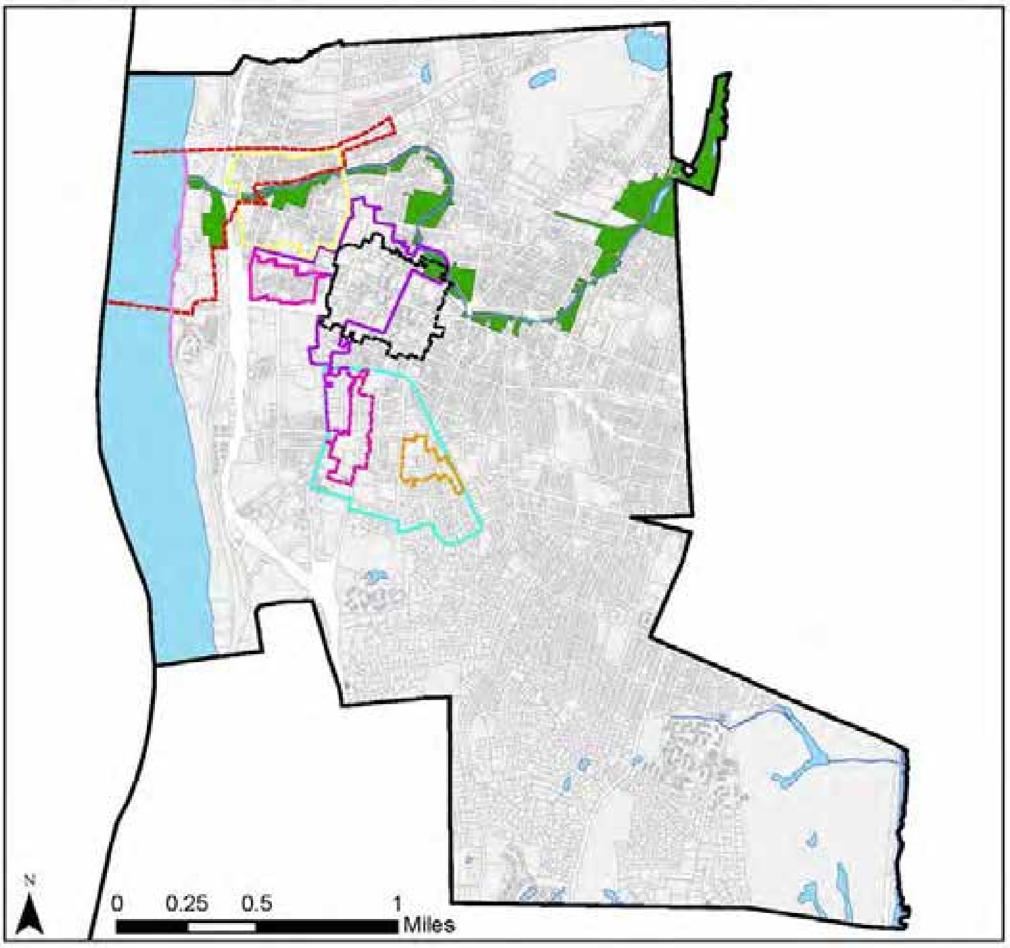
Parcels with Fall Kill Frontage

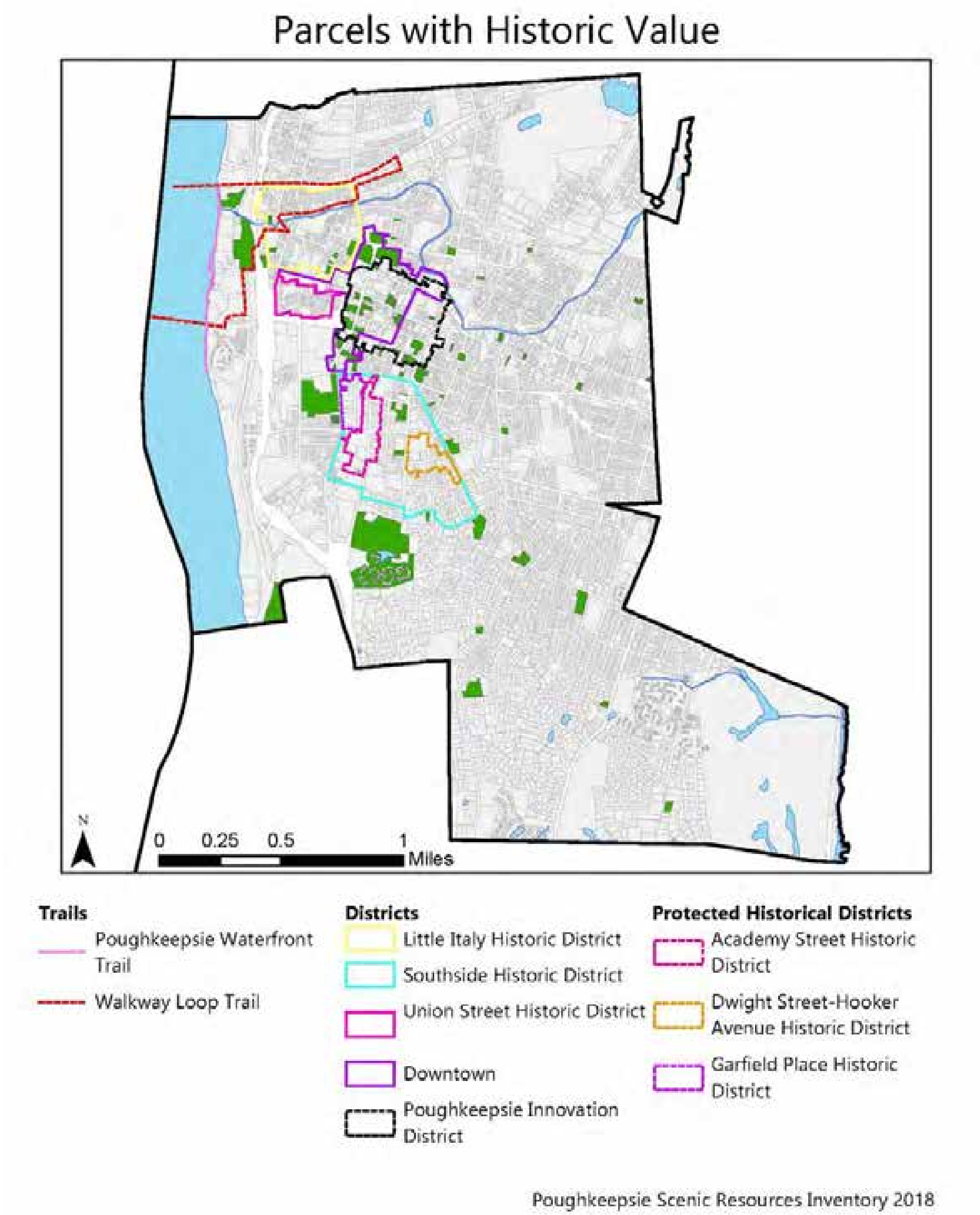


Trails
- Poughkeepsie Waterfront Trail
- Walkway Loop Trail

Districts
- Little Italy Historic District
- Southside Historic District
- Union Street Historic District
- Downtown
- Poughkeepsie Innovation District

Protected Historical Districts
- Academy Street Historic District
- Dwight Street-Hooker Avenue Historic District
- Garfield Place Historic District

Poughkeepsie Scenic Resources Inventory 2018



Parcels with Historic Value
N
0 0.25 0.5 1
Miles
Trails
Poughkeepsie Waterfront Trail
Walkway Loop Trail
Districts
Little Italy Historic District
Southside Historic District
Union Street Historic District
Downtown
Poughkeepsie Innovation District
Protected Historical Districts
Academy Street Historic District
Dwight Street-Hooker Avenue Historic District
Garfield Place Historic District
Poughkeepsie Scenic Resources Inventory 2018

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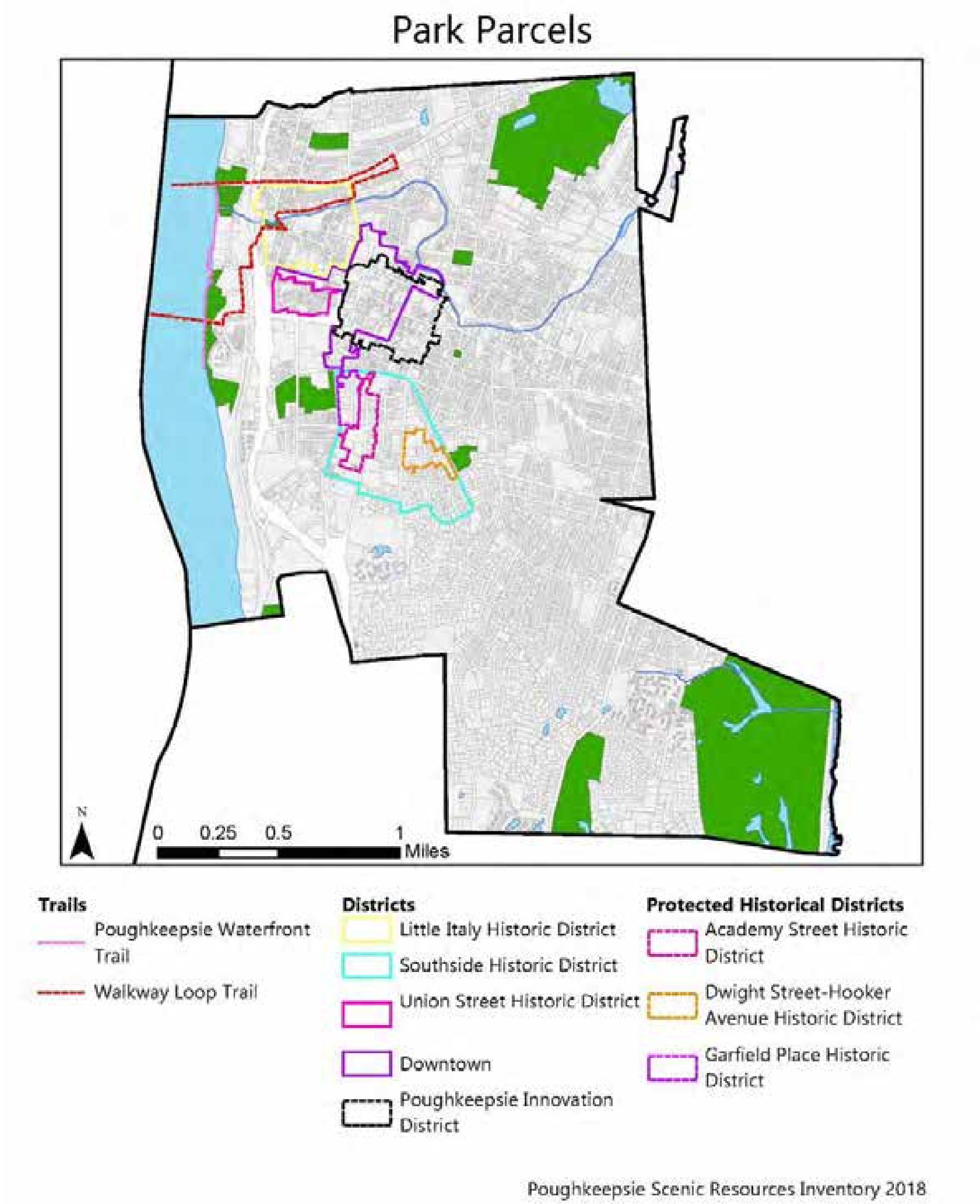
Park Parcels
N
0
0.25
0.5
1
Miles
Trails
Poughkeepsie Waterfront Trail
Walkway Loop Trail
Districts
Little Italy Historic District
Southside Historic District
Union Street Historic District
Downtown
Poughkeepsie Innovation District
Protected Historical Districts
Academy Street Historic District
Dwight Street-Hooker Avenue Historic District
Garfield Place Historic District
Poughkeepsie Scenic Resources Inventory 2018

