Chapter 3. Water Resources

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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

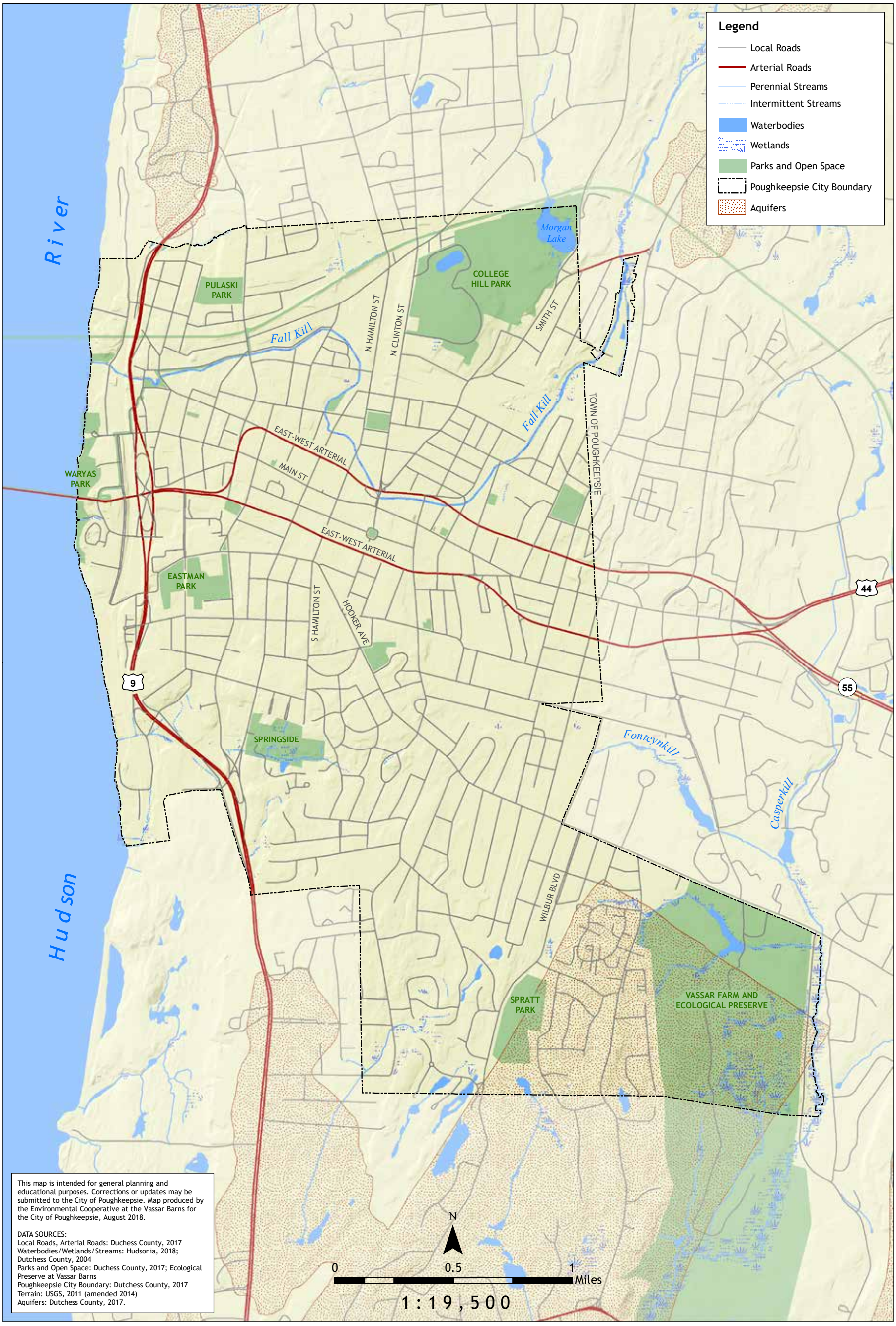
Groundwater feeds our rivers and streams and is the primary source of water for aquatic habitats during times of drought. Aquifers are areas with significant amounts of groundwater saturation. This groundwater is used to supply wells and other water sources. Groundwater recharge occurs primarily through 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

Aquifers

City of Poughkeepsie, New York



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.

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Aquifers: Dutchess County, 2017.

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.

