FALL KILL WATERSHED NEIGHBORHOOD SOURCE ASSESSMENT

A survey of pollution potential and restoration opportunities

Prepared in 2012-2013, by Hudson River Sloop Clearwater and the Fall Kill Watershed Committee

Fall Kill Watershed
Neighborhood Source Assessment

Prepared by Hudson River Sloop Clearwater and the Fall Kill Watershed Committee. 2012-2013.

Primary Authors:

Ryan Palmer, Director, Green Cities Initiative, Hudson River Sloop Clearwater

Paul Hesse, Clearwater Green Cities Intern, Master Watershed Steward Graduate

Secondary Authors:

Michael Kiel, Vassar College

Michael Carraher, Vassar College

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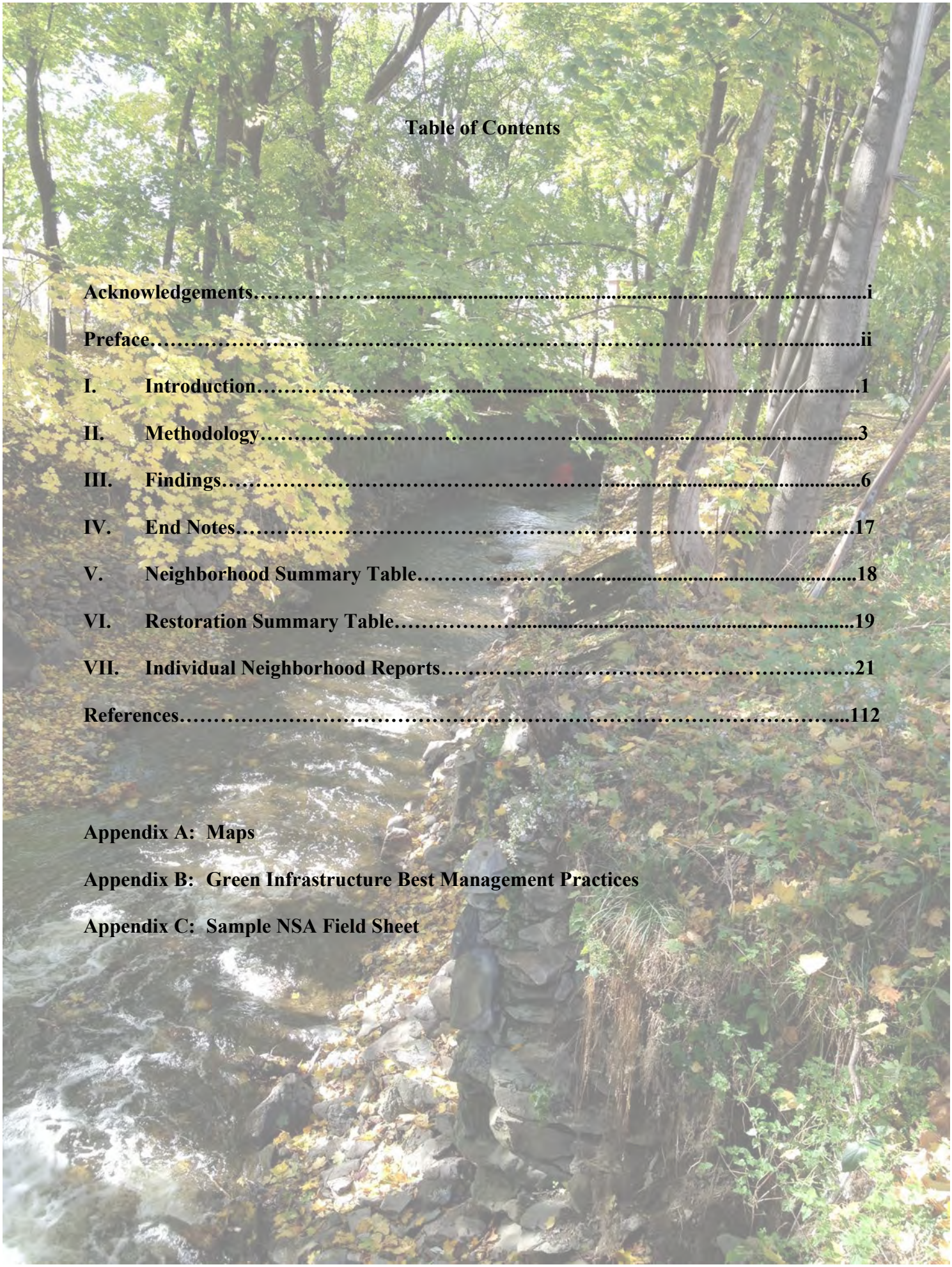

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Preface

This Neighborhood Assessment was initiated by Clearwater in response to the needs of the community, as expressed through the Fall Kill Watershed Committee.

The Committee, formed in 2002, serves as an advisory board for the watershed and is comprised of a coalition of community groups, educational institutions, businesses, local governmental officials, environmental groups, social services groups, and interested community members living and working in the Fall Kill watershed.

The report is meant to provide an overview of the existing conditions of the watershed, and what can be done to help protect and restore it, through the lens of a critically important land use scale - the neighborhood. The neighborhood is the unit of space where the human element becomes uniquely apparent and succinct, and unlike a hard civic boundary, is flexible - defined by the character of a place, the people there, and their behaviors.

The report contains our best attempt to delineate the watershed at the human scale, and assess not only each neighborhood's physical infrastructure that influences water quality, such as stormwater systems and stream and wetland buffers, but also its stewardship infrastructure – or human behavior such as fertilizer use and littering – and the role they play in water quality.

The report is not meant to be exhaustive - it is our hope that it will serve as a guide and starting point for future conversations about local priorities and how to best manage our watershed.

On behalf of everyone who was involved in this effort, thank you for your interest and please get in touch if you have any feedback or questions.

Sincerely,

Ryan Palmer

Coordinator, Fall Kill Watershed Committee

Director, Green Cities Initiative, Clearwater

I. Introduction: Fall Kill Watershed

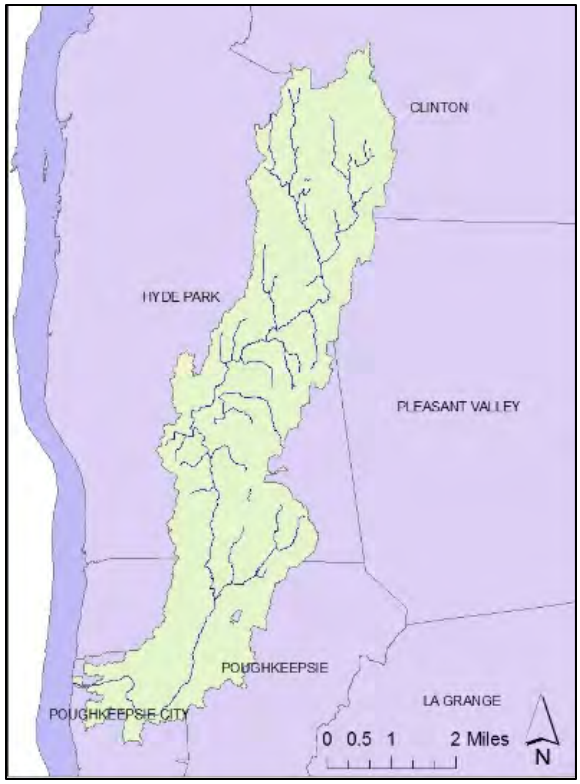
Characteristics

The Fall Kill Watershed is situated within the Hudson Direct Drainage area on the western edge of Dutchess County, NY and drains over 12,000 acres of land into the Hudson River. The Fall Kill Creek and its tributaries meander through five Dutchess County municipalities, including the Towns of Clinton, Hyde Park, Pleasant Valley, and the Town and City of Poughkeepsie. According to the 2010 U.S. Census, slightly more than 30,000 people now live within the watershed.[1]

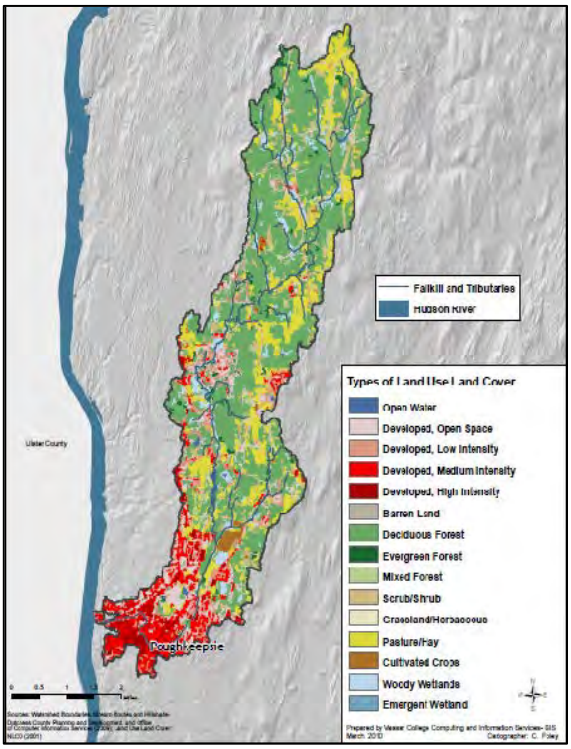
The Fall Kill Creek spans over 38 miles in length, including unnamed first order streams in the northern reaches of the watershed, and becomes a third order stream just north of the City of Poughkeepsie as it approaches the Hudson River.[2] Water is conveyed swiftly through the City from both the New Deal-era channelization of the creek and the increased gradient (3.35%) west of Garden Street.[3]

From its headwaters to its mouth, over approximately 16 miles, the creek mainstem undergoes a dramatic transformation from rural agricultural uses and forested areas to the highly urbanized setting of the City of Poughkeepsie.[4] Forested land comprises the largest percentage of land cover within the watershed at over 40 percent, and residential land use comprises nearly 30 percent (see map).

The 2006 Fall Kill Watershed Management Plan acknowledges that many wetlands, marshes, and large wooded lots in the northern half of the watershed contribute to the health of the stream system in the central and upper reaches, while simultaneously providing critical wildlife habitat, including habitat for several threatened and endangered species. However, water quality diminishes markedly in the southern portion of the system as the creek approaches the more urban environment of the City of Poughkeepsie.



The Fall Kill Watershed, with municipal boundaries.



Land Use/ Land Cover, prepared by Vassar College Computing and Information Services, 2010.

Water Quality

Water quality standards in New York State are determined by the Department of Environmental Conservation (DEC) and essentially consist of two components: designated uses and criteria or thresholds.[5] A designated use is the use for which a waterbody is best suited. The Fall Kill Creek is classified by the New York State Department of Environmental Conservation (NYSDEC) as a "Class C" stream, suitable for fishing but not for primary contact recreation such as swimming.[6] The 2006 Fall Kill Watershed Management Plan lists achieving Class B status, meaning capable of supporting swimming, as one of its goals, and the Clean Water Act of 1972 sets a national goal of achieving water quality capable of supporting swimming and fishing for all waterbodies throughout the country.

Criteria or thresholds are those measurements, including fecal or total coliform counts, water temperature, pH, total suspended solids, nutrient and trace metal loading among others, used to determine whether an individual waterbody is meeting its best use. The Fall Kill Creek is included in New York State's 2010 Priority Waterbody List (PWL) as an impaired segment because it exceeds certain thresholds for meeting water quality standards. The PWL lists aquatic life and recreation as impaired along the Fall Kill and its tributaries, and aesthetics are considered "stressed," meaning diminished because of debris/floatables in the stream. The cause of impairment listed by NYSDEC is nutrients, likely phosphorus, and the probable sources of nutrient loading are combined sewer overflows, urban/stormwater runoff, and municipal waste discharges.[7]

The 2006 Management Plan acknowledges that aesthetic quality of the creek dramatically decreases in the downstream segments, especially in the City of Poughkeepsie. Trash such as plastic bottles, aluminum cans, and other small pieces are readily found throughout the creek and its banks in the City, and this can be attributed to both simple littering and stormwater runoff. However, the presence of the large objects in the creek such as furniture, auto parts, and shopping carts also suggests the use of the creek for illegal waste disposal. A 2008 trash assessment conducted by Hudson River Sloop Clearwater and the Fall Kill Watershed Committee reported that the two highest percentages of trash were in the form of plastics (39%) and glass (32%), and that the area around the Family Partnership Center in the City of Poughkeepsie had the highest overall counts of trash.[8]

Need for Neighborhod Assessment

The 2006 Management Plan concluded that the entire length of the stream has been negatively impacted by human activity. And while the most impaired segment of the stream is found in the lower portion in the City of Poughkepsie, the report suggests that there are "hot spot" areas in the central and upper reaches of the system where several pollutants have been identified. The report found that nutrient levels were high in the middle reaches of the creek and in the City of Poughkeepsie, and that coliform counts were found at every sample location and were found at high levels system wide.

The health of the Fall Kill Creek must be examined on a watershed – and inter-municipal level – rather than solely in areas where high levels of pollution are found. Human activity in the central and northern reaches of the watershed affect water quality, too, and must be given the same consideration as the lower portions. The 2006 Management Plan acknowledges that certain "hot spots" in the upper reaches of the watershed need further investigation into how they impact the Fall Kill Creek. This report seeks to address that need using the Center for Watershed Protection's Neighborhood Source Assessment (NSA), which identifies land uses and residential behaviors that contribute to water quality issues.

This assessment seeks to illuminate the interconnectedness between human behavior and water quality, and between certain neighborhoods and the health of the watershed. Ultimately, the goal of this study is to encourage greater inter-municipal cooperation through a better understanding of how we all impact the health of our local ecosystems.

II. Methodology

CWP Protocols and the NSA

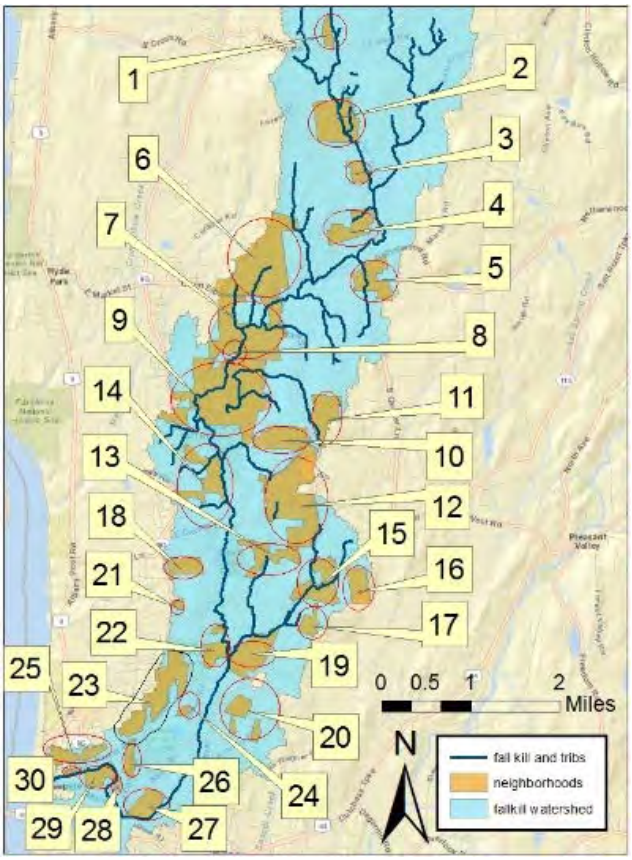
The Center for Watershed Protection's (CWP) Urban Subwatershed Restoration Manual contains a number of assessments aimed at restoring the health of watersheds, one of which is the Neighborhood Source Assessment (NSA). The NSA attempts to quantify potential pollution sources within residential neighborhoods, as well as identify potential restoration opportunities. The NSA field form is composed of six sections:[9]

- *Neighborhood Characterization* – Compiles basic information about the neighborhood.
- *Yard and Lawn Conditions* –Assesses vegetative cover and management practices on the typical lawn.
- *Driveways, Sidewalks, and Curbs* – Estimates pollutant accumulation and evaluates housekeeping on these impervious areas.
- *Rooftops* – Quantifies how rooftop runoff is managed on the average residential lot.
- *Common Areas* – Evaluates practices in common neighbhorhood areas, such as stormwater ponds, buffers, and flood plains.