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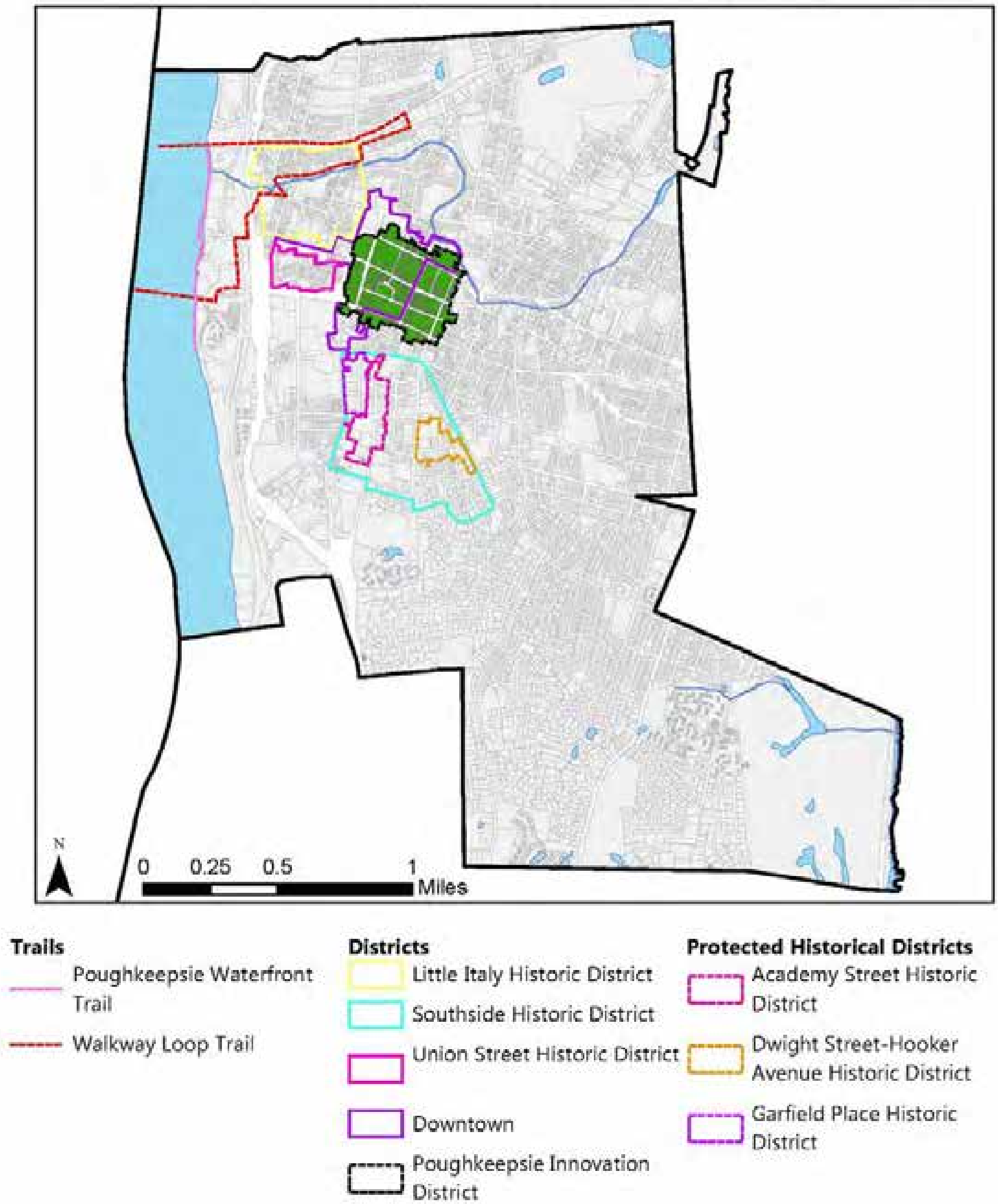
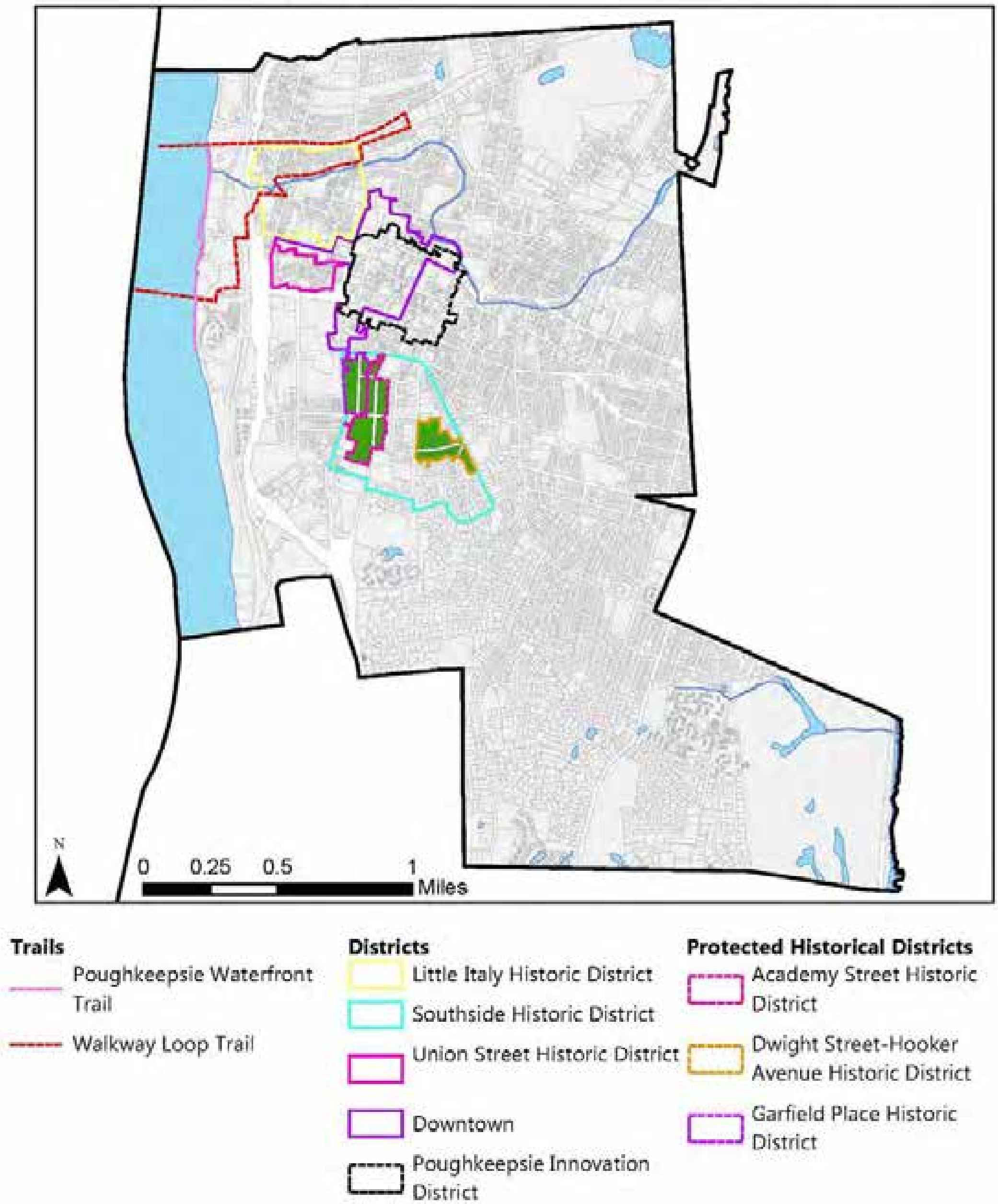
Parcels within Poughkeepsie Innovation District

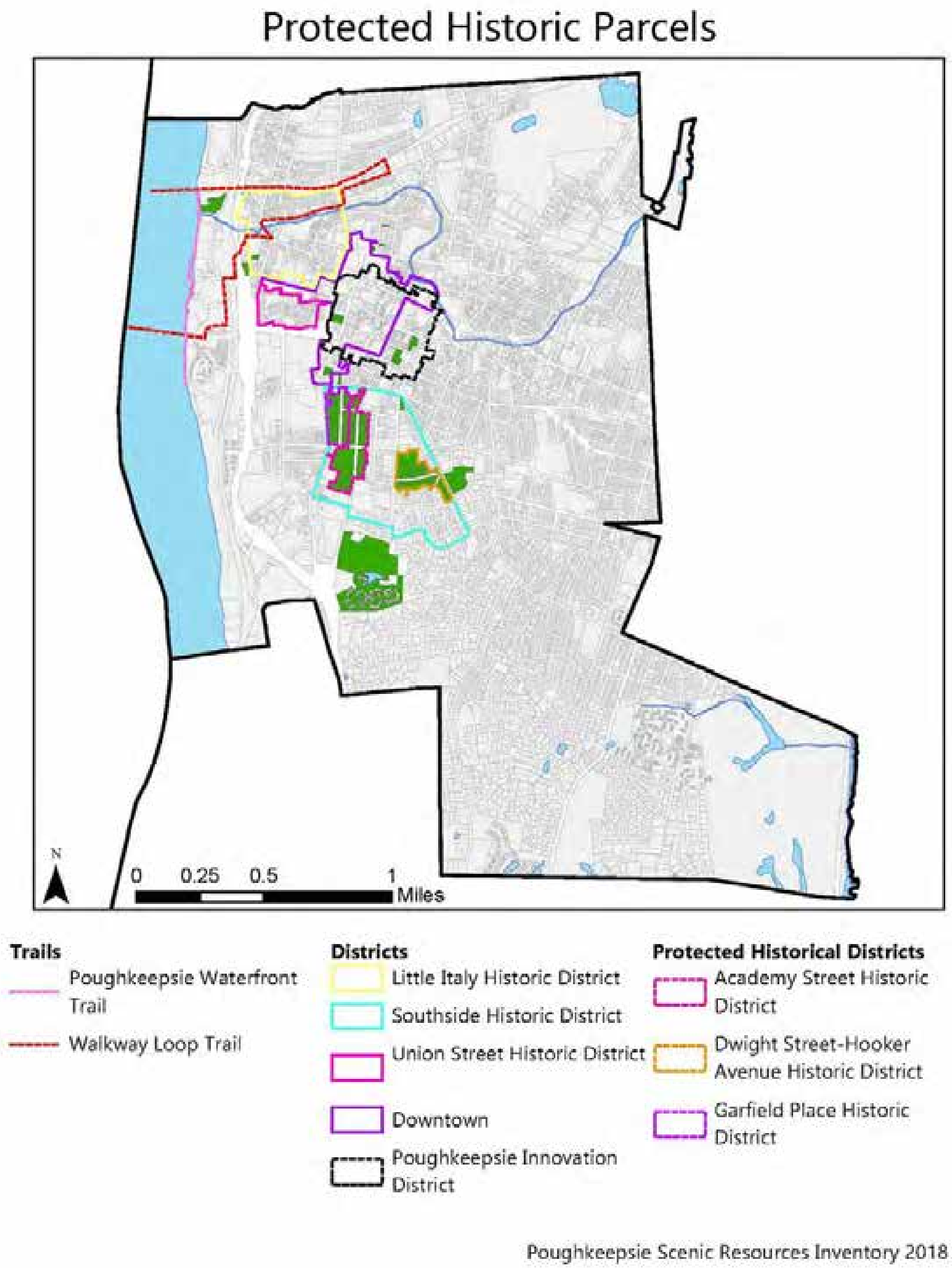


Poughkeepsie Scenic Resources Inventory 2018

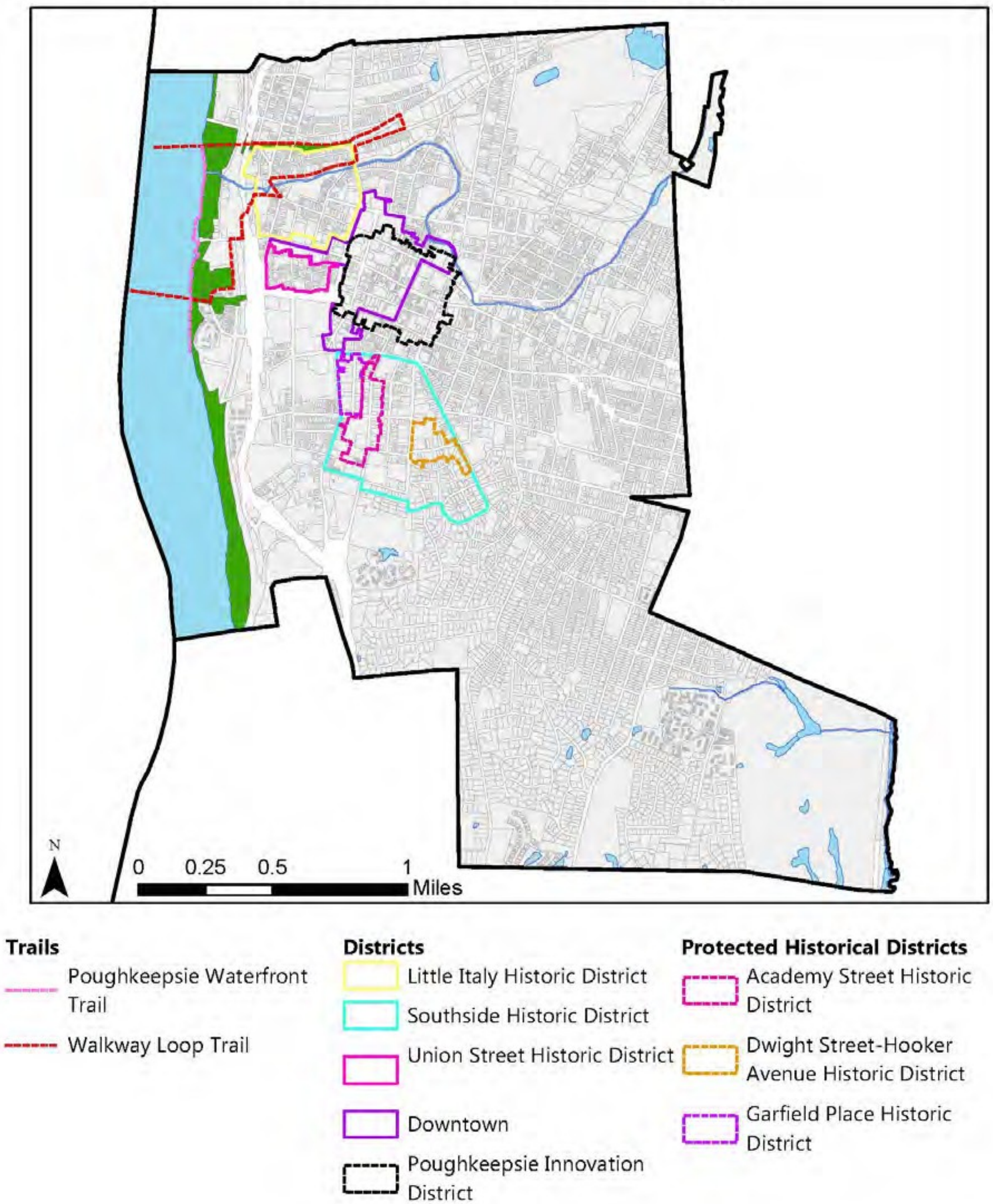
Parcels within Protected Historic Districts