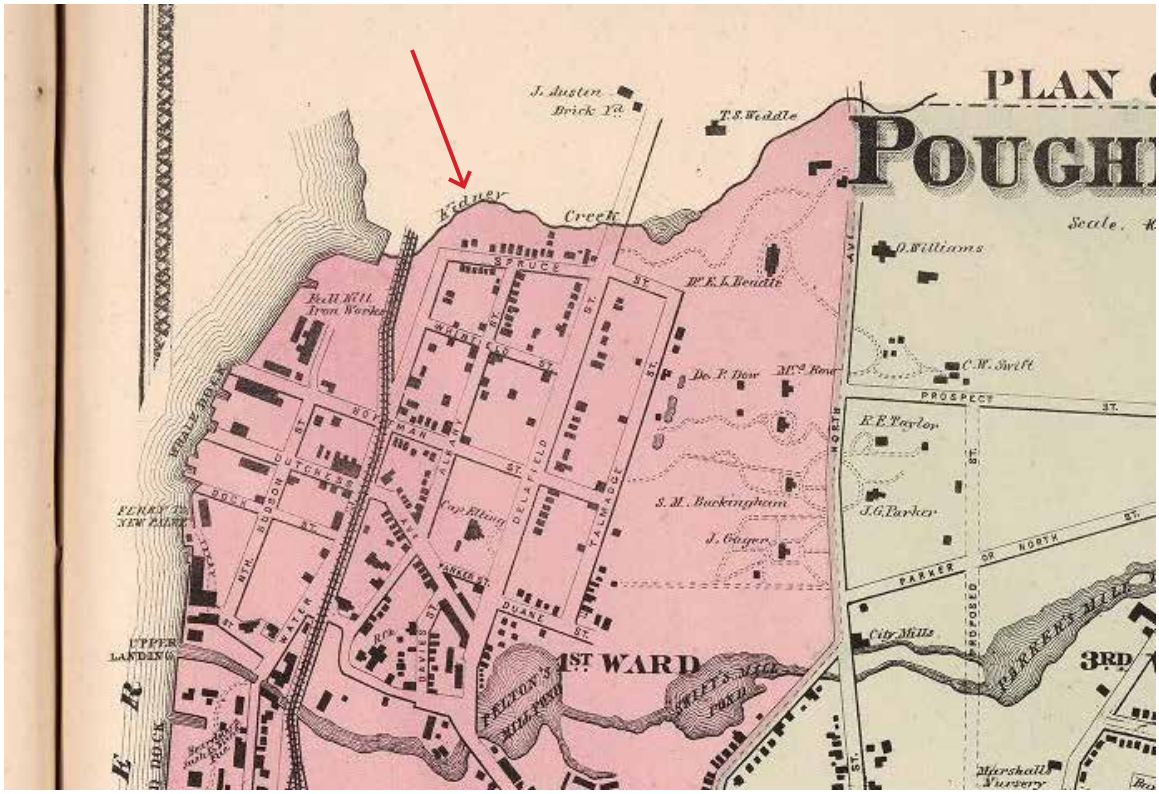


Figure 3.2. 1867 map of the City of Poughkeepsie showing the now buried Kidney Creek and its outfall into the Hudson River.

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).