- *Recommended Actions and Initial Assessment* – Makes specific recommendations on key residential behaviors that could be improved, and derives an index that rates pollution severity and restoration opportunities in the neighborhood as a whole.

Table 9: Key Behaviors Within Residential Source Areas

Source Area	Polluting Behavior
Yards and Lawns	Over-Fertilization
	Excessive Pesticide Application
	Over-Watering
	Extensive Turf Cover
	Tree Clearing
	Improper Yard Waste Disposal
	Soil Compaction
	Soil Erosion
	Failing Septic Systems
	Pool Discharges
Driveways, Sidewalks, and Curbs	Car Washwater Flows
	Hosing/Leafblowing
	Application of Salts and other Deicers
	Dumping of Household Hazardous Waste
	Dumping of Oil/Antifreeze
Rooftops	Downspout Connections
	Added Impervious Cover/Exposed Soils
Common Areas	Pet Waste
	Unmaintained Storm Water Practices
	Buffer Encroachment
	Storm Drain Dumping



Desktop Analysis and Deliniation of Neighborhoods

The most important desktop analysis for the NSA is deliniating the neighborhoods within the watershed. With the assistence of Marist College GIS staff, thirty neighborhoods were identified throughout Hyde Park and the Town and City of Poughkeepsie, and no neighborhoods were deliniated in either Clinton or Pleasant Valley. Neighborhoods were identified using orthoimagery and parcel data from Dutchess County Parcel Access, and a GIS layer was created. Neighborhoods were identified by basic characteristics such as lot size, age and housing type, zoning, etc. Adjustments to the map were made after site visits to each identified neighborhood.

Collection of Data

Over the course of approximately two months, each neighborhood was visited at least once, and an NSA field form was completed for each site (sample field forms available in the appendix). Each site was thoroughly observed by driving every street, and in some cases walking in order to inspect catch basins or other items of interest. The survey team collected data on the following areas on interest:

- *Yard and Lawn Condition* – each lot within a neighborhood was broken down into percentages according to land cover. For example, the survey team would estimate the percentage of pervious cover, impervious cover, landscaping or mulched areas, and tree/forest canopy. The survey team also observed lawn management practices, in order to estimate whether fertilizer use may be present within the neighborhood.

- *Rooftops* – each neighborhood was broken down into percentages according to where rooftop rainwater is directed. For example, the survey team would estimate the percentage of rooftops with downspouts directed to impervious and pervious surfaces, as well as downspouts that are directly connected to storm or sanitary sewer.

- *Storm Drain Inlets* – each neighborhood was examined for stormwater infrastructure, such as storm drain inlets. If a neighborhood had stormwater infrastructure, the survey team was asked to observe the condition of catch basins to see whether they were stenciled with notification that they drain to local waterways, whether they were clean or had organic debris, and whether they had trash or other litter.

- *Sidewalks, Curbs, and Gutters* – each neighborhood was examined for whether sidewalks, curbs, and gutters were present, and if they were present, what their condition was, i.e. organic matter or litter.

- *Pollution and Restoration Potential* – each neighborhood was given an initial "grade" according to pollution contribution and restoration opportunity. Grades consist of low, moderate, and high.

Notetaking and photographs were encouraged for each site visit, and all data for each site was organized into an individual report for each neighborhood. Neighborhood characterization data and field observations were accompanied by a table with the pertinent criteria described above and photographs. And finally, benchmark criteria from the CWP manual was used to identify pollution severity and restoration opportunity.

Table 14: Benchmarks Used to Establish Pollution Severity Index

Reference Question	Neighborhood Feature	Benchmark (% of neighborhood)
Part A	Septic System Presence	Answering "No" to sewer
Part A	Construction Activity	At least 5%
B2	High Turf Coverage on Lot	At least 50%
B4	Bare Soil Coverage on Lot	At least 5%
B6	Irrigation Evident	At least 15%
B7	High Turf Management	At least 20%
B8	Outdoor Swimming Pools	At least 10%
B9	Junk or Trash	At least 25%
C2	Driveway Condition (Stained)	At least 25%
C3	Sidewalk Condition (Leaf Cover)	At least 25%
C3	Pet Waste	At least 25%
C4	Curb and Gutter Condition	At least 20% with flowing/standing water and/or sediment/organic matter
D1	Rooftop Connection	At least 25%
E1	Catch Basin Condition	More than three inches of accumulation
E3	Open Space Management	At least 40% answering "Yes" to either *OR* At least 25% answering "Yes" to both
Part F	Source of Pollutant	Any pollutant is selected

Table 15: Benchmarks Used to Establish Restoration Opportunity Index		
Reference Question	**Neighborhood Feature**	**Benchmark (% of neighborhood)**
B3	Landscaping	Less than 25%
B5	Forest Canopy Coverage	Less than 40%
C3	Sidewalk Zone	At least 25% with sidewalk zone width of six feet or more
C4	Curb and Gutter	At least 25% of curb and gutter with trash, organic matter, *or* sediment accumulation
D1	Rooftop Connection	More than 25% of connected roofs are feasible for disconnection
D5	Rain Garden	More than 25%
E1	Storm Drain Inlets	Less than 10% stenciled
E2	Storm Water Pond	Answering "Yes" to overgrown or to dry pond

III. Findings

General Findings

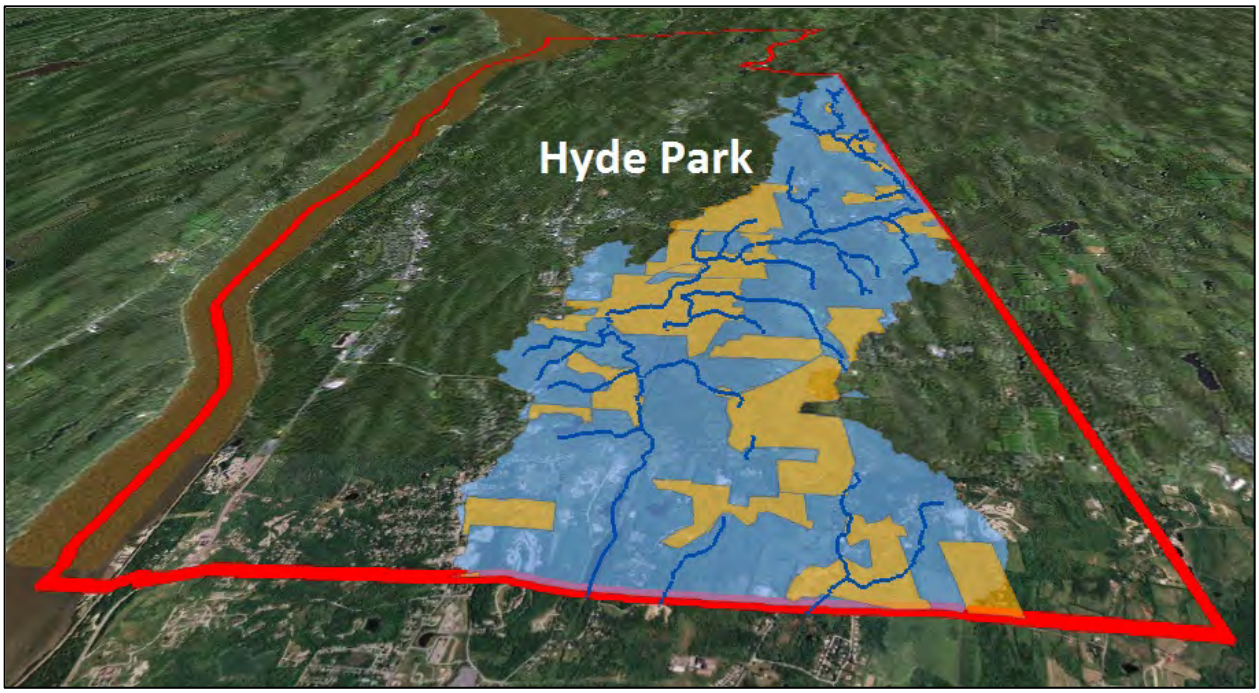
Research for the 2006 Fall Kill Watershed Management Plan led to the conclusion that the creek in its entirety is negatively impacted by human activity. While impacts and their causes are most noticeable in the more urbanized stretches of the creek in the Town and City of Poughkeepsie, there are some areas in the middle and upper reaches of the creek that also contribute to water quality impacts. Research and field investigations for this report have led to similar findings, mainly that the greatest pollution threats are downstream but that there are areas in the upper reaches of the system in Hyde Park that are worth some attention. This section will focus on possible water pollution sources, and recommendations for restoration opportunities will be discussed in the following section.

Hyde Park

The neighborhoods in the Town of Hyde Park portion of the watershed are generally considered to be low contributors to water pollution. The most commonly observed residential behaviors that may lead to pollutants entering the creek and tributaries are fertilizer use on lawns and improper maintenance of riparian buffers along the creek. Heavy fertilizer use can lead to nutrient loading in the creek system, stimulating algal blooms and decreasing dissolved oxygen, which impairs aquatic species. Mowing lawns and removing trees and brush in riparian areas can lead to soil erosion and sediment loading in the creek and can also encourage Canada geese to graze, which can lead to increased coliform levels.

Minor algae growth was observed in several Hyde Park neighborhoods that also had high intensity lawn management practices. (Please see the appendix for detailed reports on each neighborhood.) While numerous wetlands likely prevent more widespread pollutant loading into the creek and tributaries, evidence of even minor algae growth indicates a problem and a

restoration opportunity. Likewise, a small number of areas within Hyde Park neighborhoods were observed to have improperly encroached upon the riparian buffer, such as mowing grass to the creek or tributary edge. This is likely one source of coliform loading that comes from the Hyde Park stretch of the creek system (in addition to faulty septic systems) and represents a restoration opportunity. Septic systems that are poorly sited, not properly maintained, or faulty are another likely source of coliform loading.



Map showing Hyde Park municipal boundary in red and Fall Kill watershed in blue, with target neighborhoods in orange.

Other issues observed were more serious but less frequent. For example, considerable flooding issues are known to occur in several Hyde Park neighborhoods. During field survey work, a nearly 30 year resident of Neighborhood 2 (Quaker Hill Estates) told of severe flooding of the tributary behind his house that has begun only in recent years; Neighborhood 8, a mobile home park that is almost entirely enveloped within the 100 year floodplain, has experienced at least one major flood in the last 10 years and likely experiences minor periodic flooding; and residents of Neighborhood 18 told of severe flooding at their property on Bircher Avenue. These flood events occur not only during major storm like Irene and Lee, but with smaller storms as well.

Flooding can be problematic for residents for a number of reasons, but it is especially problematic to the health of the creek and its tributaries. In the case of Neighborhood 8, Parcel data indicates that these mobile home sites are served by septic systems. According to the 2006 Fall Kill Watershed Management Plan, the soils around these sites are excessively well drained, meaning that there is an increased risk of bacterial contamination from septic systems during a heavy rain event. Similarly, the flooding at Neighborhood 18 occurs in the area of a large leach field used for the Valley Forge Mobile Home Community. Bacterial contamination due to flooding here is not only a risk to the health of the creek and its tributaries but also public health hazard.

Restoration Opportunities

Restoration opportunities in Hyde Park neighborhoods include the following:

- Redirect downspouts to pervious surfaces
- Reduce fertilizer use
- Tree planting opportunities
- Maintain open space
- Maintain riparian buffers
- Zoning regulation for floodplain areas

Downspouts

The simple act of directing roof downspouts to pervious areas where they are currently directed toward impervious areas such as driveways is low-hanging fruit, particularly in Hyde Park, where 11 of 18 neighborhoods had a quarter or more of downspouts directed to impervious surfaces. Neighborhoods in Hyde Park typically have an abundance of open space per parcel to which rooftop rainwater can be directed. This will allow water to infiltrate into the ground and pollutants can be naturally filtered. Alternatively, nearly every property in Hyde Park would have the necessary room for a rain barrel or possibly even a rain garden, to which roof rainwater could be directed. However, these sorts of treatments would be more expensive than simply directing water to a lawn and may not be worth the cost in light of the benefits.

Fertilizer Use

Fertilizer use can lead to nutrient loading in the creek and tributaries. Nutrients in waterbodies can lead to algal blooms and possible decreased oxygen levels in the water, which can harm aquatic species. Changing fertilization behaviors can be difficult, but some techniques include:

- Seasonal media awareness campaigns
- Outreach material such as pamphlets
- Master gardening programs
- Neighbor word-of-mouth

Tree Planting Opportunities

There is a lot of forest cover in the Town of Hyde Park, but some newer subdivisions lack mature trees. Trees are known to have many benefits, including shading homes and acting as a

Tree planting opportunity in Neighborhood 7.