Poughkeepsie Scenic Resources Inventory 2018

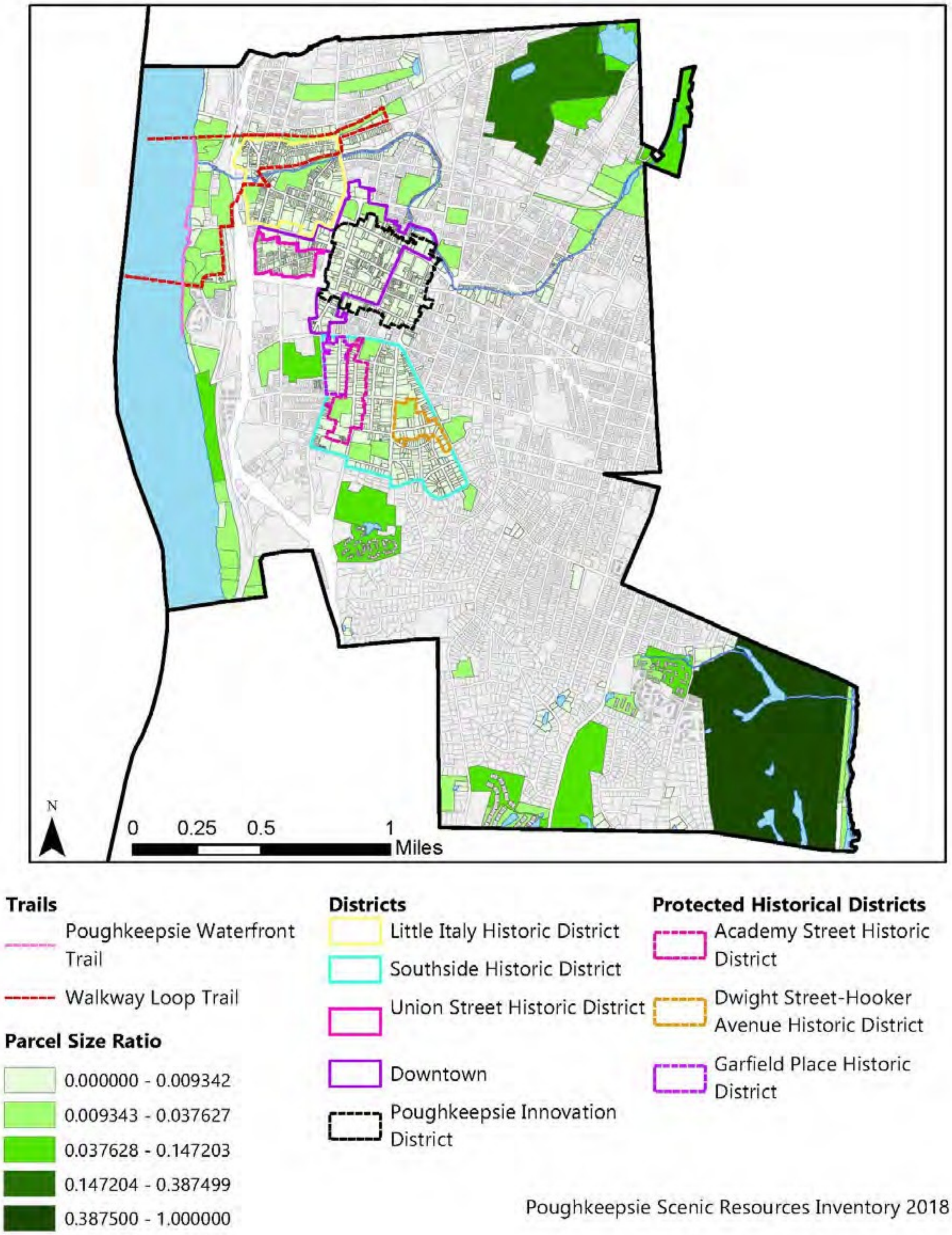

Protected Historic Parcels
N
0
0.25
0.5
1
Miles
Trails
Poughkeepsie Waterfront Trail
Walkway Loop Trail
Districts
Little Italy Historic District
Southside Historic District
Union Street Historic District
Downtown
Poughkeepsie Innovation District
Protected Historical Districts
Academy Street Historic District
Dwight Street-Hooker Avenue Historic District
Garfield Place Historic District
Poughkeepsie Scenic Resources Inventory 2018

Parcels with River Frontage

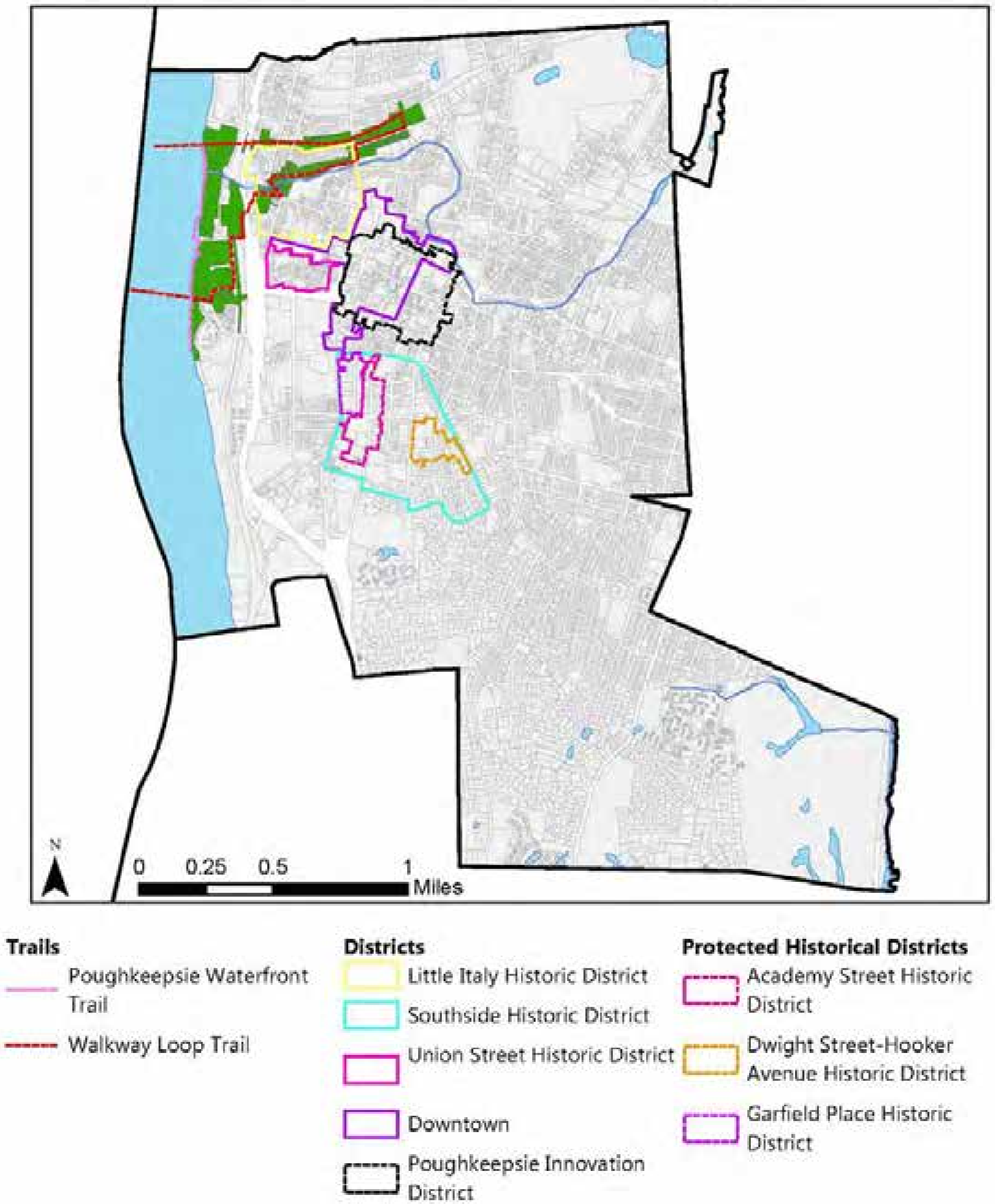


Poughkeepsie Scenic Resources Inventory 2018

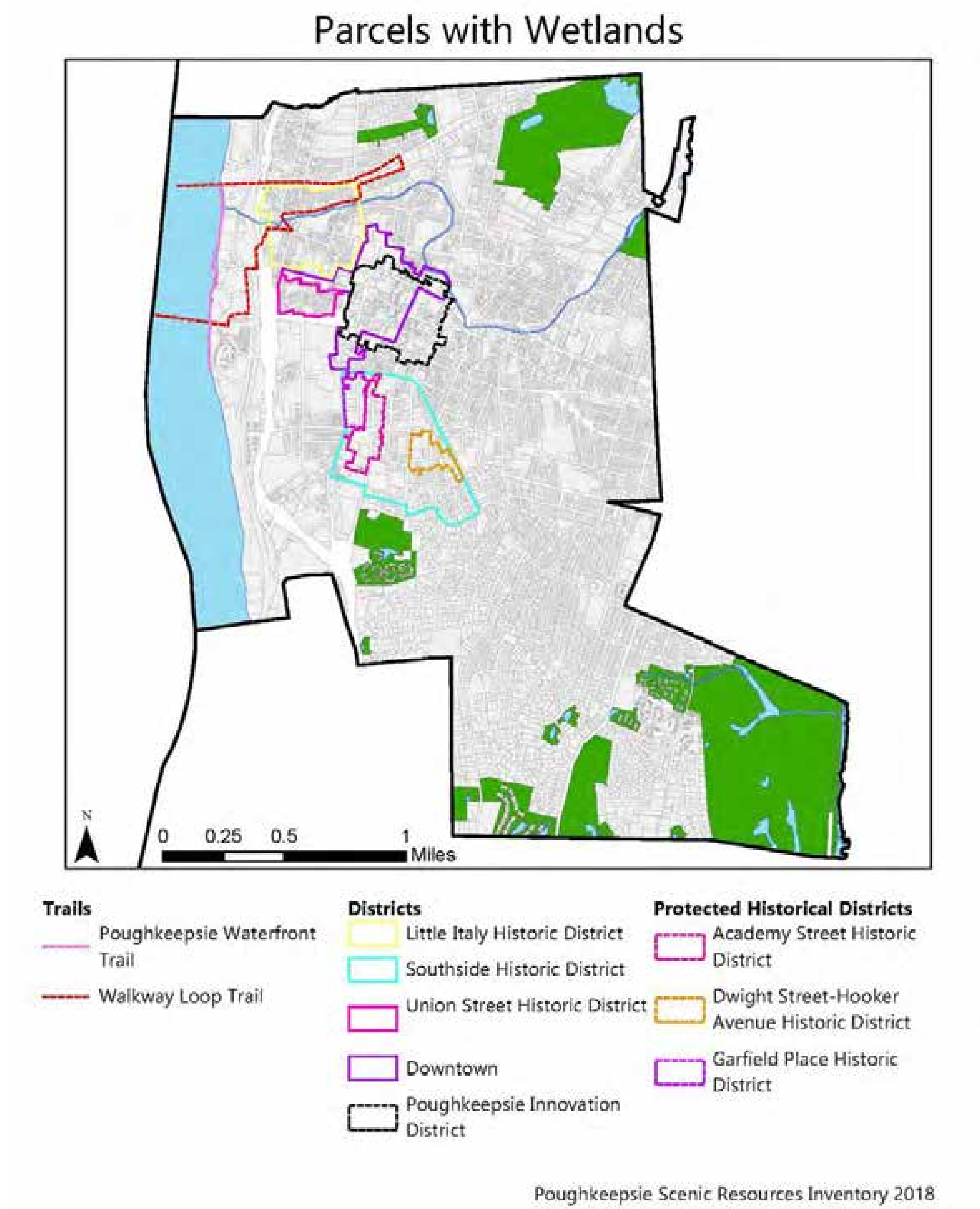
Parcel Size


N
0 0.25 0.5 1
Miles
Trails
Poughkeepsie Waterfront Trail
Walkway Loop Trail
Parcel Size Ratio
0.000000 - 0.009342
0.009343 - 0.037627
0.037628 - 0.147203
0.147204 - 0.387499
0.387500 - 1.000000
Districts
Little Italy Historic District
Southside Historic District
Union Street Historic District
Downtown
Poughkeepsie Innovation District
Protected Historical Districts
Academy Street Historic District
Dwight Street-Hooker Avenue Historic District
Garfield Place Historic District
Poughkeepsie Scenic Resources Inventory 2018