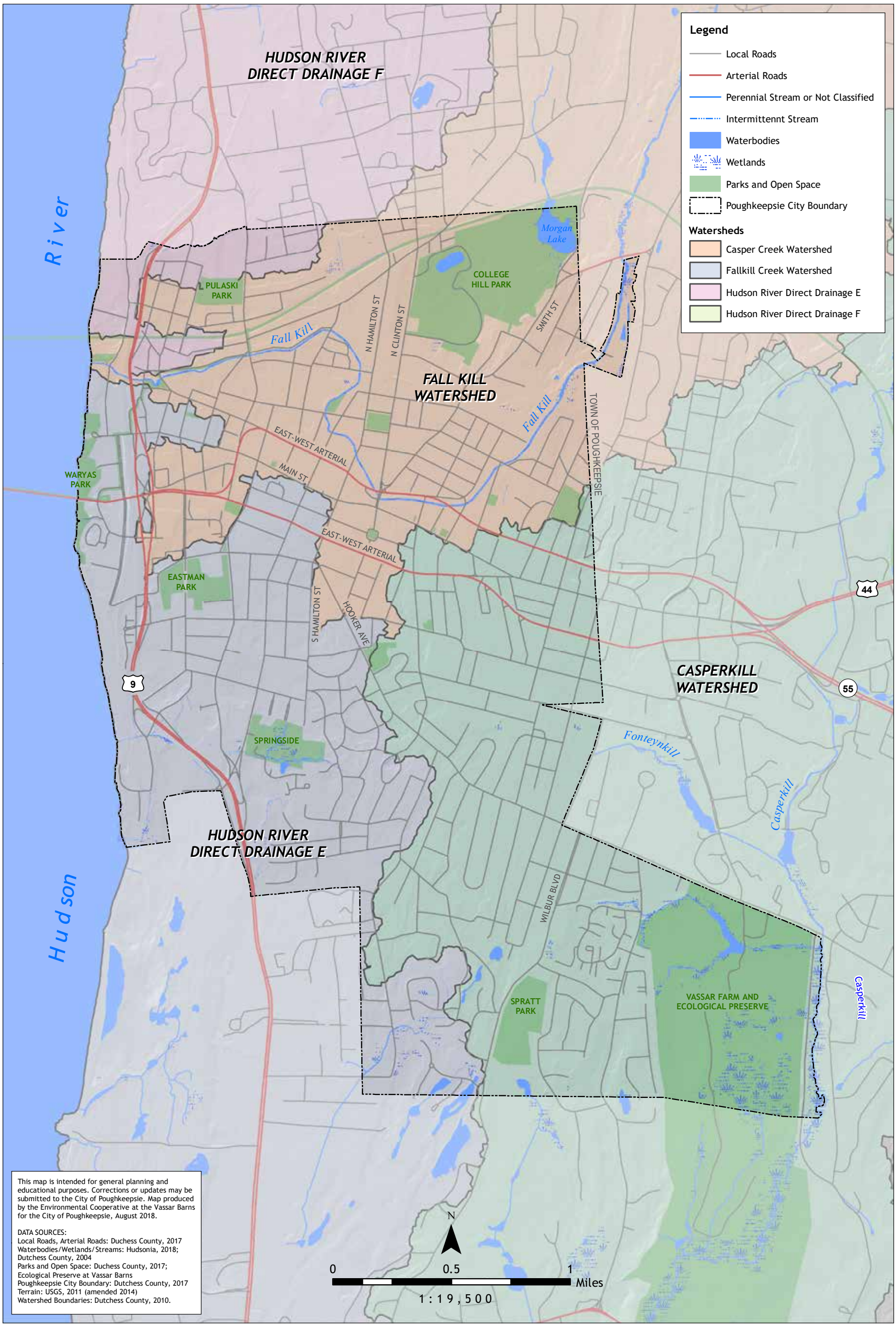
Additional resources that discuss the Fall Kill and Casperkill include:

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

Surface Water and Watersheds

City of Poughkeepsie, New York



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Terrain: USGS, 2011 (amended 2014)
Watershed Boundaries: Dutchess County, 2010.

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.