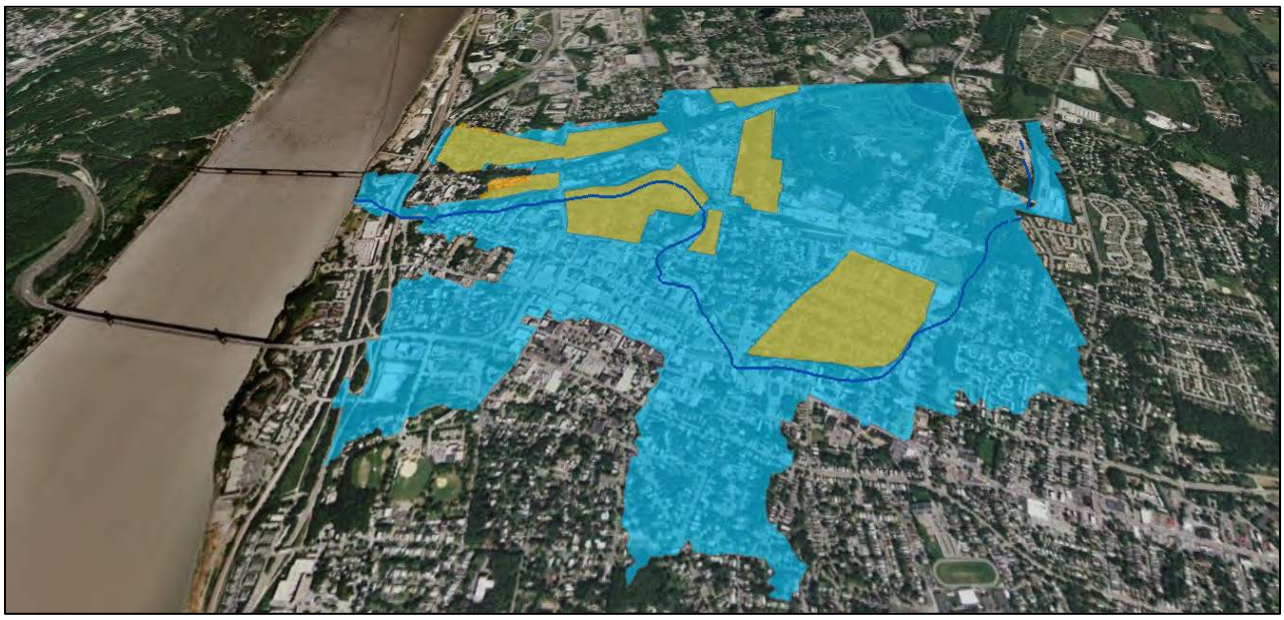
wind barrier, leading to lower energy costs; reducing urban heat island effect in cities; and absorbing air pollutants. But trees are especially good at reducing stormwater runoff. Trees can intercept rainfall, diminish the impact of rain on barren soil and minimize soil moisture, which can allow more water to infiltrate the ground. Trees can also provide shade from the summer sun for lawn turf, which could reduce the need to irrigate and fertilize lawns. Because trees take a long time to mature, and because their full benefits will not be immediately realized, maintaining open space as much as practicable is also recommended. Increasing impervious surfaces due to increasing urbanization is a threat to water quality and the health of wildlife habitat. To the maximum extent practicable, the Town of Hyde Park should continue to promote the purpose and intent of such zoning districts as the Greenbelt District, which allows for low-density development while preserving open space to protect streams, wetlands and other natural resources. In addition, infill development in established neighborhoods and redevelopment of existing properties should be encouraged as a means to protect open space.

Riparian Buffers

Several neighborhoods in Hyde Park were observed to have riparian areas that were encroached upon, usually by a landowner who has cleared trees and brush along the creek. Healthy riparian buffers naturally slow and filter pollution runoff and help protect against soil erosion and sediment loading. Trees along riparian corridors help to regulate temperatures in the water, which is important for aquatic species. A vegetated buffer will also discourage Canada geese from grazing along the creek side, which will help prevent coliform loading from geese waste.

Wherever possible, native trees and shrubs should be allowed to grow in the riparian area along the creek and tributaries. The Hudson River Estuary Program's "Trees for Tribs" Initiative helps qualifying areas restore a natural riparian buffer and could be one source of assistance for landowners who wish to protect the tributary in their area.

Example of a buffer restoration opportunity, NBD 2.



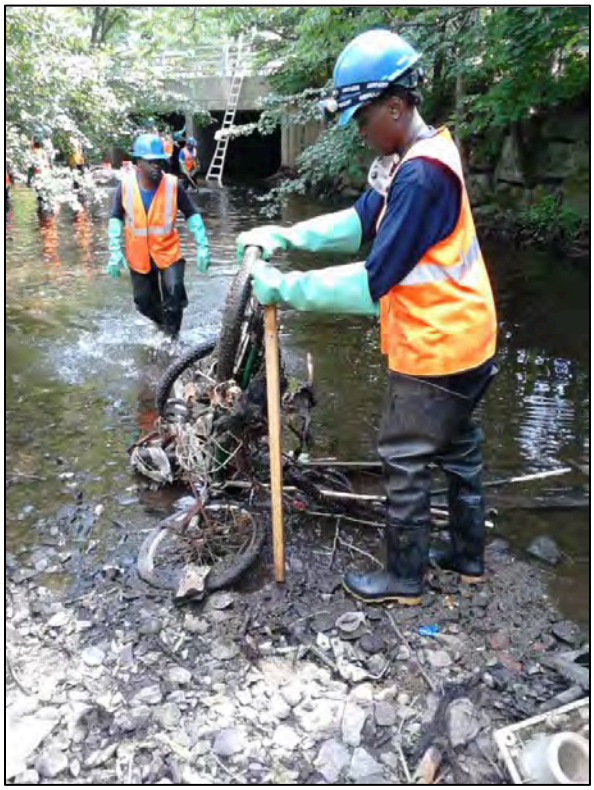
Map showing the City of Poughkeepsie portion of the Fall Kill watershed in blue, with target neighborhoods in orange.

On the whole, the urban portion of the watershed – in the City of Poughkeepsie – has the largest impact on water quality throughout the Fall Kill. Our research and field investigations of Poughkeepsie neighborhoods revealed that the biggest issues are illicit garbage disposal in the creek, combined sewer overflows (CSOs), and stormwater runoff from impervious surfaces (rooftops, right of ways, parking lots, and other paved areas).

Trash and other debris were observed along many curb sides and at storm drain catch basins. Larger trash items were also observed in some Poughkeepsie neighborhoods that border the creek, such as Neighborhood 29/Garden Street, where two television sets were observed, one in the creek and the other at the top of the wall looking over the creek.

While large items such as these were not the norm, it should be noted that at the time of field investigation the Fall Kill had recently been cleared of debris by workers with Nubian Directions, a Poughkeepsie-based job training non-profit who had received a federal grant to restore the Fall Kill Creek after Hurricane Irene. Much debris was found in the creek during the summer 2012 clean up, including hypodermic needles, tires, shopping carts, bicycles, and even guns. The relative cleanliness of the creek during field observations is likely not typical.

Catch basin with organic debris and litter

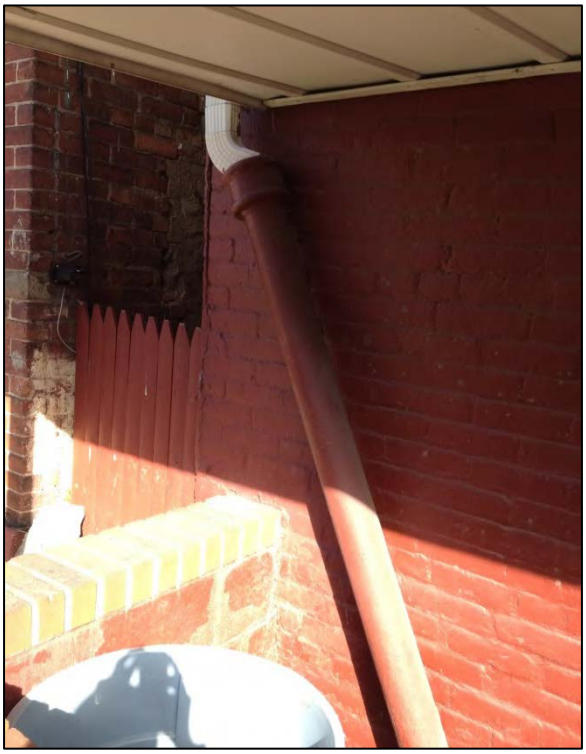


A Nubian Directions worker sorts through debris

Television observed during field investigation

Other neighborhood characteristics that were observed during field investigation were a high percentage of rooftop downspouts that are either directly connected to the sewer or that drain to impervious surfaces. For example, Neighborhood 30/Verrazano Blvd. has an estimated 90 percent of rooftop downspouts draining to impervious surfaces such as driveways, and Neighborhood 25, which spans from Taylor Avenue to Albany Street, has an estimated 60 percent of downspouts directly connected to the sewer.

Finally, data from City of Poughkeepsie Engineering Department revealed sewersheds on the northside of Poughkeepsie that are known to be combined sewer areas. It is important to understand where these combined sewer areas are throughout the watershed because these are areas that should be prioritized for stormwater runoff reduction.



A directly connected downspout in NBD 25

This map represents where CSO areas (blue) and neighborhoods (orange) intersect (yellow)

The 2006 Management Plan recognizes high levels of fecal coliform bacteria in the creek that often exceed public health guidelines. Likely sources of coliform loading, according to the Plan, include "leaking pipes, illegal connections, leaking septic systems, surface runoff from areas hosting large concentrations of waterfowl, or urban runoff containing pet waste." In the urban portions of the watershed in Poughkeepsie, pet waste from right-of-way common areas (grassy areas between the sidewalk and curb) and combined sewer outfall events are the likely sources of coliform loading.

Finally, the large amount of combined impervious surface in the City of Poughkeepsie contributes to increased stormwater runoff and enhanced risk of nonpoint source pollution in the Fall Kill Creek. Sidewalks and roadbeds, parking lots, and roof tops comprise a considerably high percentage of land cover in the City.

Restoration Opportunities

Restoration opportunities in the City of Poughkeepsie include the following:

- Downspout disconnection, drain to pervious
- Right-of-way bioswales to reduce stormwater runoff
- Parking lot bioswales to capture overland sheet flow
- Street trees to reduce stormwater runoff

<u>Downspouts</u>

As in Hyde Park, there is a significant opportunity to disconnect rooftop downspouts in the City of Poughkeepsie. While Poughkeepsie is much more urban than Hyde Park, most residential lots in the City have lawns to which downspouts could be directed. For example, Neighborhoods 26

and 29, Hamilton/N. Clinton Street and Garden Street respectively, each drain approximately 80 percent of their rooftop rainwater to pervious areas. The other four neighborhoods in the City – 25, 27, 28, and 30 – each drain between 60-95 percent of their rooftop rainwater to either pervious areas or directly to the sewer.

Educating residents and building owners to the importance of rooftop disconnection is one place to start to address this issue. Community outreach through pamphlets and flyers or neighborhood how-to workshops sponsored by local non-profits or local community-based organizations are two possible sources for educating the public.

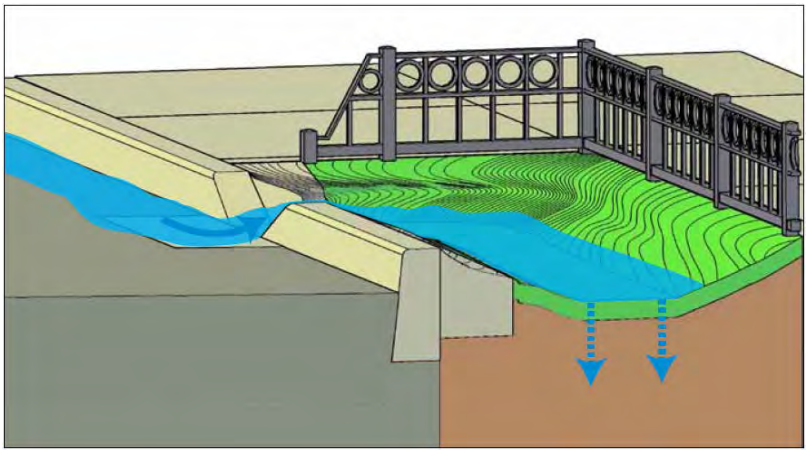
Disconnecting rooftop downspouts to rain barrels or cisterns is another option for properties that have adequate space in rear or side yards. A rain barrel give-away program modeled on the DEP rain barrel give-away program in New York City, could be a possibility. The sponsor of the program could give how-to demonstrations in neighborhoods and to community groups.

At the municipal level, local land use ordinances could be passed to require, where feasible, new construction to direct their rooftop stormwater to pervious areas, and for existing buildings requiring site development plan approval from the Planning Board to also direct their rooftop rainwater to pervious areas.

<u>Bioretention</u>
Right-of-way Bioswales

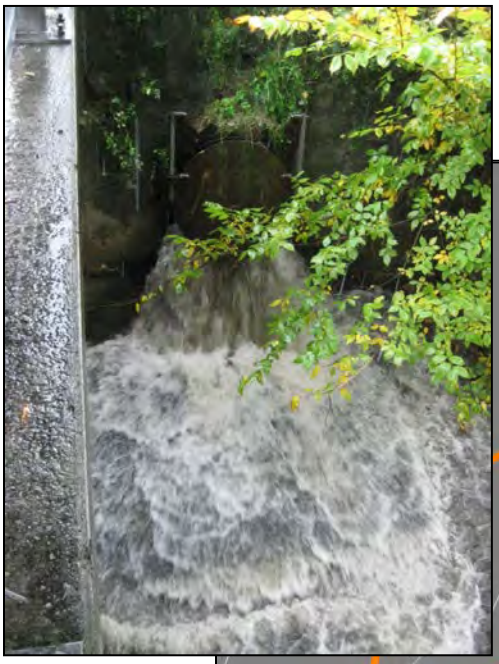
One of the greatest opportunities for bioretention in urbanized areas such as the City of Poughkeepsie is in the public right-of-way, which is made of mostly impervious asphalt and concrete and typically channels stormwater directly into the sewer system. The New York City Department of Environmental Protection (DEP), as well as other cities such as Seattle and Portland, has been designing right-of-way bioswales (ROWBs) to fit into tight spaces within the crowded streetscape.[10]

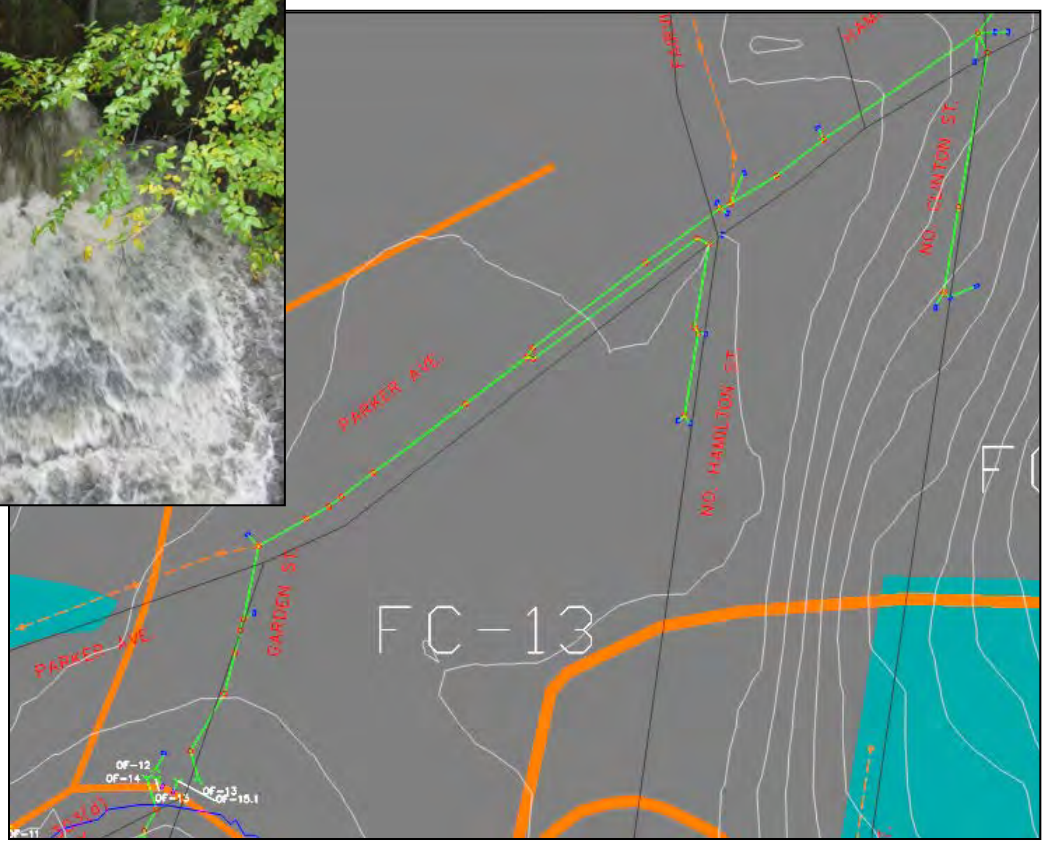
These ROWBs are typically sited on the sidewalk or as a curb extension "bulb-out" and divert stormwater from entering the sewer system. Runoff is either detained and allowed to slowly release into the sewer system or retained and allowed to infiltrate into the ground. The ROWB is designed to allow overflow of stormwater to the sewer during heavier rain events.