Parcels with Trail Frontage



Poughkeepsie Scenic Resources Inventory 2018


Parcels with Wetlands
N
0
0.25
0.5
1
Miles
Trails
Poughkeepsie Waterfront Trail
Walkway Loop Trail
Districts
Little Italy Historic District
Southside Historic District
Union Street Historic District
Downtown
Poughkeepsie Innovation District
Protected Historical Districts
Academy Street Historic District
Dwight Street-Hooker Avenue Historic District
Garfield Place Historic District
Poughkeepsie Scenic Resources Inventory 2018

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The following GIS data layers were used, modified, or created to complete the maps and calculate geographic statistics included in the City of Poughkeepsie NRI. Each listing includes the source of the data layer, a description that includes a brief explanation of the contents and/or process steps in the modification or creation of the data layer, and a link to more detailed information (metadata) about the source data from which it was created. The geographic extent of each layer is indicated in the parentheses next to the title.

10ft Contours (Poughkeepsie City)
Source title: National Elevation Dataset (NED), 1/3 arc-second resolution
Source: US Geological Survey (USGS)
Publication Date: 1/28/2016
Description: NED is an elevation dataset that consists of raster elevation data of the conterminous United States, Alaska, Hawaii, territorial islands, Mexico and Canada. The 10ft Contours layer were created by Environmental Cooperative at Vassar Barns from the NED using the Contour tool in ESRI ArcGIS 3D/Spatial Analyst, and clipped to the extent of the City of Poughkeepsie boundary plus approximately 1 mile. No attempt was made to correct contour lines to physical features, such as shorelines and built infrastructure. The NED data used to create this layer was obtained from The National Map (link below).
Link: https://viewer.nationalmap.gov/basic

Aerial Photos
Source: NYS Information Technology Services (NYSITS), GIS Program Office
Publication Date: 9/30/2016
Description: OGC Web Map Service (WMS) layer provided by NYSITS GIS Program Office. Contains true-color ortho-imagery of Dutchess County, New York. The photographs that comprise the service were captured in March 2016. Image pixel size represents 0.5 feet ground surface distance.
Link: http://gis.ny.gov/gateway/mg/2016/dutchess/ (metadata), http://gis.ny.gov/gateway/mg/webserv/webserv.html (WMS information)

Aquifers (Dutchess County)
Source: Dutchess County OCIS, GIS Division
Publication Date: 1992
Description: This layer represents location of aquifers in Dutchess County and three major aquifer protection zones for aquifers that are in several prioritized classes. Attributes of the aquifers and aquifer protection zones are defined by the Dutchess County Water Supply Protection Program report by Horsley, Witten, and Hegemann, Inc., prepared for the Dutchess County Water and Wastewater Authority, 1993. The boundaries were delineated at 1:24,000 scale by the University of New Hampshire GIS Laboratory for Horsley, Witten and Hegemann, Inc. in January 1992.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Ash Trees (Poughkeepsie City)
Source: Urban Forestry, LLC (September 2006), Environmental Cooperative at Vassar Barns
Publication Date: September 2017
Description: This layer was created by the Environmental Cooperative at Vassar Barns from the street tree inventory database by Urban Forestry, LLC for the City of Poughkeepsie Shade Tree Commission. Address locations of street trees in the database were mapped by Environmental Cooperative at Vassar Barns using the geocoding tools in ESRI ArcGIS Desktop. Ash trees were extracted from the resulting dataset and their locations were ground-truthed in the field using ArcGIS Collector. Trees that were no longer present since the 2006 inventory was completed were removed, and ash street trees observed that were not present or included in the 2006 inventory were added to the dataset.
Link: N/A

Bedrock Geology (Lower Hudson)
Source title: Lower Hudson Bedrock Geology
Source: New York State Museum, NYS Geological Survey
Publication Date: 1999
Description: Bedrock geology of the lower Hudson Valley of New York and Long Island.
Link: http://www.nysm.nysed.gov/research-collections/geology/gis

BOA Pre-Nomination Area
Source: County of Dutchess-City of Poughkeepsie 2008-2012 Consolidated Plan, Figure 3 (Brownfields Opportunity Area Boundary Map, Brownfields Opportunity Area Pre-Nomination Study)
Publication Date: July 2007
Description: The Brownfield Opportunity Areas Program (BOA) provides municipalities and community based organizations with assistance to complete revitalization plans and implementation strategies for areas or communities affected by the presence of brownfield sites, and site assessments for strategic brownfield sites. The Environmental Cooperative at Vassar Barns digitized the BOA boundary layer from the Brownfields Opportunity Area Pre-Nomination Study boundary map referenced above. Where practical, the BOA boundary was digitized to coincide with the boundaries of current tax parcel boundaries.

City of Poughkeepsie Contrast
Source: Ecological Preserve at Vassar Barns
Publication Date: 2019
Description: A polygon dataset extending from the City of Poughkeepsie boundary approximately 1 mile. Used to partially mask features outside of the City of Poughkeepsie to de-emphasize them from features within the city. This layer was created from the Dutchess County OCIS municipal boundaries layer.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

CSO Outfalls, CSO Outfall Pipes, and CSO Drainage Areas (Poughkeepsie City)
Source: City of Poughkeepsie, Engineering Department
Publication Date: 11/5/2015
Description: Digitized from City Sanitary Sewer Map by Environmental Cooperative at Vassar Barns. These layers depict the CSO outfall locations, pipes to their receiving waters, and drainage areas that contribute runoff to the CSO outfall.
Link: N/A

DEC Wetlands (Dutchess County)
Source: NYS Department of Environmental Conservation (NYSDEC)
Publication Date: 8/28/2013
Description: This layer is based on official New York State Freshwater Wetlands Maps as described in Article 24-0301 of the Environmental Conservation Law. They are not a substitute for the official maps. Coverages are available on a county basis for all areas of New York State outside the Adirondack Park.
Link: https://cugir.library.cornell.edu/catalog/cugir-008187

Development Projects (City of Poughkeepsie)
Source: City of Poughkeepsie
Publication Date: Obtained 5/22/2009
Description: This layer is was created from a list of recent, ongoing, or planned development projects in the City of Poughkeepsie provided to the Environmental Cooperative at Vassar Barns by the City of Poughkeepsie Senior City Planner, Natalie Quinn. Address locations of each project were mapped using the geocoding tools in ESRI ArcGIS Desktop 10.5.1.
Link: N/A

Dutchess County Forests (Dutchess County)
Source: Dutchess County Department of Planning and Development
Publication Date: 4/21/2017
Description: Forest landcover for Dutchess County, delineated using raster-based GIS techniques on County 2014 digital elevation model and second-return surface model, checked against 2014 orthophotography, and rules developed by the Cary Institute of Ecosystem Studies. No differentiation is made between deciduous and coniferous forest, nor species.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Flood Hazard Areas (Dutchess County)
Source: National Flood Hazard Layer (NHFL), Federal Emergency Management Agency
Publication Date: 9/28/2019

Description: The National Flood Hazard Layer (NFHL) data incorporates all Flood Insurance Rate Map (FIRM) databases published by the Federal Emergency Management Agency (FEMA), and any updates since their publication date. It is updated on a monthly basis. The FIRM Database is the digital, geospatial version of the flood hazard information shown on the published paper FIRMs. The FIRM Database depicts flood risk information and supporting data used to develop the risk data. The primary risk classifications used are the 1-percent-annual-chance flood event, the 0.2-percent-annual-chance flood event, and areas of minimal flood risk. The Vassar Farm and Ecological Preserve obtained the Dutchess County FIRM database from the FEMA Map Service Center (link below) and extracted only the Special Flood Hazard Areas – those areas subject to the 1-percent annual flood chance flood, or so-called "100 year floodplain" areas – to create this layer.
Link: https://msc.fema.gov/portal/home

Golf Courses (Dutchess County)
Source: Dutchess County OCIS, GIS Division
Publication Date: 2003
Description: The location of all private and public golf courses in Dutchess County
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Historic Sites (Poughkeepsie City)
Source: Dutchess County Department of Planning and Development, New York Office of Parks, Recreation & Historic Preservation, Dutchess County Real Property Tax Service Agency, Environmental Cooperative at Vassar Barns
Publication Date: 2018
Description: Selected historic properties in the City of Poughkeepsie. Selected properties were extracted from the Dutchess County tax parcel layer to include those identified as historic in the Dutchess County historic site survey and/or National Register of Historic Places.
Link: http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=429

Historic Districts (Poughkeepsie City)
Source: New York Office of Parks, Recreation & Historic Preservation, Dutchess County Real Property Tax Service Agency, Environmental Cooperative at Vassar Barns
Publication Date: 2018
Description: Buildings, structures, objects, historic districts listed in the National Register. Archeological sites and properties determined eligible for listing are not included. Selected properties were extracted from the Dutchess County tax parcel layer to include those located within the polygon layer of National Historic Districts.
Link: http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=429

Hudson River
Source: Scenic Hudson
Publication Date: 2012
Description: A polygon dataset of the majority of the Hudson River estuary, from the federal dam in Troy to the City of Yonkers.
Link: http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1301

Hudsonia Streams and Waterbodies (Poughkeepsie City)
Source: Hudsonia, Ltd.
Publication Date: May 2018
Description: Stream (line) and waterbodies (polygon) digitized by Hudsonia, Ltd. as part of the report,
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Hudsonia Wetlands (Poughkeepsie City)
Source: Hudsonia, Ltd.
Publication Date: May 2018
Description: Inland wetland habitats extracted from the GIS database of all habitats mapped by Hudsonia, Ltd. as described *in Significant Habitats in the City of Poughkeepsie* by Elise Heffernan and Gretchen Stevens, May 2018 (Appendix A of this report).

Impervious Surface (Poughkeepsie City)
Source: Multi-resolution Land Characteristics (MRLC) Consortium
Publication Date: May 2014
Description: Impervious Surfaces, expressed as percent Imperviousness for each cell (approximately 30m x 30m) in the raster layer, is a product of the National Land Cover Database (NLCD), created through a cooperative of several federal agencies (MRLC) and obtained by Environmental Cooperative at Vassar Barns from the USGS National Map (link below). While the impervious layer was published in 2014, the latest LANDSAT imagery from which this product is derived was collected in 2011 and reflects surface conditions captured at that time.
Link: https://viewer.nationalmap.gov/basic/

MS4 Outfalls (Poughkeepsie City)
Source: Dutchess County Soil and Water Conservation District
Publication Date: 5/26/2009
Description: Storm sewer outfalls operated by the City of Poughkeepsie under the Phase II stormwater regulations for Small Municipal Separate Storm Sewer Systems (MS4s) as specified in
SPDES GP-02-02 (Small MS4 General Permit for Stormwater Discharges). The Environmental Cooperative at Vassar Barns obtained the data from Dutchess County OCIS, GIS Division.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Remediation Site Boundaries (Poughkeepsie City)
Source: NYS Department of Environmental Conservation
Publication Date: Obtained October 2017. Updates and topology corrections are ongoing.
Description: For sites in the State Superfund program, the site boundary identifies where the disposal or spill took place, and may not represent the boundary of associated soil or groundwater contamination. For sites in the Environmental Restoration, Brownfield Cleanup, and Voluntary Cleanup programs, the site boundary identifies the property (being) cleaned for redevelopment or reuse. The locations in the dataset were obtained from a number of sources. In many cases the site boundaries match real property boundaries, and boundaries are nearly survey-accurate. In other cases, the site boundary is a poorly defined area within a large parcel, and the boundary is hand sketched with very considerable uncertainty as to the location and meaning of the boundary. This data has not been field-verified. The data should not be used for precise determination of facility buildings, or property.
Link: https://www.dec.ny.gov/chemical/102009.html