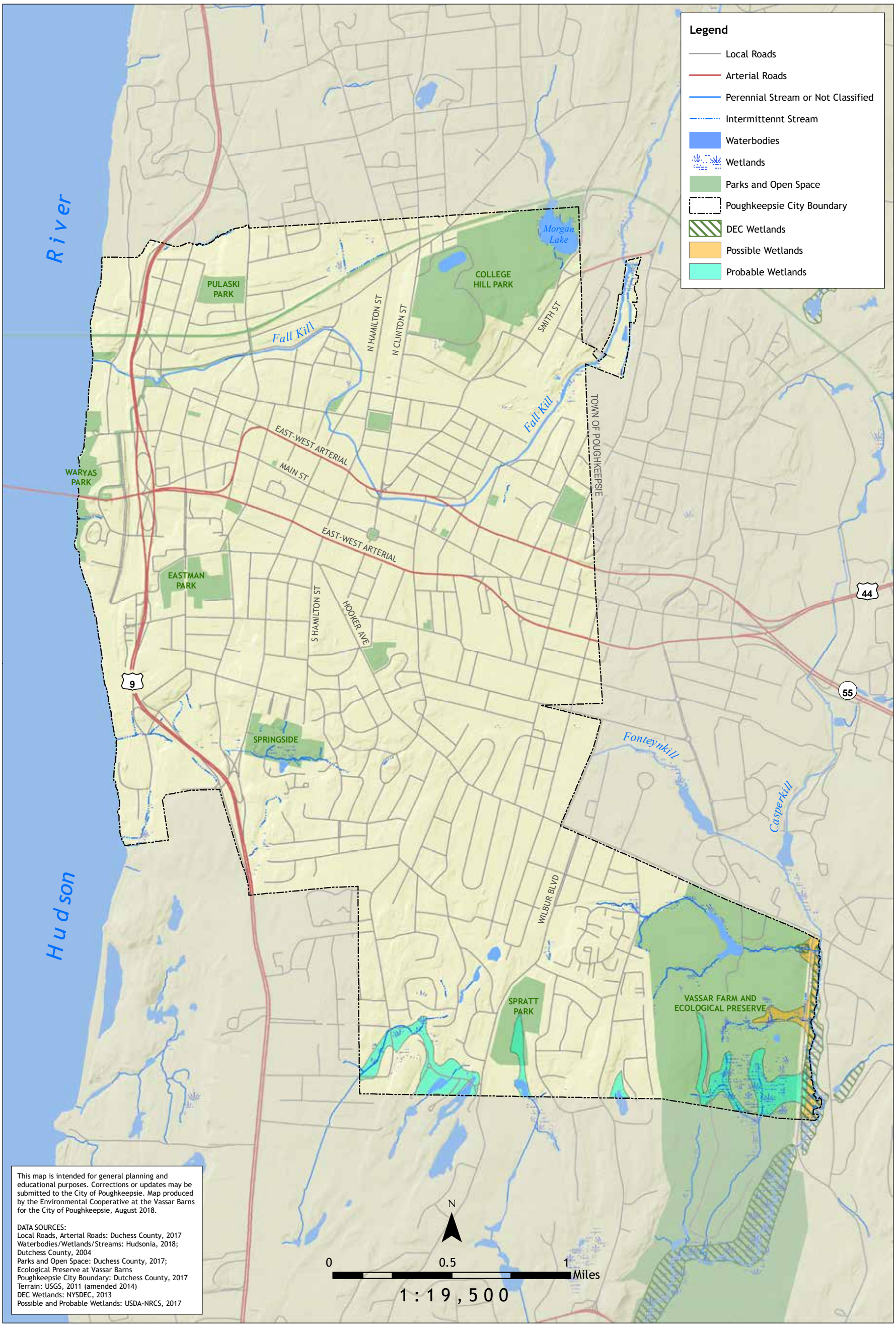
The wetlands that are located adjacent to the Fall Kill near the Department of Public Works parcel and just south of that on a privately owned parcel are worth noting (Figure 3.5) since the Fall Kill is not channelized by stone walls yet at this point. This means that during flood events the creek may 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

Wetlands

City of Poughkeepsie, New York



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.