ROWBs divert runoff through a curb cut and allow water to infiltrate into the ground (Image source: NYC DEP)

There are many areas throughout the six assessed neighborhoods in Poughkeepsie that could serve as model sites for a ROWB. For example, the photo to the right from Neighborhood 25 has room for a bioswale and enough of a gradient to send stormwater into the infiltration system. Another excellent candidate would be any areas along Parker Avenue from North Clinton Street to Garden Street. This stretch of Parker Avenue collects a considerable amount of stormwater during rain events, all of which drains to the Garden Street outfall. Installing right-of-way bioswales along this corridor would provide the opportunity to remove a large volume and nonpoint source pollutants from entering the Fall Kill Creek.



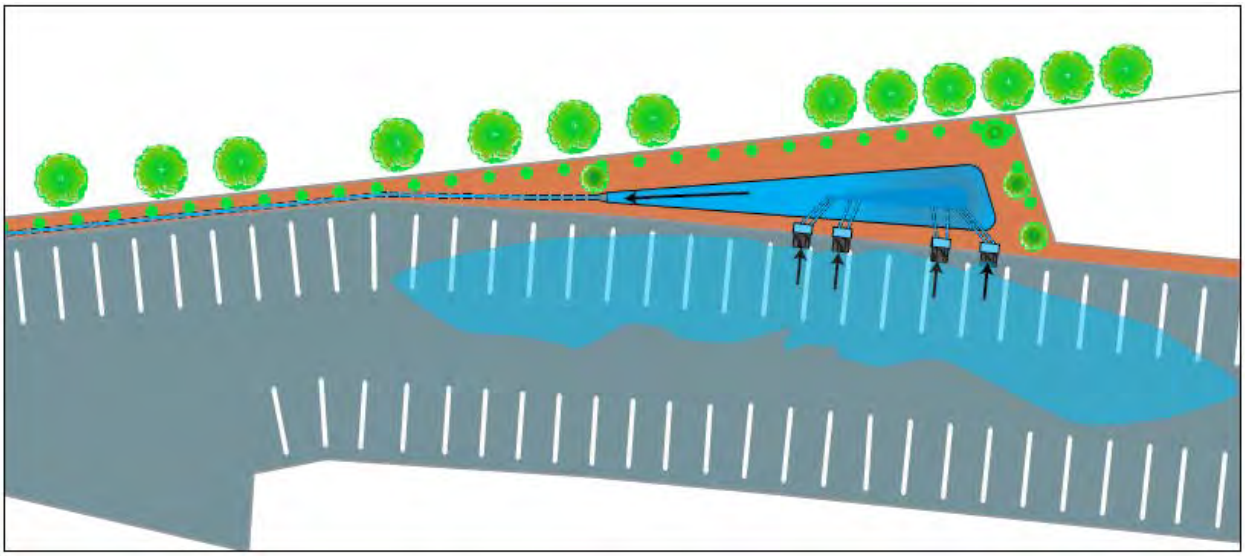


The Garden St Outfall, labeled in white at the bottom left, is the end point of a system that drains a heavily trafficked commercial area on Parker Ave., as well parts of North Hamilton and North Clinton.

Bioretention

Parking Lot Bioswales

Another restoration opportunity in urban areas such as the City of Poughkeepsie is in parking lots. NYCDEP has been monitoring several pilot parking lot bioretention systems with encouraging, if preliminary, results. A typical system is comprised of two components: a constructed mini-wetland and a bioswale. During rain events, runoff will flow to the perimeter of the parking lot into catch basins which convey the water directly into the bottom of the wetland. As the wetland fills to capacity it overflows into the bioswale through a perforated pipe. From the bioswale, the water is allowed to infiltrate into the ground.



Schematic representation of the NYC DEP system described above.

The sizing of the system, with consideration given to available space and calculated runoff volume, will determine the performance of the treatment. In the above example from DEP, the wetland component is 1700 sf and the linear bioswale is 900 sf, with a total drainage area of 28,950 sf. Performance data collected by DEP staff in 2011 showed promising results. If the anomalous event of Hurricane Irene is excluded, the system captured 77 percent of all rainfall over the course of eight rainfall events during the summer of 2011.[11]

Beulah Baptist Church in NBD 28 presents an excellent opportunity for a parking lot bioswale.

This type of green infrastructure practice would be appropriate for parking lots in the City of Poughkeepsie. There are numerous parking lots throughout the City, some of which are located in the assessed neighborhoods. For example, Beulah Baptist Church on Catherine and Mansion Streets is a large impervious surface that directly abuts the creek. A wetland/bioswale could be installed here, with the DEP example as a model.

Street Trees

Tree planting is the most basic green infrastructure technique, one in which many services are provided. In an urban setting such as the City of Poughkeepsie, street trees can reduce stormwater runoff, reduce energy use, improve air quality, reduce atmospheric CO_2, reduce urban heat island effect and increase neighborhood aesthetics.[12] This collection of benefits makes tree planting one of the most important investments a municipality can make.

Depending on the size of a tree's canopy, its leaf type (broad leaf deciduous, conifer, etc) and climate zone, a healthy urban forest can offer substantial hydrological benefits. During rain events, leaves and branches intercept and evapotranspirate rainfall, thereby reducing the volume of rainfall on impervious surfaces and delaying peak flow. According to the USDA Northeast Community Tree Guide, a single representative medium tree (red maple) can intercept 1,014 gallons of rain water per year at twenty years maturity.[13]

There are numerous areas in the assessed neighborhoods in Poughkeepsie that have restoration potential for tree planting. Neighborhoods 26 and 27 are just two examples offered below. Conflicts with overhead and subsurface utilities must be considered when siting new trees, but those two considerations notwithstanding, Poughkeepsie has a wealth of tree planting opportunities.

IV. End Notes

1. 2010 U.S. Census. https://www.census.gov/2010census/

2. Dutchess Watersheds. http://www.dutchesswatersheds.org/fallkill-creek-information

3. Fall Kill Watershed Committee. *A Watershed Management Plan for the Fall Kill, Dutchess County, New York*. October 2006. http://www.hudsonwatershed.org/plans09/fallkill.pdf

4. Dutchess Watersheds. http://www.dutchesswatersheds.org/fallkill-creek-information

5. Findlay, Stuard, et al. "Water Resources of Dutchess County, NY". *Natural Resource Inventory of Dutchess County, NY.* http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/nrichapfive.pdf

6. Dutchess Watersheds. http://www.dutchesswatersheds.org/fallkill-creek-information

7. EPA Water Quality Assessment Report, Fall Kill and Tribs, 2010. http://ofmpub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=NY1301-0087&p_cycle=2010&p_state=NY&p_report_type=

8. Rubbo, Jennifer. *A Rapid Trash Assessment of the Fall Kill*. Fall Kill Watershed Committee. 2008. http://www.dutchesswatersheds.org/images/dwp/fallkill/fall_kill_trash_report-final.pdf

9. Center for Watershed Protection, Neighborhood Source Assessment. http://www.cwp.org/

10. NYC Green Infrastructure Plan. 2010. http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml

11. NYC Green Infrastructure Plan, 2011 Update. 2011. http://www.nyc.gov/html/dep/pdf/green_infrastructure/gi_annual_report_2012.pdf

12. Center for Neighborhood Technology. The Value of Green Infrastructure. 2010. http://www.cnt.org/repository/gi-values-guide.pdf

13. USDA Northeast Community Tree Guide. August 207. http://www.fs.fed.us/psw/publications/documents/psw_gtr202/psw_gtr202.pdf

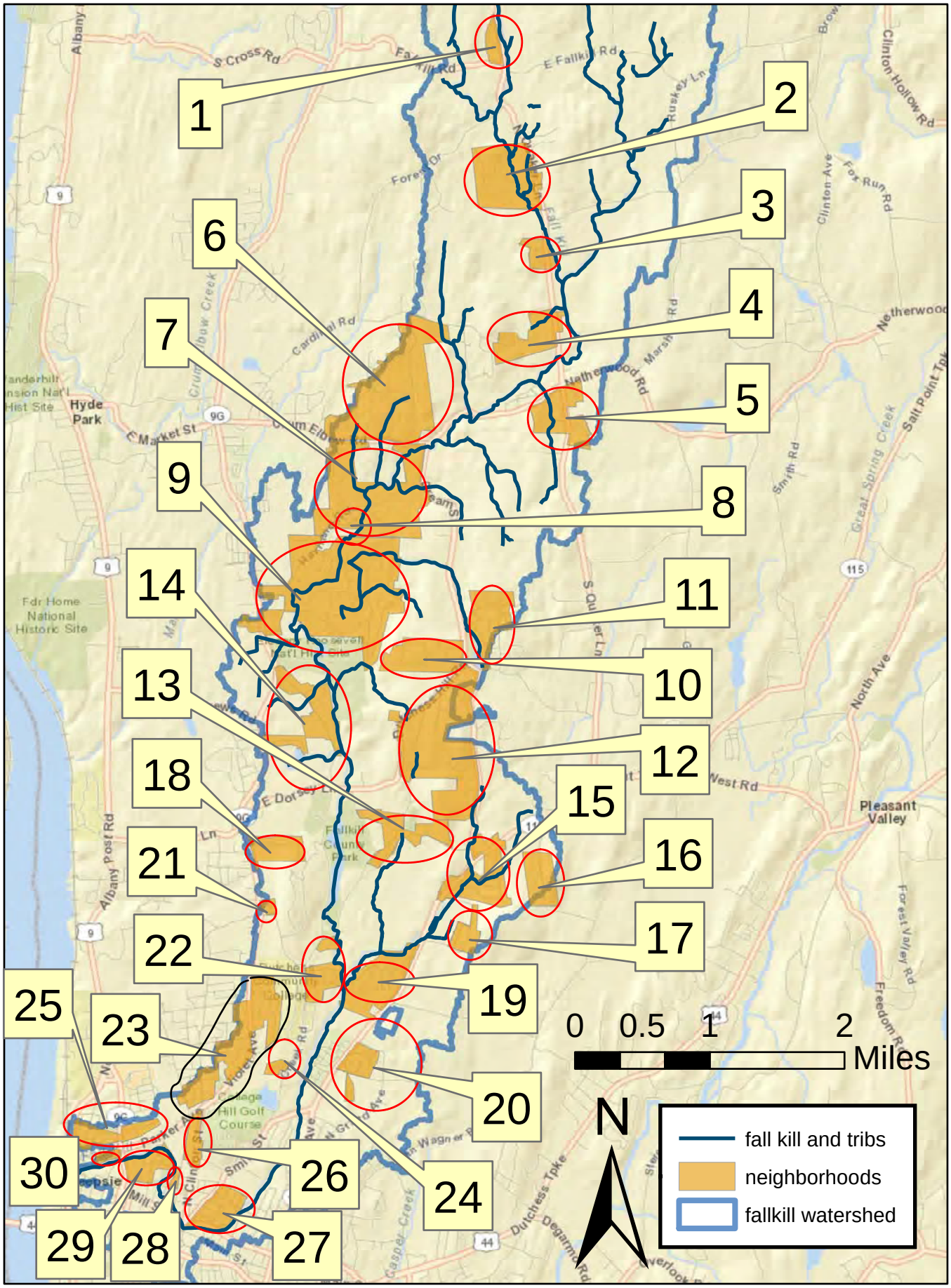
V: Summary of Neighborhoods Assessed

Site ID	Name	Location	Acres	# parcels/ homes	% Drain to Impervious	% Of Lot Impervious	Pollution Severity	Restoration Potential
NBD 1	N. Quaker Lane	Hyde Park	20	16	60%	20-25%	Low	Low
NBD 2	Quaker Hills Estates	Hyde Park	115	128	25%	10%	Low	Low
NBD 3	N. Quaker/Mackey Ln.	Hyde Park	26	24	30%	20-30%	Moderate	Moderate
NBD 4	N. Quaker/Cardinal Rd.	Hyde Park	64	33	20%	10-40%	Low	Low
NBD 5	Crum Elbow – East	Hyde Park	80	56	20-30%	20-40%	Moderate	Moderate
NBD 6	Crum Elbow –West	Hyde Park	228	184	30%	20-40%	Moderate	Moderate
NBD 7	Haviland Road	Hyde Park	65	114	0-5%	15%	Low	Low
NBD 8	Haviland – Mobile Home	Hyde Park	15	67	100%	55%	High	Moderate
NBD 9	Roosevelt Road	Hyde Park	355	560	25%	10-25%	Moderate	Moderate
NBD 10	Cream Street	Hyde Park	86	50	25%	10-30%	Low	Low
NBD11	Greenfields Park	Hyde Park	71	143	10-15%	20-40%	Low	Low
NBD 12	Dutchess Hill Road	Hyde Park	174	121	35%	10-30%	Low	Moderate
NBD 13	E. Dorsey Lane	Hyde Park	41	63	40%	25-40%	Moderate	Moderate
NBD 14	Creek Road	Hyde Park	83	116	20%	15-40%	Moderate	Low
NBD 15	Marshall Drive	Hyde Park	96	109	5%	20%	Moderate	High
NBD 16	Peach Road	Hyde Park	53	20	0%	15%	Low	Low
NBD 17	Edgewood Drive	Hyde Park	14	36	10%	30%	Low	Low
NBD 18	Bircher Avenue	Hyde Park	48	66	25%	10-20%	Moderate	Moderate
NBD 19	The Gables	Poughkeepsie (T)	105	200	40%	50%	Low	Low
NBD 20	Underhill Road	Poughkeepsie (T)	31	--	--	--	Low	Low
NBD 21	School Street	Poughkeepsie (T)	7	20	10%	20%	Low	Low
NBD 22	Pine Echo Drive	Poughkeepsie (T)	50	56	5%	25%	Low	Low
NBD 23	Violet Avenue	Poughkeepsie (T)	65	447	25%	25%	Low	Low
NBD 24	Colonial Manor	Poughkeepsie (T)	9	29	5%	50%	Low	Low
NBD 25	Taylor Ave/Albany St	Poughkeepsie (C)	29	351	30%	75%	High	Low
NBD 26	Hamilton/Clinton	Poughkeepsie (C)	26	110	10%	30%	Moderate	Moderate
NBD 27	Winnikee Avenue	Poughkeepsie (C)	53	358	40%	75%	High	Moderate
NBD 28	Mansion Street	Poughkeepsie (C)	4	33	50%	90%	Moderate	High
NBD 29	Garden Street	Poughkeepsie (C)	26	196	10%	75%	Low	Moderate
NBD 30	Verrazano Blvd	Poughkeepsie (C)	9	65	90%	75%	High	Moderate

VI: Summary of Common Restoration Opportunities

Pollution Potential	Recommended Management Practices	Affected Neighborhoods
Flooding and erosion, especially at culverts and road crossings	Barrier mitigation assessment and replacement of undersized infrastructure; Stream Daylighting	2, 15, 18
Stormwater runoff and combined sewer overflow	Downspout disconnection, Green Infrastructure, Sewer Separation	25 – 30
High turf management intensity and fertilizer use	Resident Education	3, 5, 7 (portions of), 12, 19, 21, 24, 26
Lack of riparian buffers	Resident Education, Riparian planting (Trees for Tribs), Zoning Regulations	2, 7, 9
Litter, Excess organic material	Catch basin cleaning, street sweeping, and clean up programs	All sites with stormdrains

VII: Individual Neighborhood Reports



Neighborhood 1 – North Quaker Lane

This neighborhood consists of approximately 16 lots located in the Town of Hyde Park bounded by North Quaker Lane/Route 16 to the east and Fallkill Rd to the south. The area is a mix of open and residential parcels ranging from just under 1 acre to approximately 2.5 acres. The housing is all single family residential, with a mix of ranch, split-level, and mobile home styles built between the 1960s and the 1980s. Where residences exist, water and sewer are both private, i.e. wells and septic systems.