Industrial and Vacant Industrial Property
Source: Dutchess County Real Property Tax Service Agency
Publication Date: 2017
Description: This layer consists of industrial and vacant industrial properties extracted by the Environmental Cooperative at Vassar Barns from the Dutchess County tax parcels polygon layer using attributes from the Real Property System v4 (RPS4) database. The RPS4 database includes assessment information about each property, including its use. Land uses are determined by municipal assessors from the property type classifications outlined in the NYS Property Tax and Assessment Administration Assessors' Manual
(https://www.tax.ny.gov/research/property/assess/manuals/prclas.htm). All parcels in the City of Poughkeepsie classified as industrial land use (700s classes) or vacant land located in industrial areas (class 340) are included in this layer.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Land Use (City of Poughkeepsie)
Source: Dutchess County Real Property Tax Service Agency
Publication Date: 2017
Description: This layer consists of the Dutchess County tax parcels polygon layer with attributes from the Real Property System v4 (RPS4) database. The RPS4 database includes assessment information about each property, including its use. Land uses are determined by municipal assessors from the property type classifications outlined in the NYS Property Tax and Assessment Administration Assessors' Manual
(https://www.tax.ny.gov/research/property/assess/manuals/prclas.htm). The land use classifications assigned to each property were generalized to create the Land Use map in this NRI (Map 5.1) and discussed in Chapter 5.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Parks (Poughkeepsie City)
Source: Dutchess County OCIS, GIS Division
Publication Date: 7/10/2003.
Description: This data layer contains most state, county, and local parks, athletic fields, and picnic areas within Dutchess County. Several parks and greenspaces were added to this layer by Environmental Cooperative at Vassar Barns.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Poughkeepsie City Boundary (Poughkeepsie City)
Source: Dutchess County OCIS, GIS Division
Publication Date: February 2001. Last updated 3/1/2017. Obtained October 2017.
Description: This layer was created by Environmental Cooperative at Vassar Barns from the polygon layer of municipal boundaries of towns, villages, and cities in Dutchess County. For map display purposes, the Hudson River portion of the City of Poughkeepsie polygon was erased using the Scenic Hudson, Hudson River Estuary layer. The resulting layer includes only the land area of the city.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Recreational Features (Poughkeepsie City)
Source: Environmental Cooperative at Vassar Barns
Publication Date: 2019
Description: Point locations of public recreational amenities, including baseball fields, basketball courts, boat launches, community gardens, dog parks, flower gardens, playgrounds, pools, skate park, soccer fields, tennis courts.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Riparian Buffers (Poughkeepsie City)
Source: NYS Department of Environmental Conservation (NYSDEC), Division of Fish, Wildlife & Marine Resources, Habitat Inventory Unit
Publication Date: September 2012
Description: Based on the NHD High Resolution Flowlines data set, using the Riparian Buffer Delineation Model and associated methods, developed by Ann Maclean and Sinan Abood (http://www.sfi.mtu.edu/muses/GIS_Riparian.htm). For more information on the Riparian Opportunity Assessment project and the methods used, please refer to the website: http://nynhp.org/trees4tribsny. Clipped to the City of Poughkeepsie plus approximately 1 mile.

Roads (Dutchess County)
Source: Dutchess County OCIS, GIS Division
Publication Date: 2012. Updates and topology corrections are ongoing.
Description: Roads with address ranges for Dutchess County, New York.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Soils (Dutchess County)
Source: USDA-NRCS Soil Survey Geographic (SSURGO)
Publication Date: 2/14/2017
Description: Depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey. The Environmental Cooperative at Vassar Barns obtained the SSURGO Dutchess County soils layer from the NRCS Geospatial Data Gateway (link below).
Link: https://datagateway.nrcs.usda.gov/

SPDES Facilities, MSGP Facilities (Poughkeepsie City)
Source: NYS Department of Environmental Conservation (NYSDEC)
Publication Date: Retrieved October 2018
Description: Facilities with discharge permits under New York's State Pollutant Discharge Elimination System (SPDES) program and facilities with coverage under the Multi-Sector General Permit (MSGP) for stormwater discharges from industrial facilities as of 12/4/2017. Facility lists at the link below were filtered to include only

sites in Poughkeepsie, which were mapped using address geocoding using ESRI's ArcGIS Online Geocoding Service (https://geocode.arcgis.com/arcgis/).
Link: http://www.dec.ny.gov/permits/6054.html ["State Pollutant Discharge Elimination System (SPDES) Individual and Multi-Sector General (MSGP) Permits" (link leaves DEC's website)]

Streams and Waterbodies
Source: The Sanborn Map Company, Inc.
Publication Date: Obtained March 2018.
Description: Stream (line) and waterbodies (polygon) visible in the 2004 edition of digital orthophotography. Clipped to the Town of Poughkeepsie municipal boundary, excluding the City of Poughkeepsie, by Environmental Cooperative at Vassar Barns.
Link: https://www.dutchessny.gov/County-Government/GIS-Data.htm

Stream Barriers (Dutchess County)
Source: North Atlantic Aquatic Connectivity Collaborative (NAACC), Department of Environmental Conservation (NYSDEC)
Publication Date: Obtained August 2017
Description: This layer was obtained by Environmental Cooperative at Vassar Barns from the NAACC Data Center using the search tool at the link below. All observations in the City of Poughkeepsie were downloaded to a geospatial data layer and used in NRI maps, unedited. All observations were made in June 2016.
Link: https://naacc.org/naacc_search_crossing.cfm

Street Trees (Poughkeepsie City)
Source: Urban Forestry, LLC (September 2006), Environmental Cooperative at Vassar Barns
Publication Date: September 2017
Description: This layer was created by the Environmental Cooperative at Vassar Barns from the street tree inventory database by Urban Forestry, LLC for the City of Poughkeepsie Shade Tree Commission. Address locations of street trees in the database were mapped by Environmental Cooperative at Vassar Barns using the geocoding tools in ESRI ArcGIS Desktop.
Link: N/A

Surficial Geology (Lower Hudson)
Source title: Lower Hudson Surficial Geology
Source: New York State Museum, NYS Geological Survey
Publication Date: 1999
Description: Surficial geology of the lower Hudson Valley of New York and Long Island.
Link: http://www.nysm.nysed.gov/research-collections/geology/gis

Terrain (Poughkeepsie City)
Source title: National Elevation Dataset (NED), 1/3 arc-second resolution
Source: US Geological Survey (USGS)
Publication Date: 1/28/2016
Description: NED is an elevation dataset that consists of raster elevation data of the conterminous United States, Alaska, Hawaii, territorial islands, Mexico and Canada. The Poughkeepsie City Terrain layer is a physical relief layer created by Environmental Cooperative at Vassar Barns from the NED using Hillshade tool in ESRI ArcGIS 3D/Spatial Analyst, and clipped to the extent of the City of Poughkeepsie boundary plus approximately 1 mile. The NED data used to create this layer was obtained from The National Map (link below).
Link: https://viewer.nationalmap.gov/basic

Species of Conservation Concern in the City of Poughkeepsie, NY

The following table lists species of conservation concern that have been observed in the City of Poughkeepsie and some adjacent areas. The information comes from the New York Natural Heritage Program (NYNHP) biodiversity databases, New York State Department of Environmental Conservation (NYSDEC) wildlife biologists, the 2000-2005 New York State Breeding Bird Atlas (NYBBA), the 1990-1999 New York Amphibian and Reptile Atlas (NYARA), and New York State Department of State (NYSDOS) Significant Coastal Fish and Wildlife Habitat Assessments. Species from the NYBBA are included in the table if they were documented in Atlas blocks spanning the City's major natural areas (i.e. The Hudson River, Vassar Preserve, and College Hill Park). Note that the NYSDOS habitat assessments and NYBBA blocks include records from areas outside of the City. The table only includes species listed in New York as endangered, threatened, special concern, or Species of Greatest Conservation Need (SGCN), or a Hudson River Valley Priority Bird species recognized by Audubon New York. Historical records are provided from the NYNHP biodiversity databases. Generalized primary habitat types are provided for each species, but for conservation and planning purposes, it's important to recognize that many species utilize more than one kind of habitat. More information on rare animals, plants, and ecological communities can be found at http://guides.nynhp.org. This table was provided for the City of Poughkeepsie Natural Resources Inventory project in August 2018 by the NYSDEC Hudson River Estuary Program to inform land-use planning and decision-making.

			NYS Conservation Status					
Common Name	**Scientific Name**	**General Habitat**	Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	**Data Source**
Mammals								
Indiana Bat	*Myotis sodalis*	cave, forest		xx			US NY	NYSDEC
Little Brown Bat	*Myotis lucifugus*	cave, forest, wetland		xx				NYSDEC

Birds								
American Black Duck	*Anas rubripes*	wetland	x	xx				NYBBA
American Goldfinch	*Spinus tristis*	young forest, shrubland	x					NYBBA
American Kestrel	*Falco sparverius*	meadow	x	x				NYBBA
American Redstart	*Setophaga ruticilla*	forest	x					NYBBA
American Woodcock	*Scolopax minor*	young forest, shrubland	x	x				NYBBA
Bald Eagle	*Haliaeetus leucocephalus*	lake, stream, forest	x	x		NY		NYBBA
Baltimore Oriole	*Icterus galbula*	forest	x					NYBBA
Belted Kingfisher	*Megaceryle alcyon*	lake, stream	x					NYBBA
Black-and-white Warbler	*Mniotilta varia*	forest	x					NYBBA

			NYS Conservation Status					
Common Name	**Scientific Name**	**General Habitat**	Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	**Data Source**
Black-billed Cuckoo	*Coccyzus erythropthalmus*	young forest, shrubland	x	x				NYBBA
Blackburnian Warbler	*Dendroica fusca*	forest	x					NYBBA
Black-throated Blue Warbler	*Dendroica caerulescens*	forest	x	x				NYBBA
Blue-Winged Warbler	*Vermivora pinus*	young forest, shrubland	x	x				NYBBA
Bobolink	*Dolichonyx oryzivorus*	grassland	x	xx				NYBBA
Broad-winged Hawk	*Buteo platypterus*	forest	x					NYBBA
Brown Thrasher	*Toxostoma rufum*	young forest, shrubland	x	xx				NYBBA
Chestnut-sided Warbler	*Setophaga pensylvanica*	young forest, shrubland	x					NYBBA
Chimney Swift	*Chaetura pelagica*	urban	x					NYBBA
Common Nighthawk	*Chordeiles minor*	mixed/urban	x	xx	x			NYBBA
Cooper's Hawk	*Accipiter cooperii*	forest	x		x			NYBBA
Downy Woodpecker	*Picoides pubescens*	forest	x					NYBBA
Eastern Kingbird	*Tyrannus tyrannus*	young forest, shrubland	x					NYBBA
Eastern Towhee	*Pipilo erythrophthalmus*	young forest, shrubland	x					NYBBA
Eastern Wood-Pewee	*Contopus virens*	forest	x					NYBBA
Field Sparrow	*Spizella pusilla*	young forest, shrubland	x					NYBBA
Golden-winged Warbler	*Vermivora chrysoptera*	young forest, shrubland	x	xx	x			NYBBA
Kentucky Warbler	*Oporornis formosus*	forest	x	xx				NYNHP
Least Flycatcher	*Empidonax minimus*	forest	x					NYBBA
Louisiana Waterthrush	*Seiurus motacilla*	forest	x	x				NYBBA
Northern Flicker	*Colaptes auratus*	forest	x					NYBBA
Peregrine Falcon	*Falco peregrinus*	cliff	x	x			NY	NYNHP

Species of Conservation Concern in the City of Poughkeepsie, NY

Common Name	Scientific Name	General Habitat	NYS Conservation Status: Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	Data Source
Prairie Warbler	*Dendroica discolor*	young forest, shrubland	x	x				NYBBA
Purple Finch	*Carpodacus purpureus*	forest	x					NYBBA
Purple Martin	*Progne subis*	wetland	x					NYBBA
Red-headed Woodpecker	*Melanerpes erythrocephalus*	forest	x	xx	x			NYBBA
Red-shouldered Hawk	*Buteo lineatus*	forest	x	x	x			NYBBA
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	forest	x					NYBBA
Savannah Sparrow	*Passerculus sandwichensis*	grassland	x					NYBBA
Scarlet Tanager	*Piranga olivacea*	forest	x	x				NYBBA
Sharp-shinned Hawk	*Accipter striatus*	forest	x		x			NYBBA
Veery	*Catharus fuscescens*	forest	x					NYBBA
Willow Flycatcher	*Empidonax trailli*	young forest, shrubland	x					NYBBA
Wood Thrush	*Hylocichla mustelina*	forest	x	x				NYBBA
Worm-eating Warbler	*Helmitheros vermivorum*	forest	x	x				NYBBA
Yellow-billed Cuckoo	*Coccyzus americanus*	young forest, shrubland	x					NYBBA
Yellow-throated Vireo	*Vireo flavifrons*	forest	x					NYBBA
Reptiles								
Common Snapping Turtle	*Chelydra s. serpentina*	wetland, coast, open water		x				NYARA
Fish								
Alewife	*Alosa pseudoharengus*	coast		x				NYSDOS
American Eel	*Anguilla rostrata*	stream		xx				NYNHP
American Shad	*Alosa sapidissima*	coast		xx				NYSDOS
Atlantic Sturgeon	*Acipenser oxyrinchus*	coast		xx			US	NYSDOS