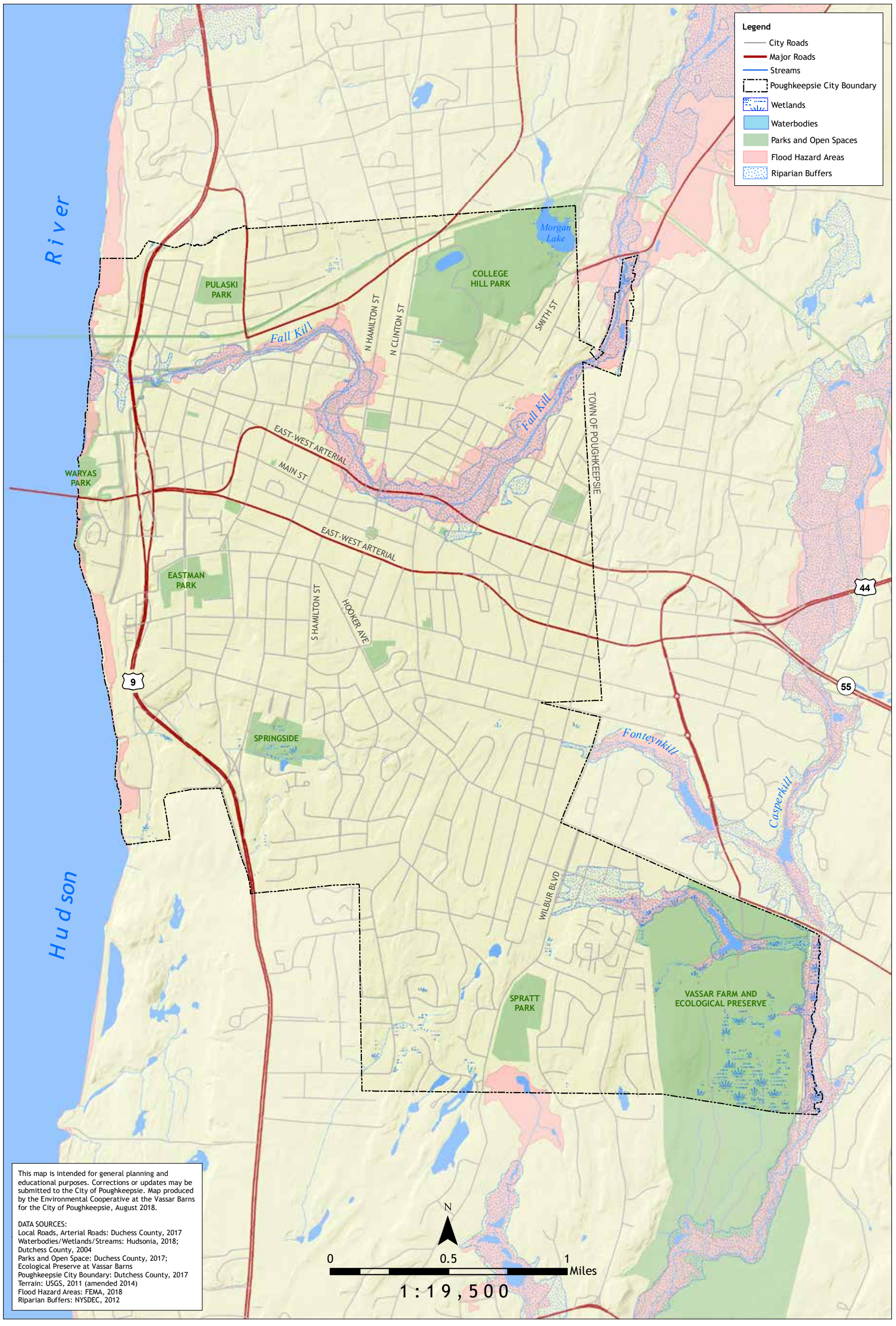
The Flood Hazard Areas and Riparian Buffer Areas map also illustrates riparian areas subject to the 2% annual chance flood (New York Natural Heritage Program, 2018). These areas may not be included in FEMA's flood zones. In Poughkeepsie one of these areas exists in the southeastern corner of the City 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