The zoning district for this area is Greenbelt District (GB). According to the Town of Hyde Park Zoning Code, the purpose of the GB district is to "provide for low-density residential uses while retaining the open space quality of the land, to preserve and expand agricultural operations in the Town, to protect historic resources, to protect streams, wetlands and other natural resources, and to integrate natural resources into existing parklands. Large-scale development in the Greenbelt is discouraged."

Neighborhood 1		
Attribute	**Score**	**Comments**
% lot with impervious cover	20-25%	
% lot with grass cover	50-70%	Medium management intensity
% lot with forest canopy	20-30%	
% downspouts drain to impervious	60%	
% downspouts drain to pervious	40%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Somewhat clean, not stenciled
Stormwater detention areas present?	no	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

The Fall Kill Creek does not run directly through this small neighborhood, but rather runs through a wooded area across a busy street. Downspouts drain to impervious surfaces 60% of the time and the other 40% drain to lawns. Also noticeable is a large percentage of gravel driveways, at least 30 to 40%. The majority of these were broken up and had puddles. Some lots also had trash debris in their yards (i.e. old cars, and piles of old appliances).

Also of note is a small pond between two houses on the side of the road. This pond was relatively well kept, not overgrown, but did have a significant amount of algae. This provides evidence of nutrient enrichment, possibly from fertilizer use.

Typical house in neighborhood 1

Flooded Dirt Driveway

Small pond filled with some algal growth

Neighborhood 2 – Quaker Hills Estates

This neighborhood, known as Quaker Hills, consists of approximately 115 residential lots located in the Town of Hyde Park generally bounded by North Quaker Lane/Route 16 to the east and large, open space parcels to the west, north, and south. Interior roads include Quaker Hill Dr., Guerney Dr., Pennington Dr., Barkely Rd., and Shaker Ln. The neighborhood is a mix of single family colonial and ranch style homes, with a few old farm houses. Homes are located on lots ranging from ¾ acres to 4 acres, and were mostly built between 1968 and 1975. Water is supplied by the Quaker Hill Estates Town Water District, and sewer is private (i.e. septic).

The zoning district for this neighborhood is Neighborhood District (N). According to the Town of Hyde Park Zoning Code, the purpose of the N district is "to reinforce the historic pattern of limited mixed-use development in these districts of the Town. [. . .] The Neighborhood Districts have minimum to moderate constraints on development that can support greater density and are suitable for expansion and infill."

Neighborhood 2		
Attribute	**Score**	**Comments**
% lot with impervious cover	10%	
% lot with grass cover	55%	Medium management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	25%	
% downspouts drain to pervious	75%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	No	
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

The pollution contribution to the watershed from this neighborhood is relatively low. Most roof leaders drain to pervious surfaces, although roughly 25% drain to impervious surfaces. Parcels are large enough with both rear and side yards for installation of rain barrels and rain gardens. Roadside ditches that receive runoff appeared oily in at least one location (see photo). Residents should informed of the benefits of diverting roof leaders away from driveways and toward pervious surfaces.

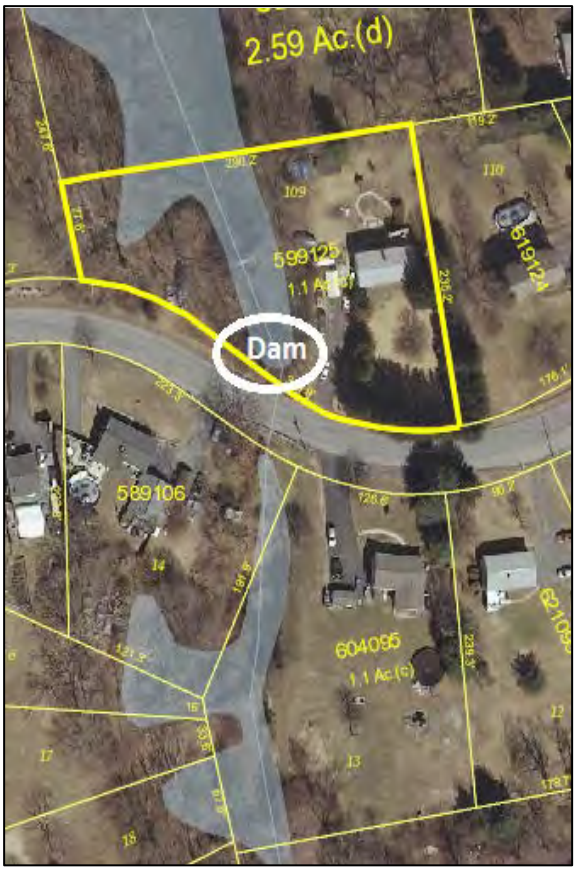
Flooding issues appear to be a problem for some residents and perhaps offer another restoration opportunity. Alfred Jiava, homeowner of nearly thirty years at 28 Quaker Hill Drive, reported considerable flooding in his backyard during recent years. An unnamed stream that flows south across his property has reportedly started flooding only in recent years and most recently pushed waters close to his home.

Oily residue from stormwater runoff

The highlighted lot is 28 Quaker Hill Dr., with stream running south on the western edge of the property.

Mr. Jiava stated that when he purchased the property he removed several trees in the rear yard, which may contribute to flooding issues. However, he stated that flooding has only been an issue in recent years, suggesting the stream is receiving increased volume, perhaps from increased development in nearby neighborhoods further upstream. Mr. Jiava's property also had a culvert installed on the northern edge of the property (see photo), which appears to receive stormwater from Quaker Hill Drive. Additional water volume from this culvert could also be contributing to increased water volume in the stream and flooding issues. Short of a hard-engineered berm or levee, perhaps some sort of bioswale could be constructed in Mr. Jiava's backyard that could act as a sort of spillway to capture water before it approaches his home.

Other issues worth noting in the neighborhood include an artificial dam, which appears to have been constructed by the resident at 10 Quaker Hill Drive. While perhaps pleasant for the resident, a dam such as this can contribute to water quality issues by disturbing natural flow and increasing water temperatures, which can lead to aquatic species impairment.

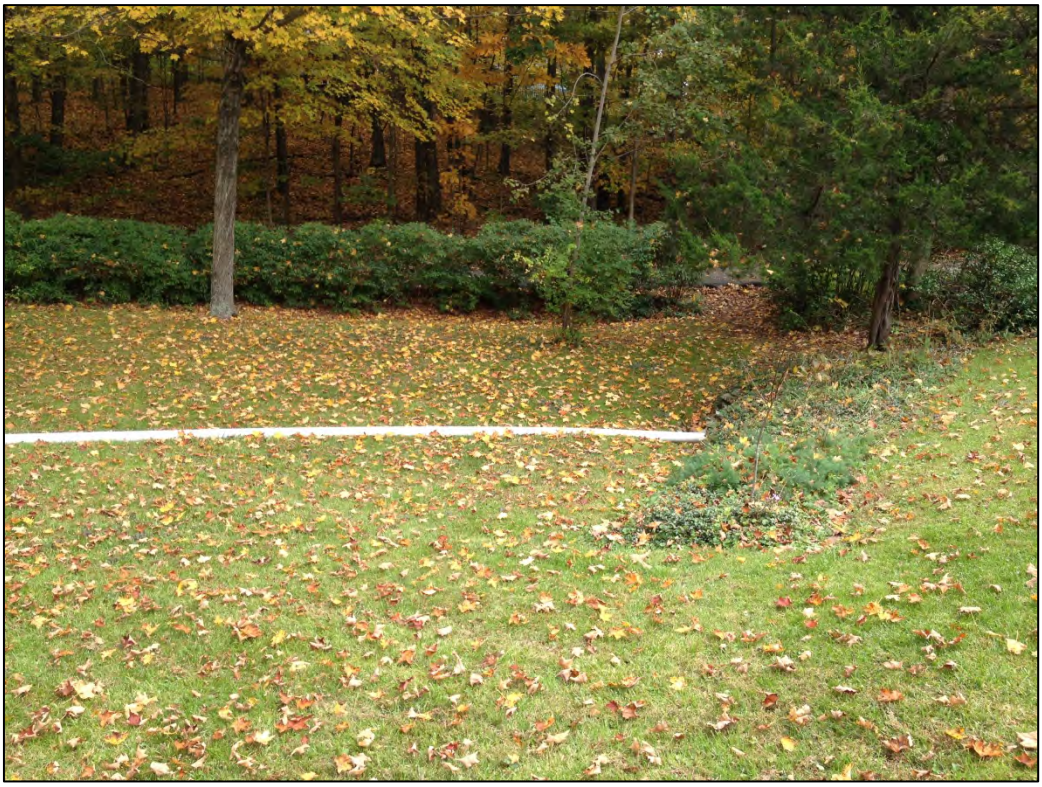


The dam constructed at 10 Quaker Hill Drive

On a second visit to the neighborhood, the resident explained that the town had removed the dam after Hurricane Irene, but that he put it right back up. This conflict between the town and the landowner should be addressed promptly, and in a non-threatening manner. A mediator such as the CAC or a local organization like Clearwater or Dutchess County Cornell Cooperative Extension could potentially help the process come to a mutually agreeable conclusion.

Culvert opposite the dam on Quaker Hill Drive

Buried pipe carrying roof rainwater to roadside ditch



Pipe carrying roof rainwater to bioretention area

Stream behind 28 Quaker Hill Drive, looking north

Stream behind 28 Quaker Hill Drive, looking south

Culvert leading to stream, 28 Quaker Hill Drive

Quaker Hills Water District

Neighborhood 3 – North Quaker/Mackey Lane

This neighborhood consists of 20 lots located in the Town of Hyde Park and straddles North Quaker Lane/Route 16. Larger parcels bound the neighborhood to the north and south. The neighborhood ends at a cul-de-sac to the west. Interior roads include Mackey Lane and Tina Drive. Homes sit on 1 to 2 ¼ acre lots and consist of a mix of contemporary and ranch styles, built mostly from the early to mid 1990s, with a few older homes on the east side of North Quaker Lane. Residences have private water and sewer, i.e. wells and septic systems.

The zoning district for this neighborhood is Neighborhood District (N). According to the Town of Hyde Park Zoning Code, the purpose of the N district is "to reinforce the historic pattern of limited mixed-use development in these districts of the Town. [. . .] The Neighborhood Districts have minimum to moderate constraints on development that can support greater density and are suitable for expansion and infill."

Neighborhood 3		
Attribute	**Score**	**Comments**
% lot with impervious cover	20-30%	
% lot with grass cover	60-75%	High management intensity
% lot with forest canopy	10-15%	
% downspouts drain to impervious	30%	
% downspouts drain to pervious	60%	
% downspouts direct to storm or sanitary	10%	
Storm drains present?	Yes	Clean
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	Yes	
Pollution Potential	Moderate	Fertilizer use
Restoration Potential	Moderate	

Neighborhood 3 is rather small, consisting only of Mackey Lane, which loops around in a circle, and Tina Drive, which dead ends in a cul-de-sac. Many of the properties on the latter street are obscured by long driveways and trees, which are not present in significant numbers in most of the rest of the neighborhood. The creek passes under N Quaker Lane across from the northeast corner of the neighborhood. The storm drains in neighborhood 3 lead directly to this creek.

The biggest pollution threat in the neighborhood is the high standards for lawn maintenance. Additionally, there is evidence of pesticide use on the lawns at one house (see photo below), and it seems likely that other property owners may also follow this example.

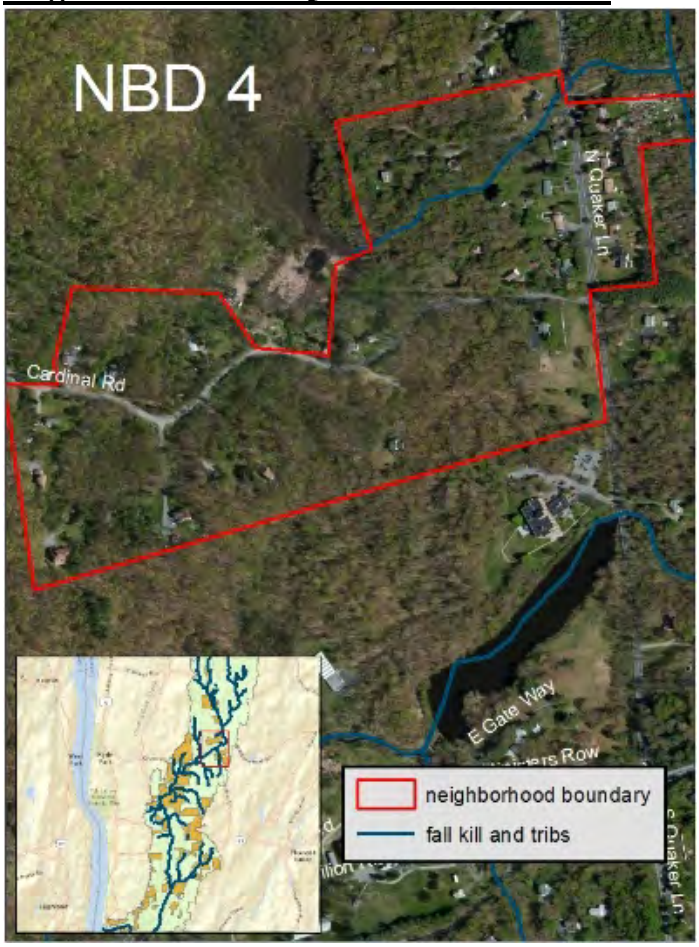
Algae in the creek across the road

Storm drain with organic matter build up

Home with lawn downspouts

Pesticide sign on a lawn, dated 10/26

Neighborhood 4 – N. Quaker/Cardinal Road



This neighborhood consists of approximately 30 lots located in the Town of Hyde Park, mostly to the west of North Quaker Lane with Cardinal Road running east-west through the neighborhood. While there are a few ½ acre lots, most homes are located on at least 1 acre lots and many are on 2-4 acre lots. There are a few vacant/open parcels off of Cardinal Road. Homes are mostly colonial or ranch style, and were built anywhere from the 1950s to the 1980s, with a few older farm houses. Water and sewer are private, i.e. wells and septic systems.