Species of Conservation Concern in the City of Poughkeepsie, NY

Common Name	Scientific Name	General Habitat	NYS Conservation Status: Hudson River Valley Priority Bird	Species of Greatest Conservation Need xx = high priority	Special Concern	Threatened	Endangered	Data Source
Blueback Herring	*Alosa aestivalis*	coast		x				NYSDOS
Fourspine Stickleback	*Apeltes quadracus*	coast		xx				NYSDOS
Shortnose Sturgeon	*Acipenser brevirostrum*	coast		x			US NY	NYSDOS
Threespine Stickleback	*Gasterosteus aculeatus*	coast		xx				NYSDOS

Natural Communities								
Tidal River								NYNHP

Historical Records								
Large Twayblade	*Liparis liliifolia*	wetland, forest					NY	NYNHP
Northern Long-eared Bat	*Myotis septentrionalis*	cave, forest		xx		US NY		NYNHP
Rattlebox	*Crotalaria sagittalis*	disturbed sites					NY	NYNHP
Side-oats Grama	*Bouteloua curtipendula var. curtipendula*	forest, rocky summit					NY	NYNHP
Violet Wood-sorrel	*Oxalis violacea*	forest, rocky summit				NY		NYNHP
Veined Skullcap*	*Scutellaria nervosa*							NYNHP

*Apparently extirpated from New York State

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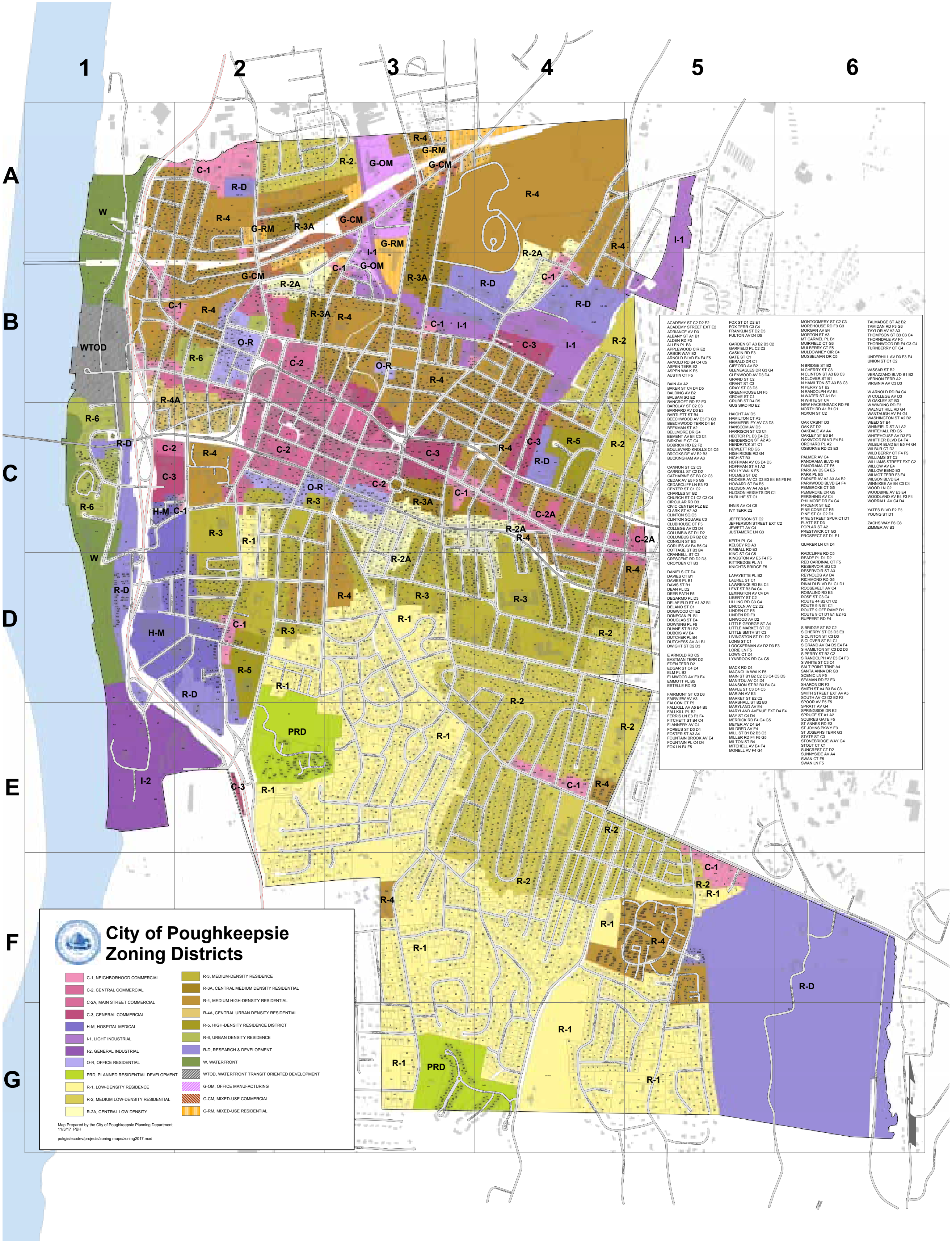
www.dec.ny.gov/lands/5094.html

Species of Conservation Concern in the City of Poughkeepsie, NY


City of Poughkeepsie
Zoning Districts
C-1, NEIGHBORHOOD COMMERCIAL
C-2, CENTRAL COMMERCIAL
C-2A, MAIN STREET COMMERCIAL
C-3, GENERAL COMMERCIAL
H-M, HOSPITAL MEDICAL
I-1, LIGHT INDUSTRIAL
I-2, GENERAL INDUSTRIAL
O-R, OFFICE RESIDENTIAL
PRD, PLANNED RESIDENTIAL DEVELOPMENT
R-1, LOW-DENSITY RESIDENCE
R-2, MEDIUM LOW-DENSITY RESIDENTIAL
R-2A, CENTRAL LOW DENSITY
R-3, MEDIUM-DENSITY RESIDENCE
R-3A, CENTRAL MEDIUM DENSITY RESIDENTIAL
R-4, MEDIUM HIGH-DENSITY RESIDENTIAL
R-4A, CENTRAL URBAN DENSITY RESIDENTIAL
R-5, HIGH-DENSITY RESIDENCE DISTRICT
R-6, URBAN DENSITY RESIDENCE
R-D, RESEARCH & DEVELOPMENT
W, WATERFRONT
WTOD, WATERFRONT TRANSIT ORIENTED DEVELOPMENT
G-OM, OFFICE MANUFACTURING
G-CM, MIXED-USE COMMERCIAL
G-RM, MIXED-USE RESIDENTIAL
Map Prepared by the City of Poughkeepsie Planning Department
11/3/17 PBH
pokgis/ecodev/projects/zoning maps/zoning2017.mxd
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City of Poughkeepsie Climate Smart Resiliency Planning

Prepared by Michelle Gluck, Cornell Cooperative Extension Dutchess County

The Climate Smart Resiliency Planning Tool (CSRP) is a checklist to identify gaps in a community's planning process.

The Climate Smart Resiliency Planning Tool was used to evaluate opportunities for the City of Poughkeepsie to improve resilience to flooding and climate change. The Planning Tool reviews many long- and short- term aspects of storm and climate change preparedness by reviewing City and County planning documents, municipal codes, activities and management. Documents were reviewed, and municipal staff members were consulted in the process of completing the assessment. The assessment and recommendations have been shared through meeting discussions, with the City Administrator's office, and presented at the September 25th, 2018 Waterfront Advisory Committee meeting session.

Municipal staff engaged in the City of Poughkeepsie Climate Smart Planning assessment:

Paul Hesse, Community Development Coordinator, Dutchess County Department of Planning and Development and City of Poughkeepsie
Natalie Quinn, City Planner
Judith Knauss, Deputy Zoning Administrator
Jennifer Rubbo, the Environmental Cooperative at the Vassar Barns
Europa McGovern, City of Poughkeepsie Waterfront Advisory Committee

The completed assessment and recommendations highlight areas of opportunity for the City of Poughkeepsie to integrate flood and climate change preparedness into its municipal operations and planning. Recommendations that align with NYSDEC Climate Smart Community Program actions are displayed in bold font.

Areas of Strength

- The City recently hired a Senior City Planner and two new code enforcement officers. This provides the City with increased staffing capabilities and capacity.
- The City has taken interest in community wellness and community development initiatives and received funding (2018) for pedestrian safety through the NYS Pedestrian Safety Action Plan.
    - In 2018, Marist College Environmental Planning students prepared a report on walkability titled, "The Poughkeepsie Northside Pedestrian Needs Assessment."
- The City has an active Waterfront Advisory Committee which works to strengthen, support and connect the City's waterfront areas.

- Collaborative community organizations (arts/culture, affordable housing, local jobs).
    - The City received $1 million through the Department of State for rehabilitation of the Poughkeepsie Trolley Barn, located along the Fall Kill to spur revitalization through arts.
    - The newly activated Northside Collaborative (2017).
- The Waterfront Redevelopment Strategy provides a sound overview of City plans, historical context and integration of various local and regional plans and strategies, description of waterfront park conditions, floodplain issues on the waterfront, and property ownership.
- The City has several ongoing initiatives to make the City more pedestrian and bicycle friendly:
    - The City was recently awarded a 75,000 Greenway grant to connect College Hill Park and the Dutchess County Rail Trail[1]
    - The Kaal Rock Connector Project (in partnership with Scenic Hudson)
- The City's land use process and procedure project: The City is currently reviewing its development process and administration (in partnership with PACE Land Use Law Center).

Areas of Opportunity

- There is interest and action to form a Conservation Advisory Council (CAC) for the City. The CAC could prove to be a valuable asset in implementing many of the CSRP recommendations and supporting the City in securing funding for them.
- The City has interest in updating its Zoning Code and is currently engaged in the Rezone Downtown Poughkeepsie project Part of the policy framework is to offer a transit-supportive, pedestrian-friendly and bike-able city. This could potentially be an opportunity to incorporate CSRP recommendations when going through updates.
- The City has secured funding for the NYS Department of State Local Waterfront Revitalization Program[2] (LWRP) to update their plan with input from their Waterfront Advisory Committee (WAC). The City released an RFP with proposals due 7/27/2018. CSRP recommendations could be referenced in the update.
- The Fall Kill Watershed Management Plan (2006), Fall Kill Plan (2012), and the Fall Kill Watershed Neighborhood Source Assessment (2012) provide substantial data on flooding of the Fall Kill and recommendations to improve its health and that of surrounding neighborhoods.
- Mass Design Group completed an assessment of a City of Poughkeepsie portion of the Fall Kill. This assessment could help inform the Comprehensive Plan update, LWRP, or Resiliency Plan.
- The City will be cutting down 50 Ash Trees due to infestation from the Emerald Ash Borer Beetle. There is an innovative educational campaign to inform residents of why the trees are being cut down and the importance of maintaining healthy city trees. This is a great opportunity to provide education about the value and benefit of green infrastructure in urban environments.
- The City of Poughkeepsie can leverage completion of this CSRP for points towards Climate Smart Communities Program (CSC) certification. **CSC PE7 Action: Climate Smart Resiliency Planning (6 pts).** For more information on the CSC Program and the actions listed in this document, visit the CSC portal: https://climatesmart.ny.gov/. CSC Certification is one of the 10 High Impact Actions of the NYSERDA Clean Energy Communities Program (CEC), which the City is actively pursuing.

1 http://midhudsonnews.com/News/2018/September/17/Pou_Greenway_grant-17Sep18.html
2 https://www.dos.ny.gov/opd/programs/lwrp.html

- The City is partnering with the Environmental Cooperative at Vassar Barns to complete a Natural Resources Inventory. This could open up opportunities for conserving beneficial land areas such as floodplains and urban tree canopy, and inform a Natural Resource Management Plan or an update to the current Open Space Plan (1976)
- The City recently started an engagement campaign with residents through promoting a Parks Improvement survey. This is part of an initiative to create a Parks Improvement Plan. This is a great opportunity for resiliency planning and green infrastructure practices to be incorporated.
- The City has a newly activated Anti-Blight Initiative headed by the City Administrator and built from the Poughkeepsie Distressed Property Initiative. The Anti-Blight Initiative aims to inventory properties and determine strategies for beneficial active use. Resilient building and land use practices could be incorporated when determining beneficial uses and restoration efforts.
- The City has been actively applying for grant funding for resiliency related topics:
    - NYS Consolidated Funding Application 2018 (CFA) to update Comprehensive Plan and create an Emergency Preparedness Plan through New York State Department of Environmental Protection (NYSDEC) CSC Program funding.
    - CFA 2018 to implement green infrastructure in a city owned parking lot.
    - NYSDEC Urban and Community Forestry Grant to conduct a tree inventory and management plan.