Flood Hazard Areas and Riparian Buffer Areas

City of Poughkeepsie, New York



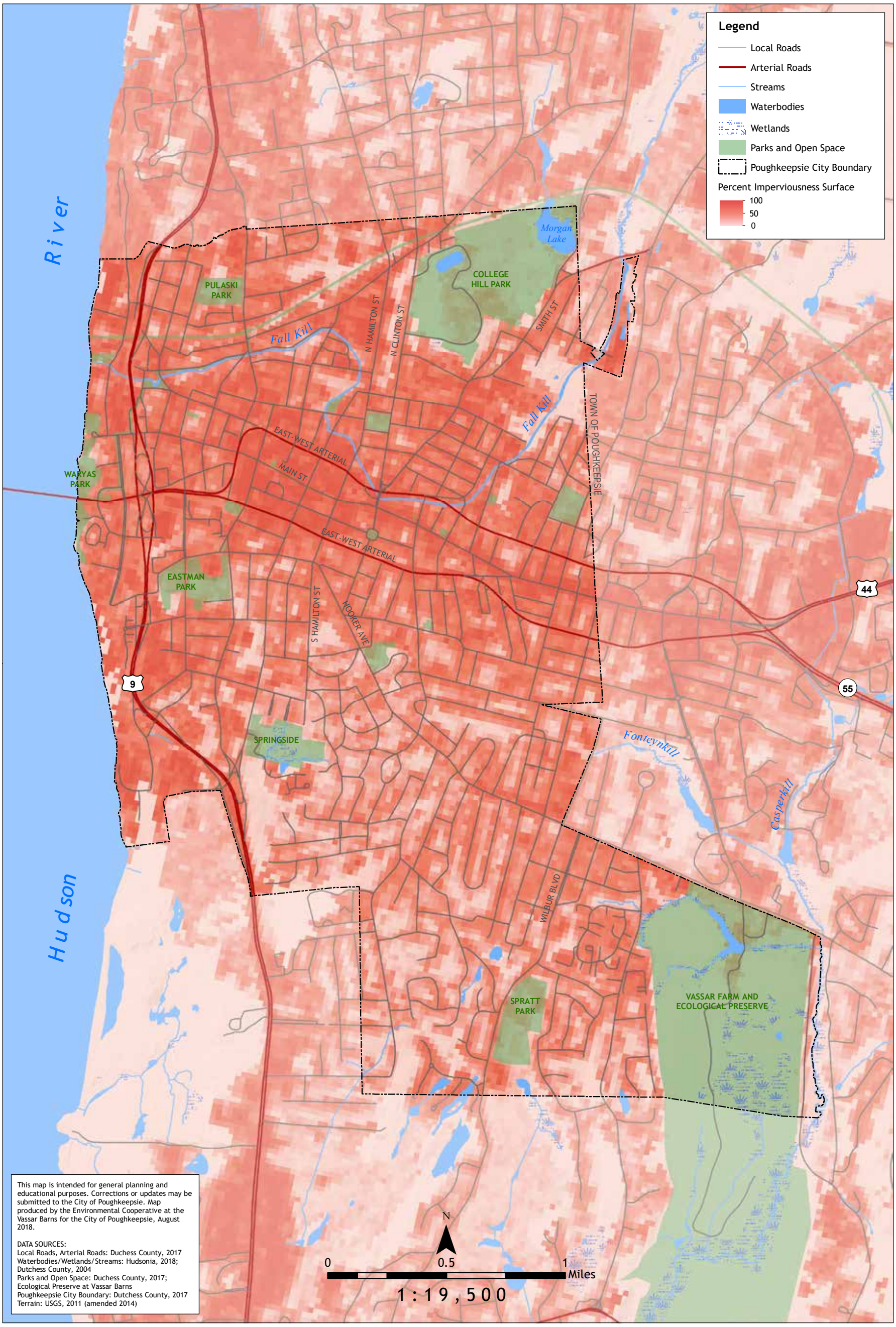
Impervious Surfaces

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

Impervious Surfaces

City of Poughkeepsie, New York



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Terrain: USGS, 2011 (amended 2014)

Water Quality Assessments and Classifications

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

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/)

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.