The zoning district for this area is Greenbelt District (GB). According to the Town of Hyde Park Zoning Code, the purpose of the GB district is to "provide for low-density residential uses while retaining the open space quality of the land, to preserve and expand agricultural operations in the Town, to protect historic resources, to protect streams, wetlands and other natural resources, and to integrate natural resources into existing parklands. Large-scale development in the Greenbelt is discouraged."

Neighborhood 4		
Attribute	**Score**	**Comments**
% lot with impervious cover	10-40%	Along N Quaker, larger percent.
% lot with grass cover	40-60%	Medium management intensity
% lot with forest canopy	50-70%	
% downspouts drain to impervious	20%	
% downspouts drain to pervious	80%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Clean
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

Neighborhood 4 is typical of many Hyde Park neighborhoods established during this era. There are a small number of properties on relatively large lots, and there is nothing particularly egregious in terms of pollution threats. There are a number of gravel driveways and the pavement on Cardinal Road is cracked in many places. It is not possible to see many of the houses from the road due to the large amounts of tree cover, number of hills, the size of the lots, and the lengths of the driveways.

A Fall Kill tributary does run through the northeast corner of the neighborhood, near N Quaker Lane, but the creek is relatively well protected with a well-established riparian buffer. Also notable about this neighborhood are the differences between the section on N Quaker Lane and the section on Cardinal Road. The Quaker section is much denser and sees more upkeep than the lower density, more private Cardinal area.

Standard restoration opportunities apply to this neighborhood, including rain barrels or rain gardens, as there is ample room for either of these options on nearly every lot. However, the pollution threat from stormwater runoff appears to be negligible.

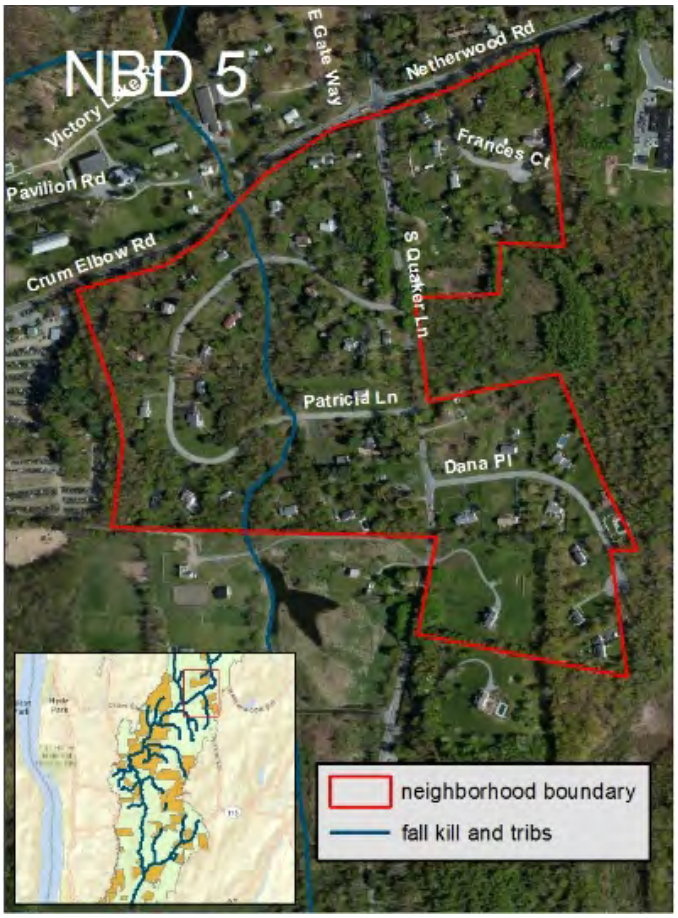
Fallkill at N Quaker Lane

Typical home along N Quaker Lane

Quiet Cardinal Road

Home near the street along Cardinal Road

Neighborhood 5 – Crum Elbow East



This neighborhood consists of approximately 50 lots in the Town of Hyde Park, straddling South Quaker Lane/Route 16 and bounded by Crum Elbow Road/Route 41 to the north, a junk yard to the west, and larger residential lots to the south. Interior roads include Patricia Lane, Dana Place, and Frances Court. Homes are located on 1 ¼ to 2 ½ acre lots and are mostly colonial and ranch styles built from the late 1980s to the early 2000s. Water and sewer are private, i.e. wells and septic systems.

The zoning district for this area is Greenbelt District (GB). According to the Town of Hyde Park Zoning Code, the purpose of the GB district is to "provide for low-density residential uses while retaining the open space quality of the land, to preserve and expand agricultural operations in the Town, to protect historic resources, to protect streams, wetlands and other natural resources, and to integrate natural resources into existing parklands. Large-scale development in the Greenbelt is discouraged."

Neighborhood 5		
Attribute	**Score**	**Comments**
% lot with impervious cover	20-40%	
% lot with grass cover	60-75%	Medium to high mgmt. intensity
% lot with forest canopy	10-20%	
% downspouts drain to impervious	20-30%	
% downspouts drain to pervious	40-60%	
% downspouts direct to storm or sanitary	25%	
Storm drains present?	Yes	Somewhat clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	Yes	Curbs present
Pollution Potential	Moderate	Likely use of fertilizer on yards
Restoration Potential	Moderate	Disconnection of rooftop drains

Overall this neighborhood is very clean and well maintained. There was some buildup of leaves and debris alongside the road and on the curb, but that could be attributed to a recent storm and the expected organic debris from the fall season.

The creek in the southern part of the neighborhood that ran between houses did have algae present, indicative of nutrient loading, which could come from fertilizer runoff or faulty septic systems. Also noticeable was the greater amount of downspouts directly connected to the storm sewers (at least 25%). This could be a restoration opportunity if enough downspouts could be disconnected.

Restoration opportunities such as stream and lake riparian plantings, and diversion of stormwater from the storm sewer system to vegetated swales or gardens before they enter the stream, are present, and can be seen in the photos below.

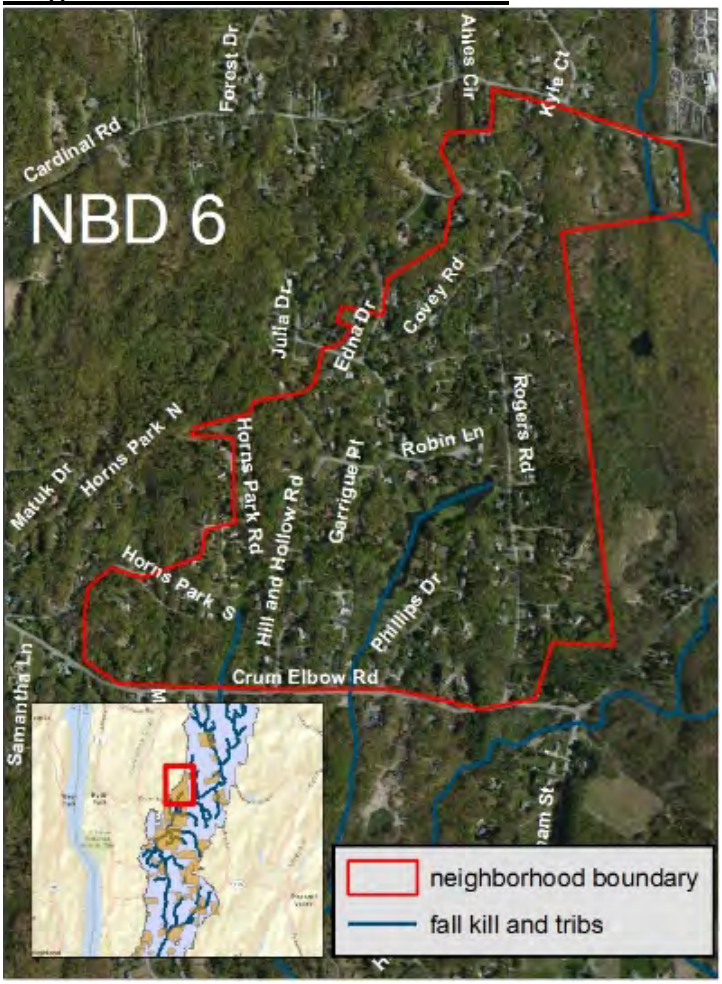
Typical home in neighborhood 5

Storm pipe leading into creek

Creek near houses

Downspout connected to storm drain

Neighborhood 6 – Crum Elbow West



This neighborhood is a large subdivision consisting of approximately 150 lots in the Town of Hyde Park. The subdivision is bounded by Crum Elbow Road/Route 41 to the South and Cardinal Road to the north, with Rogers Road running north-south on the eastern end, and the watershed boundary to the west. Interior roads include Julia Drive, Edna Drive, Robin Lane, Ahles Circle, and Phillips Drive. The majority of homes in this neighborhood are ranch or split-level style built in the 1960s and 1970s and sit on 1 to 2 acre lots. Homes have private water and sewer supply, i.e. wells and septic systems.

The zoning district for this neighborhood is Neighborhood District (N). According to the Town of Hyde Park Zoning Code, the purpose of the N district is "to reinforce the historic pattern of limited mixed-use development in these districts of the Town. [. . .] The Neighborhood Districts have minimum to moderate constraints on development that can support greater density and are suitable for expansion and infill."

Neighborhood 6		
Attribute	**Score**	**Comments**
% lot with impervious cover	20-40%	
% lot with grass cover	50-70%	Medium management intensity
% lot with forest canopy	25-40%	
% downspouts drain to impervious	30%	
% downspouts drain to pervious	60%	
% downspouts direct to storm or sanitary	5-10%	
Storm drains present?	Yes	Clean
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Moderate	
Restoration Potential	Moderate	

Tributaries of the Fall Kill Creek course both throughout and adjacent to this large neighborhood. Most homes appear to be well kept, some with extensive landscaping. Stormwater appears to be well managed through a system of storm drains likely leading to nearby wetlands. The most notable feature about the neighborhood is the presence of an auto body shop on the northern border of the neighborhood. The shop, located off of Rogers Road, is on a hill, and the autos are exposed to the elements, increasing the risk of pollution runoff to the tributaries.

There are several ponds in the neighborhood, and there is some noticeable algae in one of the ponds, hinting at an excess of nutrients. Canada geese were observed at another pond, on private property, and they may frequent multiple locations in the neighborhood. Waste from Canada geese can contribute to fecal coliform loading in the creek. Plants could be introduced here and landscaping practices could be changed to stop possible runoff of fertilizer.

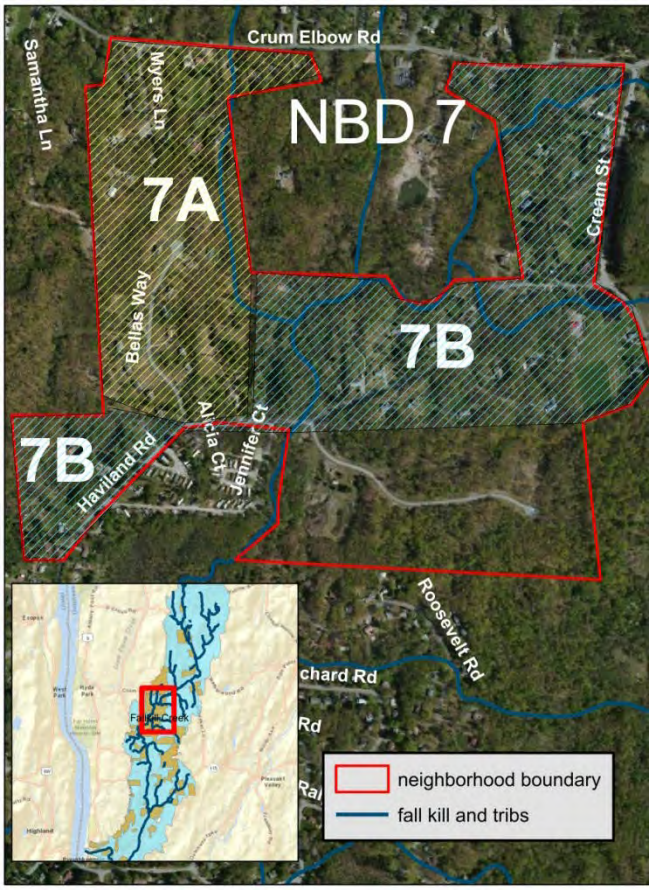
Auto shop off of Rogers Rd.

Pond with evidence of algae

Home with lawn downspouts

Evidence of landscaping on a hill

Neighborhood 7- Haviland Road



This neighborhood consists of approximately 80 parcels located in the Town of Hyde Park. The boundaries are roughly Crum Elbow Rd/Route 41 to the north, Cream St./Route 39 to the east, Haviland Rd. to the south, and large open parcels to the west. There is considerable diversity in terms of lot size, age and style of home, vacant parcels versus developed parcels, and even zoning, making this a neighborhood in only the loosest of definitions.

On the northeast section of the neighborhood, two cul-de-sacs – Bellas Way to the south and Myers Lane to the north – abut each other. Homes along these two streets are newer, built in the early-to-mid 2000s. They are mostly ranches and colonials and range from 1 acre lots on Bellas Way to 2-4 acre lots on Myers Lane. These homes are in the Green Belt zoning district, which according to the Town of Hyde Park zoning code, strive for low-density residential uses and the preservation of open space.

Parcels to the south and west of Haviland Road are in the Neighborhood zoning district, which seeks to promote historic patterns of limited mixed-use development and can support greater residential density according to the Town of Hyde Park zoning code.

To the southwest of the neighborhood (on the north side of Haviland Rd) are a handful of homes built roughly between 1948 and the 1960s, mostly ranches and cape cod styles on 2-4 acre lots. These homes are located directly across from a series of mobile home parks (Neighborhood 8), which, while not technically within the boundary of neighborhood 7 , are worthy of consideration.

Finally, on the southeast side of the neighborhood, east of the mobile home parks and southeast of Haviland Rd, are a group of vacant residential lots surrounding a cul-de-sac. These lots are roughly 2.5-3 acres in size. This is a subdivision awaiting development.

All occupied parcels within neighborhood 7 are serviced by private water and sewer, i.e. wells and septic systems.

Neighborhood 7A		
Attribute	**Score**	**Comments**
% lot with impervious cover	15%	
% lot with grass cover	80%	High management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	0%	
% downspouts drain to pervious	100%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

Neighborhood 7B		
Attribute	**Score**	**Comments**
% lot with impervious cover	15%	
% lot with grass cover	80%	50% forested, med. mgmt. intensity
% lot with forest canopy	50%	
% downspouts drain to impervious	5%	
% downspouts drain to pervious	95%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

Neighborhood 7 needs to be divided into sub-neighborhoods, including 7A and 7B, in order to better assess the impact on the watershed. 7A consists of two cul-de-sacs, Meyers Lane and Bellas Way, on the northwest corner of the map. This area is generally low contributing in terms of pollution. While there is high management intensity of lawn turf and likely fertilizer use, there appears to be a well-kept buffer of wetlands between the homes and the stream, likely preventing pollutants from entering the waterway. The biggest restoration opportunity in this area would be to simply plant more trees. This area was clearly forested prior to development, but now many lots, particularly on Bellas Way, have bare front yards that could use more trees (see photo).