Recommendations

The following opportunities emerged as a result of the CSRP assessment and are organized according to priority projects and department specific recommendations:

Priority Projects

Comprehensive Plan Update:

CSC PE6 Action: Comprehensive Plan with Sustainability Elements (3-21 pts.) *CSC Grant Funding Available.

- Reference and integrate plans and initiatives such as the Fall Kill Watershed Management Plan (2006), the Fall Kill Plan (2012), and the Fall Kill Watershed Neighborhood Source Assessment (2012). Incorporate content from the Natural Resources Inventory.
- Update the Open Space Plan (1976) and adopt plan as part of the comprehensive plan. Coordinate plan with the New York State Open Space Plan.
- Involve emergency managers, floodplain manager, and public works officials in the process and other community stakeholders. Clearly explain participation techniques.
- Incorporate resilience within the mission, vision, and goals.

- Identify flood-prone areas and discourage development in those areas as well as require strategies to reduce flood damage to building, roads, driveways, and parking lots.
    - Implement green infrastructure installation projects at strategic locations to relieve stress on combined sewers during heavy rain events.
- Include strategies to reduce stormwater runoff from roads, driveways and parking lots (i.e. green infrastructure techniques to help prevent flooding.)

- Emphasize non-structural pre-disaster mitigation measures such as acquiring flood-prone lands and adopting No Adverse Impact floodplain regulations.
- Identify strategies to determine whether to relocate structures that have been repeatedly flooded. Include an equitable approach for community involvement in relocation decisions and potential funding sources.
- Identify safer growth areas in the City. Include recommendations and policy updates to encourage development in such areas.

- Ensure plan has a recommended update frequency, even if it is just a goal for when the plan should be updated or reviewed and not an official, mandated update frequency.

Zoning Code Update/Downtown Rezoning Initiative:

- Update codes to promote more flood resistant building.
- Review the use of impact fees, accommodation taxes, or user fees to manage development in hazard-prone areas.
- When planning new development, ensure that it is compact, walkable and has a variety of uses.
    - Refer to the City Center Revitalization Plan. Consider drawing content from the Poughkeepsie Northside Pedestrian Needs Assessment (2018).
- Encourage green infrastructure and low impact development strategies and regulations.
    - Tree protection ordinances, impervious cover limits, riparian buffers, vegetated drainage channels, cluster development
    - Implement green infrastructure installation projects at strategic locations to relieve stress on combined sewers during heavy rain events.

Create a Resiliency Plan that includes:

- Community visioning through involving the public in opportunities to identify historic storm effects including storm-surge elevations, flood-prone streets, or property loss.
    - Install publicly visible high water mark signs. Consider collaboration with local artists.
- Content from various other plans, reports, assessments and initiatives such as the Natural Resources Inventory, Fall Kill reports, and Anti-Blight Initiative
- Climate change trends and predictions
- Environmental/social/economic consequences of failure to address natural hazards
- Riverine and waterfront flooding concerns and floodplain/stormwater management
- Identification of areas of significant public investment, water dependent uses, and critical infrastructure that require structural protection because options for relocation, elevation, or employment of non-structural measures are not feasible
- A full Climate Vulnerability Assessment **CSC PE7 Action: Climate Vulnerability Assessment (4-16 pts.) *CSC Grant Funding Available.** Include;
    - Identification of climate hazards, past events, and details such as magnitude of consequences, operations disruptions, operating costs, number of persons affected.
    - Information from the Hazard Mitigation Plan (municipal annex) Section 9.3.4 Hazard Risk/Vulnerabilities and Ranking.

- Future estimates of losses that may result from hazards using the Department of State's Asset Inventory Worksheet and Risk Assessment Tool[3] to identify vulnerabilities.
- Categorized adaptation strategies prioritized by cost, type, administration, geography, feasibility, timing of implementation, efficacy, and co-benefits. Include strategies to reduce vulnerability through non-structural measures where possible. **CSC PE7 Action: Climate Adaptation Strategies (2-8 pts.)**
- Maps of vulnerabilities in relationship to risks; vulnerable populations, natural resources, cultural resources, landslides, sea-level rise. The City could work with Dutchess County to complete these maps.
- A procedure for coordinating with neighboring jurisdictions to explore a watershed-wide approach to stormwater management.
- Ensure plan has a recommended update frequency, even if it is just a goal for when the plan should be updated or reviewed and not an official, mandated update frequency

Local Waterfront Revitalization Project (LWRP) Update:

- Consider engaging in sustainable wetland or shoreline restoration, including non-structural and ecologically enhanced methods. **CSC PE7 Action: Restoration of Floodplains and Riparian Buffers (1-10 pts.) or PE7 Action: Nature-based Shoreline Protection (under review).**
    - Include guidance to control invasive plant species, especially near riparian buffers and shorelines of the Fall Kill and Hudson River.
    - Inform property owners of preferred sustainable shoreline protection techniques.
- Use all available authorities to restrict or prohibit any activities, development or other actions in erosion hazard areas, in order to minimize damage to property, and to prevent the exacerbation of erosion hazards.
- Adopt the projections of sea-level rise from the State Sea Level Rise Task Force report or more recent studies for planning purposes.

Create an Emergency Preparedness Plan:

- Include a procedure for public outreach on;
    - Storm preparedness including expected inundation areas, evacuation routes, evacuation bus pick-up locations, severe weather shelter locations, and pet shelters.
    - What to include in an at-home emergency kit, emergency supplies and in an evacuation kit. Guide residents on the development of personal or family evacuation plans.
- Become a Storm Ready Community
- Create an Emergency Response and Short-term Recovery Plan.
    - Include a hierarchy of authority during emergencies and identify first responders.
    - Include a list of contacts for operators of municipal facilities.
    - Include steps for emergency protective measures (sandbagging, erecting warning devices, search and rescue).
    - Include organizational framework to conduct preliminary damage assessments.
    - Incorporate best available projections for extreme storm frequency and severity.

[3] https://stormrecovery.ny.gov/community-regions/hudson-valley-and-westchester

- Include guidance on coordination among critical stakeholders such as local community organizations, businesses, health departments, utilities, and local government leaders.
    - Identify a designated emergency operations center and designated storm shelters that are located outside of flood-hazard areas; designed to withstand high winds; and have an elevated back-up power source.
- Create an Evacuation Plan. **CSC PE7 Action: Early Warning Systems and Evacuation Plans (under review[4])**.
    - Clearly define responsibilities for municipal evacuation
    - Identify a time frame to evacuate residents from storm hazard areas
    - Identify flood prone locations on evacuation routes and identify more than one route.
    - Provide consideration that neighboring jurisdictions could be evacuating concurrently.
    - Identify evacuation options for populations that rely on public transportation.
    - Identify conditions for which a traffic lane reversal would be implemented.
    - Identify local and state evacuation assistance programs for the following special needs; hospitals, nursing homes, prisons, residents without personal transportation, elderly, disabled, schools.
- Maintain and promote a special needs registry for vulnerable populations.
- Establish a volunteer community emergency response team.
- Establish an adequate heat-warning system and cooling-center program for vulnerable populations. **PE7 Action: Cooling Centers (under review**). *CSC Grant Funding Available
- Create a Continuity of Operations Plan including guidance on post-disaster waste management.
- Define procedures to conduct habitability and substantial damage assessments
- Store FEMA elevation certificates outside of flood-hazard areas.
- Create a Long-Term Recovery Plan. This plan could:
    - Identify redevelopment opportunities outside of flood-hazard areas.
    - Employ advisory flood maps to define post-disaster redevelopment building elevations.
    - Identify opportunities to retrofit or relocate existing structures in hazard-prone areas.
    - Utilize risk and vulnerability mapping to determine the location of future development.
    - Identify clear lines of coordination to transition from short-term to long-term recovery.
    - Include organizational framework for coordination and use of state, federal and NGO resources to provide maximum benefit to the disaster area.
    - Include provisions to reduce greenhouse gas emissions from reconstructed areas through energy efficiency, use of renewable energy and smart growth principles.
- Establish a temporary post-disaster building moratorium, if possessing the authority to do so.
- Ensure plan has a recommended update frequency, even if it is just a goal for when the plan should be updated or reviewed and not an official, mandated update frequency

Website Updates/Public Outreach Opportunities:

- Conduct public outreach on the natural and beneficial functions of floodplains, wetlands, and green infrastructure and other flood mitigation practices through webpage content, brochures, educational programs, public art, and increased signage.

[4] Definition of "Under Review": These actions are currently being revised by the Climate Smart Communities interagency team and will be uploaded to the portal within the next few weeks.

- Use the City's website to conduct outreach to residents and businesses by adding a link to the City's website directing residents and businesses to Dutchess County's webpage on storm-preparedness[5], brochures and newsletters, community meetings, television, radio or on social media pages. **CSC PE9 Action: Social Media (3 pts.)**
- Add a link to the City's website directing residents to Dutchess County's webpages[6] on developing personal and family evacuation plans, at-home emergency kits, emergency supplies, evacuation kits (FEMA's Ready.gov checklist), and ASPCA's disaster preparedness steps for domesticated animals. Other public outreach on these topics could be conducted through social media pages, brochures, community newsletters, etc. **CSC PE9 Action: Social Media (3 pts.)**
- Employ multilingual and culturally sensitive approaches when providing outreach to residents.
- Inform residents of the NY-Alert Program
- Consider developing a public outreach plan on climate outreach and engagement comprised of the elements above. **CSC PE9 Action: Climate Change Education and Engagement (4-8 pts.).**

Conservation Advisory Council:

- Take the CSC Program Pledge and consider eventually becoming a certified CSC.
    - Establish a Climate Smart Communities Task Force **(CSC PE1.2 (20 Points.)**
    - Appoint a Climate Smart Community Coordinator **(CSC PE1.3 (10 Points.)**
- Create a local Climate Action Plan. **CSC PE2 Action: Government Operations Climate Action Plan (12-16 pts.) or Community Climate Action Plan (16pts.).**
- Review existing tools used to manage development in hazard-prone areas and consider employing the following;
    - Rolling easements
    - Buyouts of vulnerable properties and other land acquisition programs
    - Transfer of development rights or purchase of development rights
- Prohibit automatic replacement of hardened structures impacted by flooding

Department Specific

Engineering/Public Works:

- Ensure staff capacity for using vulnerability assessment (like FEMA's HAZUS-MH) and risk-mapping tools (like flood insurance rate maps). If it is beyond the City's capacity, look to Dutchess County staff who have the capacity to use these resources.
- Have staff complete post-flood stream intervention training. For more information on this training, including upcoming scheduled trainings, visit the DEC's webpage[7]
- Work with The Nature Conservancy through their Community Resilience Building process[8].
- Increase active participation in the Dutchess County MS4 Committee.
- Describe municipal responsibilities for inspection and maintenance of facilities.

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[5] http://www.co.dutchess.ny.us/QuickLinks/17006.htm
[6] http://www.co.dutchess.ny.us/QuickLinks/17006.htm
[7] https://www.dec.ny.gov/lands/86450.html
[8] www.communityresiliencebuilding.com/crbworkshopguide

Planning:

- Publicize the availability of floodplain information to property owners, businesses, insurance agents, real estate agents, and lenders through trainings on Parcel Access, or other means such as webpages, brochures, or educational trainings.
    - Include a link to Parcel Access and FEMA flood plain information in the application for site plan review checklist.
    - Provide property owners with guidelines to retrofit existing development for flood risks. Consider providing a "new homeowner" package to share this and related information.
- Work with The Nature Conservancy through their Community Resilience Building process[9].
- Support land-acquisition programs to purchase land-conservation easements in hazard-prone areas. **CSC PE7 Action: Restoration of Floodplains and Riparian Buffers (2 pts.).**

Building:

- Address flood hazards; including making recommendations to reduce hazard vulnerability through land-use planning.
- Plan for costs associated with inspection and enforcement of building and zoning codes.
- Enhance protocol for assessing older building stock that may be more vulnerable to high winds.

City Administrator:

- When updating the Capital Improvements Plan, consider;
    - Flood risk, coastal hazards and sea-level rise projections into risk assessments over the expected service life of proposed infrastructure projects and municipal infrastructure.
    - Integration of existing plans, studies, reports, and technical information.
    - Identifying threats of coastal storms, erosion, sea-level rise, and other climate hazards.
    - Identifying the vulnerability of wildlife and habitat to coastal hazards.