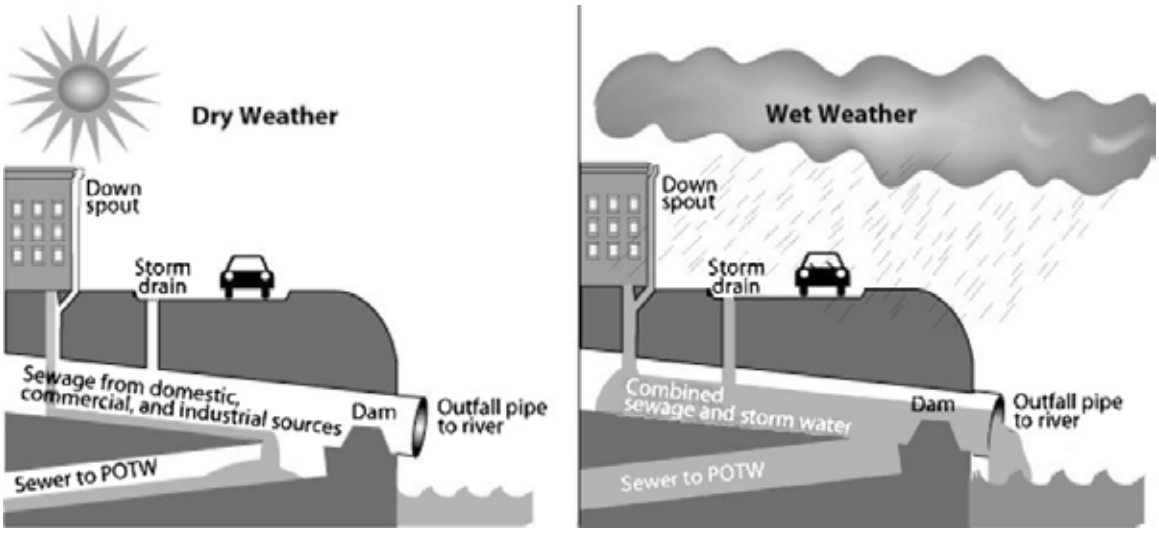


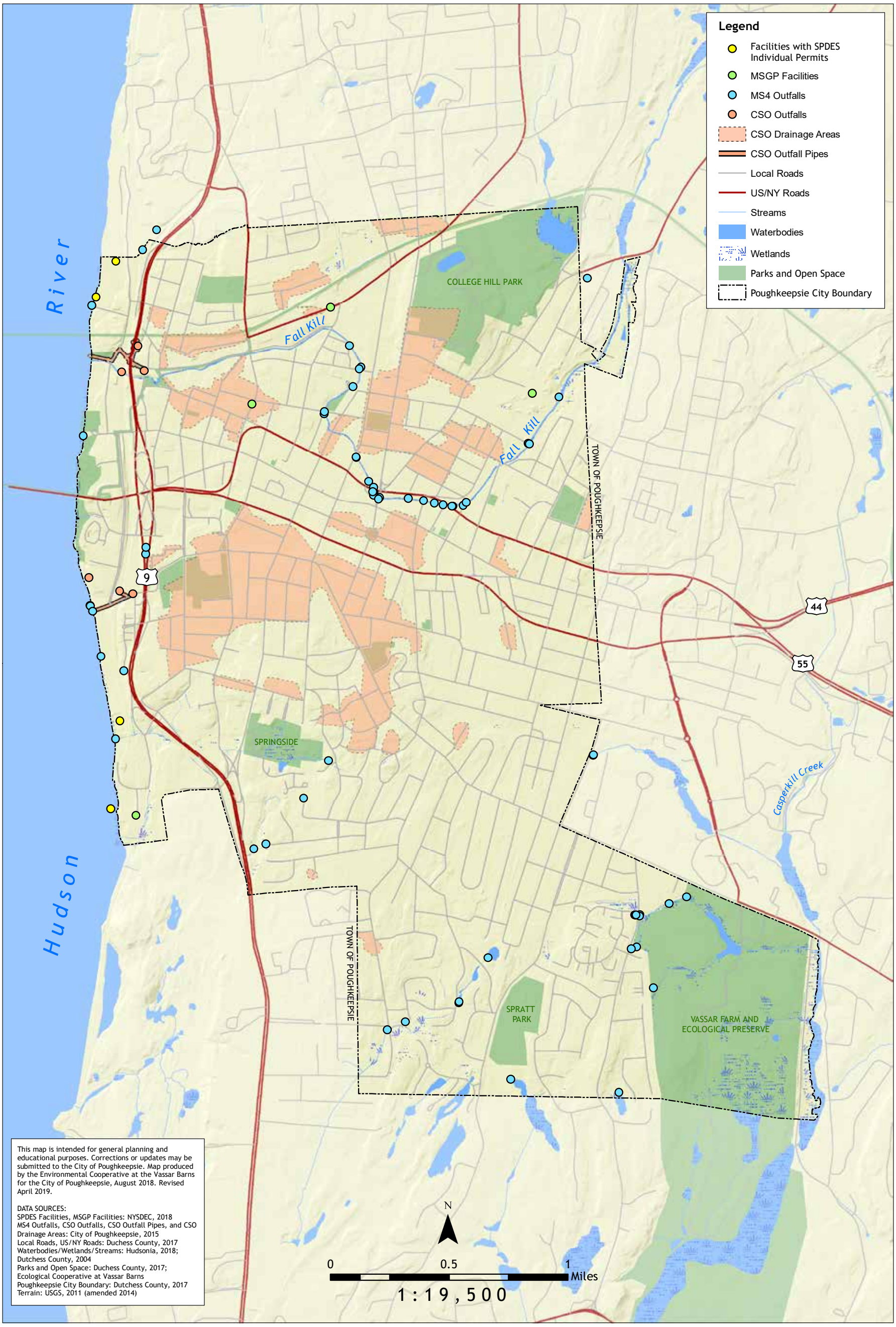
Figure 3.6 Schematic of a typical combined sewer system that discharges directly to surface waters. credit: US EPA

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

Potential and Known Sources of Pollution

City of Poughkeepsie, New York



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.