Bellas Way, in need of trees

The 7B section of this neighborhood is located on either side of Haviland Road. These areas generally do well maintaining a good riparian buffer between lawn and stream, with only a few exceptions (see photo). The culverts at road crossings appear to be sufficient to handle the considerable volume of water that passes through this neighborhood (see photo).

Lawn cut to stream edge

Stream and culvert at Haviland Road

Restoration opportunities here would include ensuring proper riparian buffers are maintained at all segments of the stream. Lawns cut to the stream edge, such as shown in the photo above, can invite Canada geese to occupy the area next to the stream, leading to increased fecal coliform loading from geese excrement.

Typical home along Haviland Road

Lastly, the area at the southeast portion of the map contains a future subdivision, with road and curb constructed, gas utilities and stormwater infrastructure installed, and subdivided lots ready for construction. While the unnamed road is blocked off by large boulders, it is evident that people are accessing the site. Large debris such as burned couches (see photo) and other garbage are present everywhere at the cul-de-sac. Stormwater runoff could carry pollutants from this debris downhill to the stream. Debris should be cleared, and the no-trespassing should be enforced.

Burned couch at the cul-de-sac of the unnamed, unfinished subdivision

Neighborhood 8 – Mobile Home Parks

This neighborhood consists of two parcels containing mobile home parks off of Haviland Road in the Town of Hyde Park. The parcel to the east, accessed by Jennifer Court, contains approximately 27 mobile homes on 7.2 acres, built between 1970 and 1988. Jennifer Court has a wetland to the north of the trailer sites. Water and sewer are listed as private according to Dutchess County Parcel Access, meaning wells and septic systems.

The parcel to the west, accessed by Alicia Court, Debra Court, Jean Court, and Andrea Court, contains over 40 mobile homes on 8.4 acres, built between the 1960s and the 1980s. Water and sewer on this parcel are also listed as private, i.e. wells and septic systems.

The zoning for both parcels is Neighborhood (N), which according to the Town of Hyde Park zoning code has the purpose of reinforcing "the historic pattern of limited mixed-use development in these districts of the Town. [. . .] The Neighborhood Districts have minimum to moderate constraints on development that can support greater density and are suitable for expansion and infill."

Neighborhood 8		
Attribute	**Score**	**Comments**
% lot with impervious cover	55%	
% lot with grass cover	45%	Low management intensity
% lot with forest canopy	40%	
% downspouts drain to impervious	0%	
% downspouts drain to pervious	100%	Downspouts not present
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Not stenciled, drain to tribs.
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	High	Septic close to creek, flooding issues
Restoration Potential	Moderate	Septic treatment could be upgraded, but not proximity to creek

This neighborhood is very much defined by its topography and proximity to the Fall Kill. Most of the park is located well within the 100 year flood plain, as seen below.

FEMA's new DFIRM map displaying the current 100 year floodplain.

The mobile park was identified in the Fall Kill Watershed Management Plan as a potential source of water quality impairment:

Septic systems built too close to the banks of the creek in excessively drained soils may result in fecal coliform and E. coli contamination of both the creek and drinking wells. Heavy rain-producing storms can cause severe flooding and bacterial contamination as the water flows quickly from the excessively drained soils into the poorly drained soils along the creek. Hyde Park experienced this problem with a storm on August 12, 2003.

The residential area between Haviland Road and Roosevelt Road experienced severe flooding and damage caused by heavy rainfall (see photo). The soils within and along the banks of the creek in that area, Sun and Carlisle, are both considered very poorly drained, while the soil throughout the surrounding residential area, Hoosic, is very well drained. Impervious surfaces associated with suburban and rural development increase the rate and volume of runoff and compound the flooding problem.

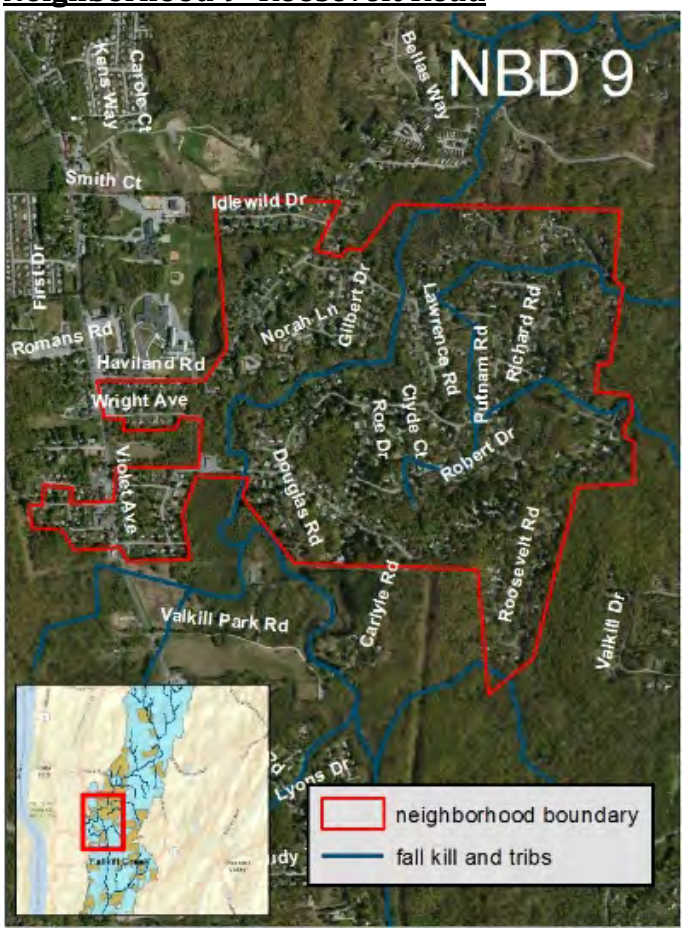
While the pollution potential is fairly clear, opportunities for restoration are more elusive. Short of relocating the park, there is no way to remedy the fact that it is built in a floodplain. Potential contamination issues from the septic system may fixable, likely at great cost, or may be a product of the soil conditions and location of the system. We recommend that the town make this neighborhood a priority for further assessment, and reach out to property owners to address these issues.

View from Haviland Rd looking at the wetland in the front of the neighborhood.

Flooding along Haviland Road in 2003

Typical homes in Neighborhood 8

Neighborhood 9- Roosevelt Road



This large neighborhood consists of well over 100 parcels, and residences share many characteristics. The neighborhood, located in the Neighborhood zoning district, is entirely single family homes but contains greater density than other neighborhoods in the Hyde Park section of the watershed. Roosevelt Road serpentines around the perimeter of much of the neighborhood while Haviland Road provides a Northwestern boundary. Two smaller subdivisions offshoot from the main neighborhood to the Southwest. Most homes are located on 1/3 acre to 1 acre lots and were built from the mid 1950s to the mid 1980s in mainly ranch and colonial styles.

The majority of this neighborhood is served by the Dutchess County Water and Wastewater Authority (DCWWA), Zone D. DCWWA provides community water at this location but not community sewer. All homes in the neighborhood have septic systems for wastewater treatment. Homes not served by the DCWWA have private water, i.e. wells.

Neighborhood 9		
Attribute	**Score**	**Comments**
% lot with impervious cover	10-25%	
% lot with grass cover	50%	Medium management intensity
% lot with forest canopy	25-40%	
% downspouts drain to impervious	25%	
% downspouts drain to pervious	75%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Moderate	Runoff and flooding
Restoration Potential	Moderate	Improve riparian buffer along creek, Address Flooding

The Fall Kill Creek winds significantly through this neighborhood and intersects several roads, making it more vulnerable to fertilizer runoff from nearby homes and pollution from the street (car runoff and litter). However, the neighborhood is well maintained with significant landscaping along the creek. Most areas have rocks along the banks in addition to plant vegetation. Some riparian areas along the creek could be better treed (see photo below). Certain areas of the neighborhood had significant amounts of tree cover, which can provide protection from the sun and rain. No sprinkler systems were observed in the area. Most houses are higher in elevation, with downspouts draining onto either the lawn or driveway, and then flowing down into the street. This water then flows into the storm drain inlets in the roads, which lead directly to the creek.

These factors combined, particularly the presence of many road crossings and culverts and the development of floodplain, have led to a number of residents in this neighborhood experiencing significant flooding problems. The neighborhood should be a priority for assessments and flood mitigation work, such as riparian restoration and culvert replacement.

Riparian area along the Fall Kill

Retaining wall along the creek

Typical drain flowing from house to street, Haviland

A typical home next to creek, Haviland

Typical storm drain inlet near creek, Haviland

Neighborhood 10 – Cream Street

This neighborhood consists of approximately 50 parcels located to the west of Cream St./Route 39 in the Town of Hyde Park. The zoning district is Neighborhood (N), which allows for limited mixed-use development and greater residential density. Interior roads include Valkill Dr., Dill Ln., and Potter Bend.

Homes in this neighborhood are located mostly on 1-2 acre lots, with just a few larger parcels. All homes are single family residential, built mostly in the colonial and ranch styles. Homes are newer as you move west away from Cream Street. Nearest to Cream St., homes were built in the 1970s, while at the western end of the neighborhood homes were built in the late 1990s and early 2000s. All homes have private water and sewer, i.e. wells and septic systems.

Neighborhood 10		
Attribute	**Score**	**Comments**
% lot with impervious cover	10-30%	
% lot with grass cover	60-70%	Medium management intensity
% lot with forest canopy	<25%	
% downspouts drain to impervious	25%	
% downspouts drain to pervious	75%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Not stenciled, drain to tribs.
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

This neighborhood is not in close proximity to the Fall Kill or its tributaries, so direct pollution into the water is minimal. However, some houses may use fertilizers on their lawns, which can be conveyed to the creek through runoff.

The neighborhood was assessed on a day when it was raining and no noticeable problems were observed. There were few puddles and no evidence of flooding anywhere. Overall, the neighborhood was very clean and well-kept.

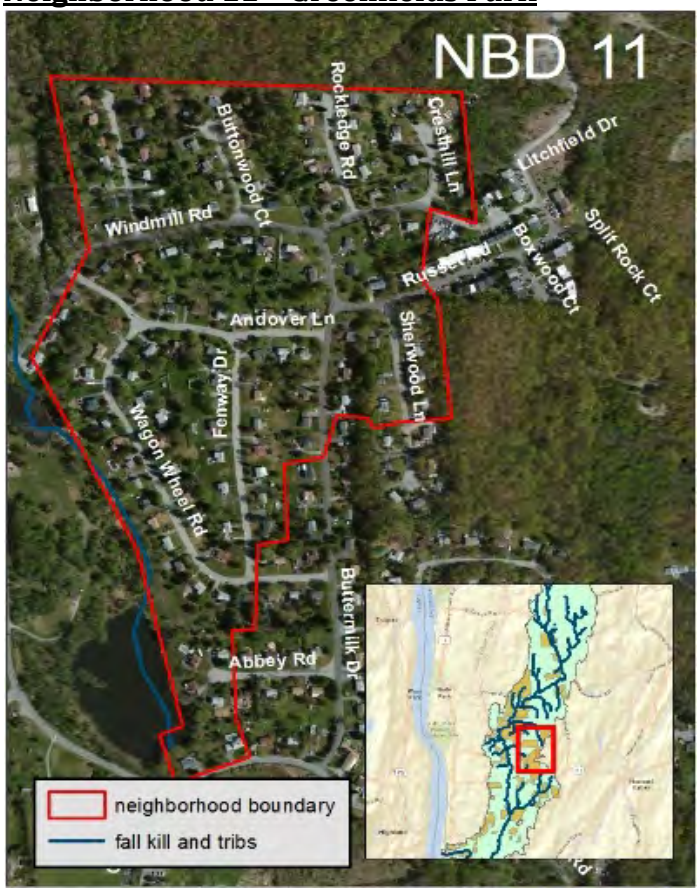
The pollution threat is low for this neighborhood, as is the restoration potential. Parcels are large enough for rain gardens, so draining roof downspouts to such biotention areas could provide some nonpoint source pollution control.

Typical house.

Standard roadside storm drain.

Vegetated detention pond.

Neighborhood 11 – Greenfields Park



This neighborhood, located in the Town of Hyde Park on the east side of Cream St. consists of approximately 120 parcels and is in the Neighborhood (N) zoning district. The N zoning district allows for greater residential density. Major interior roads include Windmill Rd., Wagon Wheel Rd., Fenway Rd., and Buttermilk Dr.

Homes are all single family residential on 1/3 to 1/2 acre, and are mostly ranch style built in the late 1960s to early 1970s. The entire neighborhood is located within the Greenfields Water and Sewer District. A roughly six acre reservoir is located to the southwest of the neighborhood, just off of Cream St./Route 39.

The roughly nine acre Greenfields Park, owned by the Town of Hyde Park, is located on the western boundary of the neighborhood. The park, coupled with the Water District reservoir directly to the south, provides nearly 20 acres of open space on the western edge of the neighborhood. Also notable, to the northeast of the neighborhood is a condominium complex which appears to still have lots available for development.

Neighborhood 11		
Attribute	**Score**	**Comments**
% lot with impervious cover	20-40%	
% lot with grass cover	50-70%	Low management intensity
% lot with forest canopy	5-15%	
% downspouts drain to impervious	10-15%	
% downspouts drain to pervious	85-90%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	Stormwater ponds; communal wastewater treatment
Restoration Potential	Low	

This neighborhood is adjacent to the water district reservoir, which helps comprise the boundary to a park. The bank on the side where houses are located does not have vegetation or trees, presenting a danger to levels of runoff or attraction of Canada Geese. Restoration potential is on the low side as the neighborhood seems clean and well-kept. However, parcels are large enough to include rain gardens as a method of filtering roof rain water rather than allow water to be conveyed to the creek via storm drains.

No drainage or flooding issues were observed in the neighborhood. Storm drains are present and routed to vegetated detention areas. Sewage is conveyed to a common sewer treatment plant, which discharges to a buffered wetland before entering the creek.

A drain by the lane into the neighborhood with a sign for "Well 12."

Gutter and growth across from the parking lot.

Typical drain in the neighborhood.

View of the reservoir from the neighborhood.

Neighborhood 12- Dutchess Hill Road

This irregularly shaped ("S" shaped) neighborhood consists of approximately 125 parcels located in the southeast corner of the Town of Hyde Park. The neighborhood is bordered on the west-northwest by Dutchess Hill Road/County Route 40 and on the east by Cream Street/County Route 39. There are several interior culs-de-sac, including Kari Boulevard, Kristin Lane, Kim Lane, and Mollys Way.

These single-family homes are generally newer, built between the mid 1980s and 2000, and mostly on 1.2-2 acre lots. Most homes are contemporary or ranch-style and all have private water and sewer service, i.e. wells and septic systems. Many homes have backyard pools.