Potential Funding Sources

- DEC Climate Smart Communities Grant Program: https://www.dec.ny.gov/energy/109181.html
- DEC Grant Applications: https://www.dec.ny.gov/pubs/grants.html
- DEC Hudson River Estuary Program Grants: https://www.dec.ny.gov/lands/5091.html
- FEMA Hazard Mitigation Grant Program: https://www.fema.gov/hazard-mitigation-grant-program
- FEMA Pre-disaster Mitigation Grant Program: https://www.fema.gov/pre-disaster-mitigation-grant-program
- FEMA Flood Mitigation Assistance Grant Program: https://www.fema.gov/flood-mitigation-assistance-grant-program
- HUD Community Development Block Grants: https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs
- NYS Department of State Grants (including Local Waterfront Revitalization Program): https://www.dos.ny.gov/funding/

[9] www.communityresiliencebuilding.com/crbworkshopguide

PE7 Action: Climate Smart Resiliency Planning

6 Points · BRONZE PRIORITY · SILVER PRIORITY

A. Why is this action important?

Local government decision makers often have the greatest capacity to influence the resiliency of their communities to climate change. Typically, they are the first to respond to emergencies and they understand the physical and social characteristics of their communities. With climate change brining more extreme weather, local decision makers have the responsibility to examine vulnerabilities and take action to protect community assets. Some strategies utilized in local plans and projects may help to build a community's resilience to climate change, while others may fail to consider how climate change will affect their implementation. Sometimes slight modifications to existing policies or projects can help a community more effectively prepare for climate change. Conducting a survey of existing plans, policies, and projects will expose gaps and vulnerabilities, and ultimately, help ensure that they will either help reduce or, at a minimum, not increase vulnerability. The Climate Smart Communities (CSC) program developed a procedure to conduct such a survey: Climate Smart Resiliency Planning. Climate Smart Resiliency Planning (CSRP) is procedure for holding a facilitated discussion and completing a questionnaire that is designed to stimulate ideas and collaboration among local government staff and officials. Implementing CSRP helps local decision makers understand the importance of climate action and creates an opportunity to integrate climate considerations into local government operations.

B. How to implement this action

Conduct a self-evaluation of local plans, policies, and projects using the Climate Smart Resiliency Planning procedure. This action can be accomplished as a standalone project, or as part of another effort such as a climate action plan, a vulnerability assessment, a comprehensive plan, or climate adaptation plan. CSRP is designed to help municipal staff and officials work collaboratively to recognize the opportunities to enhance community resilience in existing plans and begin to create a set of integrated planning documents that identify vulnerabilities, assess risk, and describe appropriate adaptation strategies. Because it is focused on existing government policies and projects, CSRP is often one of the first steps in climate adaptation planning and should be followed by the development of strategies, as per PE7 Action: Climate Adaptation Strategies.

To implement CSRP, put together a team to plan the effort and identify the most knowledgeable and relevant staff members that will contribute to the self-evaluation. A person should be appointed as a facilitator to elicit participation in discussions, oversee documentation of the CSRP process, and ensure that every question is answered. Although not necessary, local governments may find it useful to appoint someone not associated with the municipality to serve as the facilitator, e.g., a contractor who is familiar with the region and with climate change adaptation strategies, a knowledgeable volunteer from the CSC task force, or a NYSERDA Clean Energy Communities regional coordinator.

To be eligible for points under this CSC action, CSRP must have been implemented within five years of the application date. Applicants must follow the steps in the CSRP guide and fill out the CSRP tool. The CSRP tool is the Excel spreadsheet that contains the questions and checklists for each of the six sections; it provides a place to take notes and identify gaps or deficiencies in local plans, policies and projects. Applicants must also provide a summary report of the findings and show that they engaged municipal staff and officials across departments in the discussion of climate vulnerabilities as they relate to local plans, policies, and projects.

C. Timeframe, project costs, and resource needs

The timeframe for this action largely depends on the size of the local government and the number of plans, policies, and projects evaluated. A typical timeframe is one to three months. The costs are mainly related to staff time, although some local governments may choose to hire a contractor to act as a facilitator, document the process, and help produce the summary report.

D. Which local governments implement this action? Which departments within the local government are most likely to have responsibility for this action?

This action is applicable to all types of local governments and all departments. The department or office that leads climate and sustainability efforts is most likely to be responsible for this action. This action is typically led by the chief elected official's office and undertaken by the city manager's office, or the department of the environment or planning. Volunteer groups, such as the CSC task force may assist, but detailed input from knowledgeable municipal staff and officials is necessary.

E. How to obtain points for this action

Six points are available for local governments that implement CSRP and provide the required documentation.

F. What to submit

Submit a copy of the completed CSRP tool and the summary report of the findings. At minimum, the summary report must describe the evaluation process (including a record of engaging municipal staff and officials across departments) and the gaps that were identified in local plans, policies, and projects as they relate to community vulnerability to climate change. The CSRP process must have been implemented within five years of the application date.

All CSC action documentation is available for public viewing after an action is approved. Action submittals should not include any information or documents that are not intended to be viewed by the public.

G. Links to additional resources or examples

- CSC Climate Smart Resiliency Planning – A Planning Evaluation Tool for New York State Communities
- Piermont, NY, Climate Smart Resilience Planning: Results and Recommendations (2014) (posted on a Scenic Hudson webpage)

H. Recertification Requirements

For recertification, local governments must provide updated CSRP documentation every five years that reflects any infrastructure changes or any new plans, policies, or projects that were not addressed in the initial report.

Dutchess County
Department of
Planning and
Development

William R. Steinhaus
County Executive

Roger P. Akeley
Commissioner

Kealy Salomon
Assistant Commissioner

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New York
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(845) 486-3600
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November 16, 2009

Ms. Jennifer Rubbo
Fall Kill Watershed Coordinator
Hudson River Sloop Clearwater
724 Wolcott Avenue
Beacon, NY 12508

Dear Ms. Rubbo:

The Dutchess County Department of Planning and Development supports the recent passage of the Fall Kill Memorandum of Agreement which was endorsed by the Fall Kill Watershed Committee, Hudson River Sloop Clearwater and the NYS DEC Hudson River Estuary Program. It will have long-range benefits to the Hudson River and to the municipalities located in the watershed.

Located approximately 80 miles from New York City in the center of Dutchess County and draining approximately 19 square miles in five Dutchess County municipalities, the watershed has experienced intense growth and water quality degradation in recent years. As a direct tributary of the Hudson River, the health of the Fall Kill has direct impacts on the water quality of the River.

The current Memorandum of Agreement passed by the Towns of Clinton, Hyde Park, Poughkeepsie and the City of Poughkeepsie establishes an Intermunicipal Council made up of representatives of each of these municipalities and from the Fall Kill Watershed Committee. The agreement acts to formally affirm the partnerships among these municipalities and will help to address such issues as securing grant funding, supporting the Watershed Management Plan, addressing federal storm water mandates and developing educational programs focusing on watershed planning, pollution prevention and storm water management.

Dutchess County is proud of our commitment to preserve our natural resources and recognizes that watershed boundaries often cross political boundaries. Cooperation among municipalities is key to securing long-term positive impacts to watershed health. Therefore, we wholeheartedly support the work of the Fall Kill Intermunicipal Council as they work toward improving water quality, reducing the negative impacts of flooding, and provide education to the citizens of our county about caring for our water resources.

Sincerely,

Roger P. Akeley
Commissioner, Department of Planning and Development

http://www.dutchessny.gov E-mail: plandev@co.dutchess.ny.us

Memorandum of Agreement
with respect to the
Fall Kill Watershed

WHEREAS, the Fall Kill Watershed (hereinafter "Watershed") is contained entirely in Dutchess County and covers approximately 12,475 acres, spanning the following five municipalities: the City of Poughkeepsie, and the Towns of Clinton, Hyde Park, Pleasant Valley, and Poughkeepsie; and

WHEREAS, maintaining and enhancing water quality and ecological health in and along the Fall Kill Creek (hereinafter "Creek") and its tributaries, which are part of the Hudson River drainage basin, is essential to the economic well-being, the environmental and public health, and the quality of life for the local governments, residents and visitors of the Fall Kill watershed; and

WHEREAS, the Creek is an important tributary to the Hudson River which provides important habitat for many species of fish and wildlife, as well as potential recreational opportunities; and

WHEREAS, residents in the Watershed rely on water directly from the Hudson River and on private wells for drinking water; and

WHEREAS, the undersigned cooperating municipalities (hereinafter "Municipalities") wish to explore mutually beneficial ways of sharing information and resources to improve their relationship with the Creek and the Watershed, as well as improve the health, ecology, economic and recreation potential of the Creek itself; and

WHEREAS, the Municipalities realize that the Creek, as a tributary of the Hudson River, links their communities and that, therefore, land use decisions made by any municipality in the Watershed can impact downstream municipalities as well as the habitat for the Creek's flora and fauna; and

WHEREAS, in 2006 a Watershed Management Plan for the Fall Kill was developed by Patrick Bean and Thomas R. Lynch from the Department of Environmental Science and Policy, Marist College and David Burns of the Dutchess County Environmental Management Council, with funding from the NYS Department of Environmental Conservation Hudson River Estuary Program, which Plan identifies threats to the watershed as well as recommendations to protect and restore the water and habitat quality of the watershed; and

WHEREAS, the Municipalities are encountering common issues relating to the Watershed and identified in the Fall Kill Management Plan such as:

- flooding;
- storm water management;

- improving water quality;
- educating the general public and policy makers about watershed issues
- increasing public access/recreational opportunities; and
- improving aesthetics and restoring native vegetation.

WHEREAS, The Fall Kill Watershed Committee (hereinafter the Committee) is a coalition of community groups, educational institutions, businesses, local governmental officials, environmental groups and interested community individuals living and working in the Fall Kill watershed, formed in 2002 to promote the protection and revitalization of the historic Fall Kill Creek and its surrounding watershed.

WHEREAS, cooperation pursuant to this Memorandum of Agreement should result in, among other things:

a. enhanced opportunities when applying for grants to fund mutually beneficial projects in respect of the Creek and the Watershed; and
b. a more efficient and cost-effective coordinated approach to implementing current and future projects pertaining thereto.

WHEREAS, the Municipalities wish to formally affirm their continuing partnership in order to protect, conserve, and enhance the water resources of the Creek and the Watershed; and

Now therefore, pursuant to the authority vested in them by Section 119-o of the General Municipal Law of the State of New York, the Municipalities hereby agree as follows:

1. The Municipalities hereby form and establish the Fall Kill Watershed Intermunicipal Council (hereinafter the "Council"), to be comprised of one representative and one alternate from each Municipality. The administrative functions of the Council shall be supplied by the Committee, which shall designate one representative and one alternate to attend and support all meetings of the Council.

2. The Council will work with the Committee to address the aforementioned issues, which efforts may include, but are not limited to, the following:

   a. securing and sharing the public and private grants available to address issues pertaining to the Creek and the Watershed;
   b. supporting the current Fall Kill Watershed Management Plan and suggesting updates when needed;
   c. coordinating other organizational efforts in each of the individual municipalities to ensure their compatibility in the context of the Fall Kill watershed;
   d. addressing federal storm water mandates, including the joint implementation of new technologies such as Green Infrastructure Projects, and associated joint training opportunities; and

e. developing educational programs on watershed planning, pollution prevention, and storm water management.

3. The Council may act as an interested party when development within the Watershed affects the Watershed corridor's ability to function as necessary to prevent flooding and the degradation of water quality and water habitat.

4. Each Municipality may, at its discretion and from time to time, change its representative or alternate to the Council.

5. The Council shall meet at least twice a year. Meetings will be hosted and chaired on a rotating basis by each Municipality.

6. The Council shall at least once a year present to the Municipalities a report on the progress made in achieving the projects envisioned hereunder.

7. The Council may establish subcommittees including nonmembers, as needed, to obtain public input and participation from nonmembers in ongoing activities.

8. Any Municipality may terminate its participation in the Council and this Agreement at any time by notifying all other Municipalities in writing of the determination, reasons for the termination, and the effective date thereof. Withdrawal from the Council and this Agreement by one Municipalilty shall not operate to terminate the Agreement, which shall continue in full force and effect with respect to all other Municipalities and the Committee.

9. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original but all which, when taken together, shall constitute one and the same instrument.

10. This Agreement does not require the payment of any funds by any Municipality, nor does it commit any Municipality to take any specific action with respect to the Creek, the Watershed or the participating Muncipality.

11. Each Municipality hereby represents to the others that the municipal official executing this Agreement on behalf of the Municipality has been authorized to do so by a duly adopted resolution of the Town Board.

12. The Committee hereby represents to the Municipalities that the individual executing this Agreement on behalf of the Committee has been authorized to do so by the Committee.

Town of Clinton:

Name: [signature]
Title: Supervisor

Town of Hyde Park

[signature]
Name:
Title: Town Supervisor

Town of Poughkeepsie

Patricia Myers
Name:
Title: Supervisor

City of Poughkeepsie:

[signature]
Name: John C Tkazyik
Title: MAYOR

Fall Kill Watershed Committee:

Jennifer Rubbo
Name:
Title: Fall Kill Watershed Committee Coordinator

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