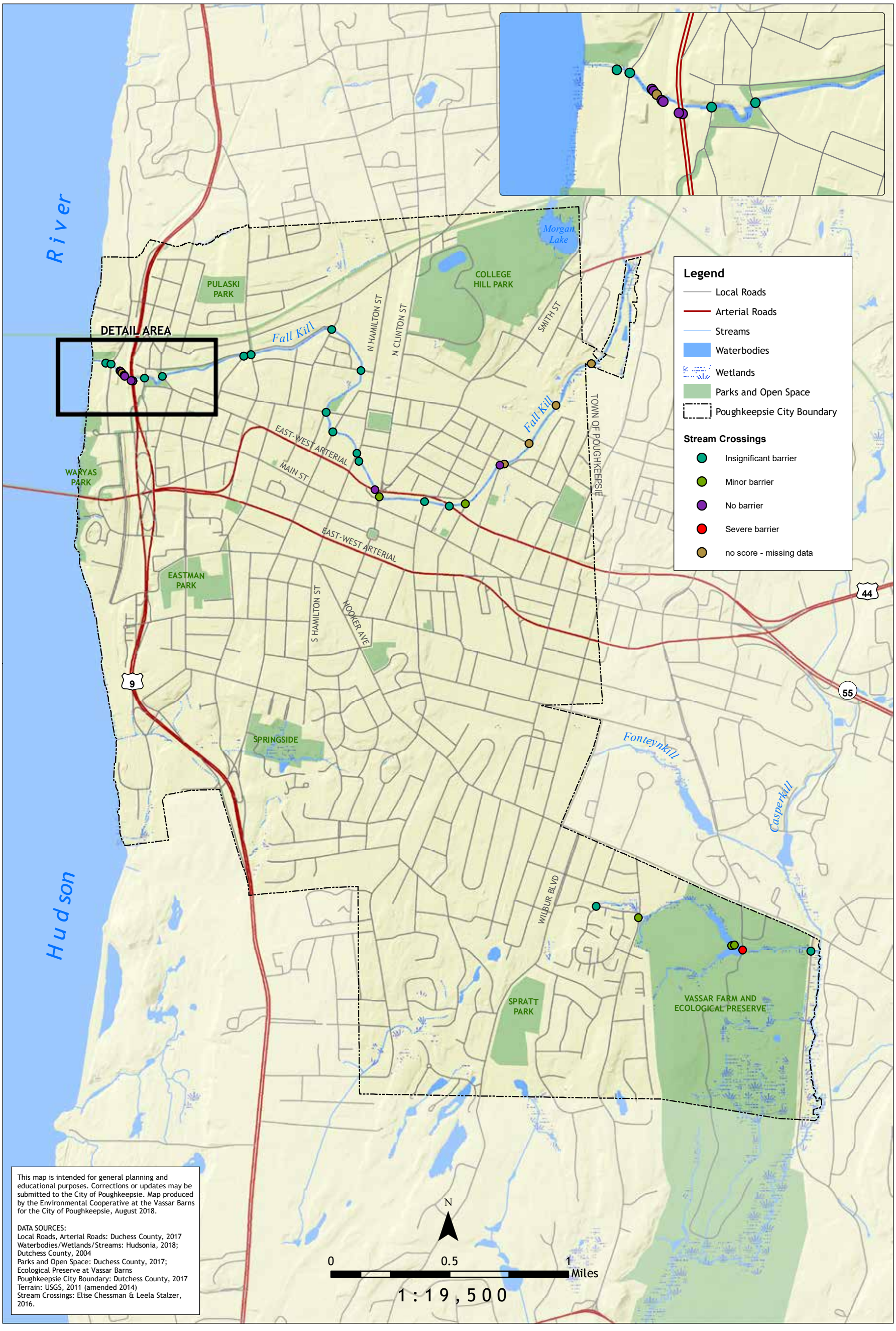
Table 3.5. Aquatic passability scores for road crossings within the City of Poughkeepsie.

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

Stream Barriers

City of Pougheepsie, New York



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