The zoning district is Green Belt (GB), which according to the Town of Hyde Park seeks to promote low-density residential uses.

Neighborhood 12		
Attribute	**Score**	**Comments**
% lot with impervious cover	10-30%	
% lot with grass cover	60-75%	High management intensity
% lot with forest canopy	5-15%	
% downspouts drain to impervious	35%	
% downspouts drain to pervious	60%	
% downspouts direct to storm or sanitary	5%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	Yes	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	Fertilizer use on yards
Restoration Potential	Moderate	Reduce fertilizer use

This neighborhood is quite large, accounting for a wide variety of characteristics. Busier streets form the boundary of the neighborhood, with lot sizes along these streets generally smaller and containing more forest canopy. The interior of the neighborhood is hillier and lacks mature trees, possibly leading to high uses of fertilizers and most likely sprinklers to maintain lawns. Since most homes were recently built, many lack significant landscaping. This presents possible restoration opportunities to minimize water pollution in the Fall Kill Creek.

The creek runs through several yards and intersects the busier streets frequently. This poses a greater threat for stormwater runoff, and could be fixed by better landscaping practice on the sides of the creek. Also noticeable are three vegetative and well-manicured stormwater ponds interspersed throughout the neighborhood. However, all three lie next to busy roads, one in the southwest corner off Cream Street; another on the western edge off Beck Road; and another in the northwest corner off Dutchess Hill Road. All three are wet ponds, with only one (on Dutchess Hill Rd.) displaying signs of algae.

The biggest pollution threat from this neighborhood is simply lawn management practices and swimming pools. Residents should be aware of the water quality issues, namely nutrient enrichment, associated with fertilizer use. Swimming pools also present a risk of chlorine contamination in the creek.

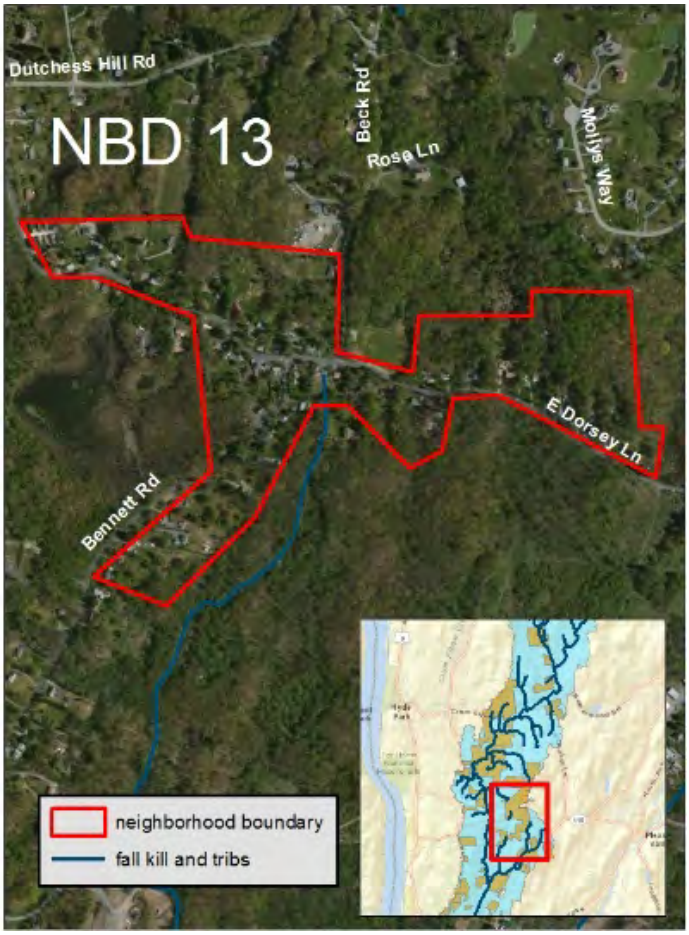
Typical house

Stormwater pond off Beck Rd

Pond with algal growth off Dutchess Hill

Stormwater pond off Cream Street

Neighborhood 13 – East Dorsey Lane



This irregularly shaped neighborhood consists of nearly 60 parcels located in the southeast corner of the Town of Hyde Park, with parcels straddling north and south of E. Dorsey Lane. Most homes are older, built between the early 1930s and the late 1950s, and are located on 1-2 acre lots.

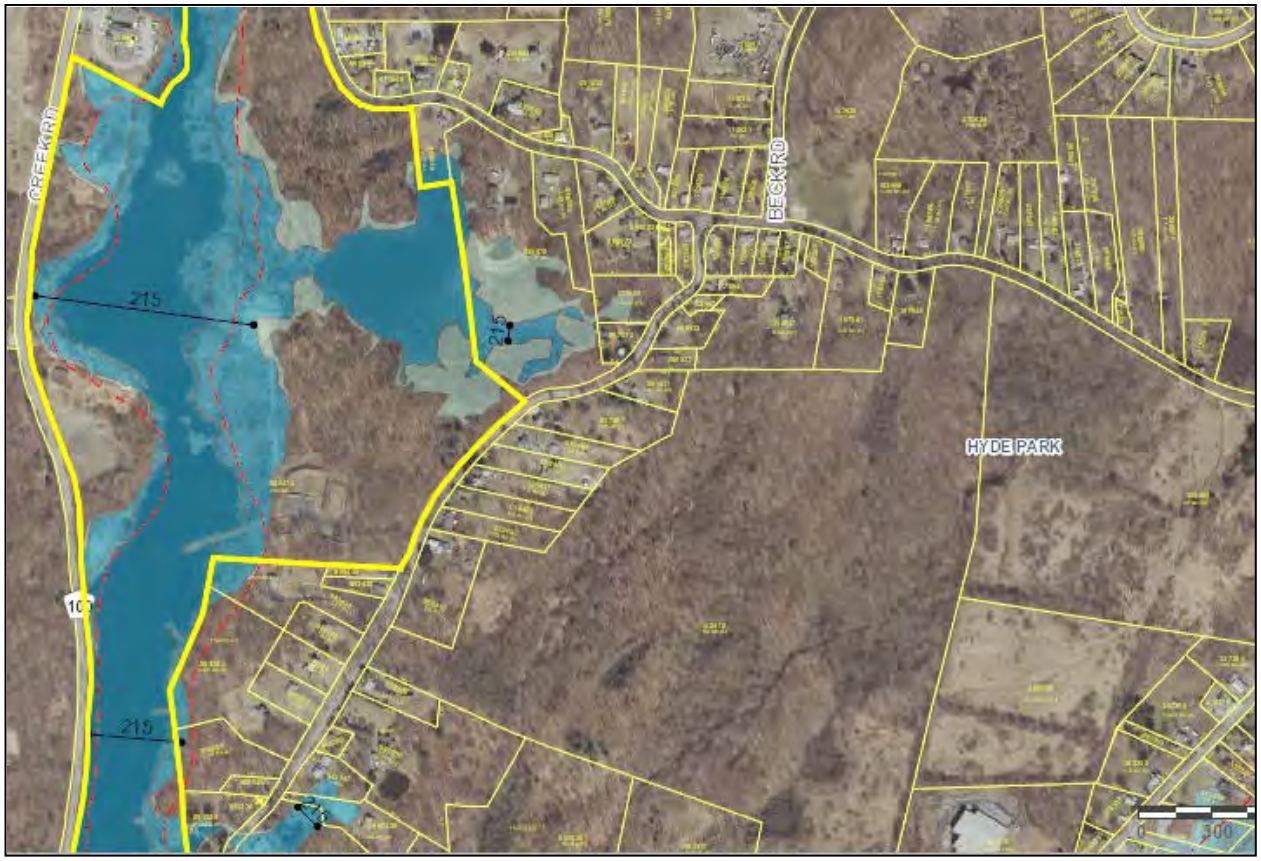
The zoning district is Green Belt (GB), which according the Town of Hyde Park zoning code seeks to promote low-density residential use and preserve open space. Water service consists of private wells and septic systems.

Notable about this neighborhood is that, while not technically within the defined neighborhood, there is a mobile home park adjacent to the north.

Neighborhood 13		
Attribute	**Score**	**Comments**
% lot with impervious cover	25-40%	
% lot with grass cover	50-60%	Medium management intensity
% lot with forest canopy	10-20%	
% downspouts drain to impervious	40%	
% downspouts drain to pervious	60%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Clean and Stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Moderate	Water flows directly into creek.
Restoration Potential	Moderate	Homes, traffic, and a construction site contribute to runoff.

Neighborhood 13 straddles Fallkill County Park, which lies to the west and encompasses 100 acres. The majority of the park is covered by FEMA's new DFIRM map, which represents the 100 year flood zone as of 2012 (see map below). Fallkill Park is one a just a few locations where residents and visitors can interact with the Fall Kill Creek on public land. However, this also means that by sheer proximity to residential areas, pollution threats such as nutrient enrichment from lawn maintenance are a concern. Stormwater runoff will ultimately make its way to the creek at Fallkill Park.

Storm drains are stenciled with fish and say "drain to waterway." Directly north of the neighborhood is a private lot, where construction is going on and many vehicles are parked. This could also be a source of pollutants.



DFIRM map depicting 100 year flood zone in Fallkill County Park (*Dutchess County Parcel Access***)**

Algae in Creek

Home with driveway downspouts

Park and storm drain

Cleaner stream north of lots

Neighborhood 14 – Creek Road

This neighborhood consists of approximately 100 parcels located in the southern portion of the Town of Hyde Park. The majority of parcels straddle Creek Road from East Dorsey Lane to Violet Avenue/Route 9G. There is a separate group of homes off of Violet Avenue/Route 9G with Prince Road running through the neighborhood, ending in a cul-de-sac.

The majority of homes are single family residential on ¼ acre to ¾ acre lots, with a few larger 2+ acre lots. Homes are mostly built in the ranch style from the mid 1950s to the mid 1960s. There is a mobile home park at the northern end of the neighborhood, just off of Violet Avenue/Route 9G. There is also a large mobile home park that, while not technically within the delineated neighborhood, is adjacent to the neighborhood in the south just off of E. Dorsey Lane.

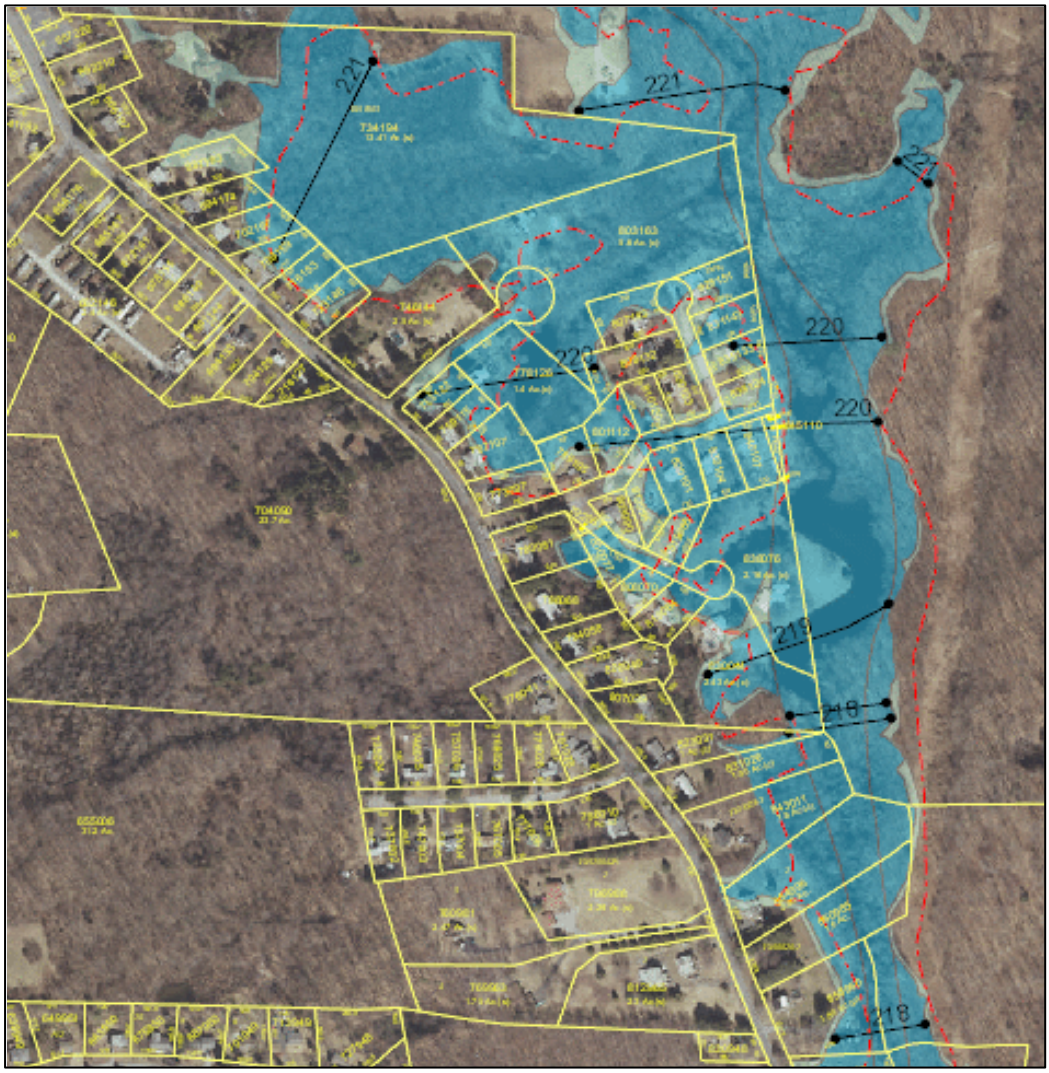
This neighborhood is located in the Green Belt (GB) zoning district, which according the Town of Hyde Park zoning code seeks to promote low-density residential use and preserve open space. Water service consists of private wells and septic systems.

Neighborhood 14		
Attribute	**Score**	**Comments**
% lot with impervious cover	15-40%	
% lot with grass cover	50-75%	Medium management intensity
% lot with forest canopy	15-25%	
% downspouts drain to impervious	20%	
% downspouts drain to pervious	70%	
% downspouts direct to storm or sanitary	5-10%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	Yes	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Moderate	No dumping signs;Auto shop nearby
Restoration Potential	Low	

This large neighborhood has a lot of diversity, as evidenced by its two separate areas. Creek Street is home to larger lot sizes and a higher percentage of forest canopy, as compared to Prince Road. The Fall Kill flows to the east of the neighborhood, and a majority of properties are located within the new DFIRM 100 year flood zone map (see map below). The proximity of the creek to residences enhances the risk of nutrient enrichment from runoff.

There is also an auto shop located near the creek on Prince Road. Petroleum and oil run off can pose a threat to the Fall Kill Creek. Additionally, the neighborhood has 'no dumping' signs to protect the creek from litter and pollution.

Two vegetated wet ponds lie within the neighborhood off Surico Drive and Prince Road, at the end of both these dead ends. These ponds appear to be privately owned. Both appear to be well-kept and clean, but they do have some algal growth.



DFIRM map depicting new 100 year flood zone (*Dutchess County Parcel Access***)**

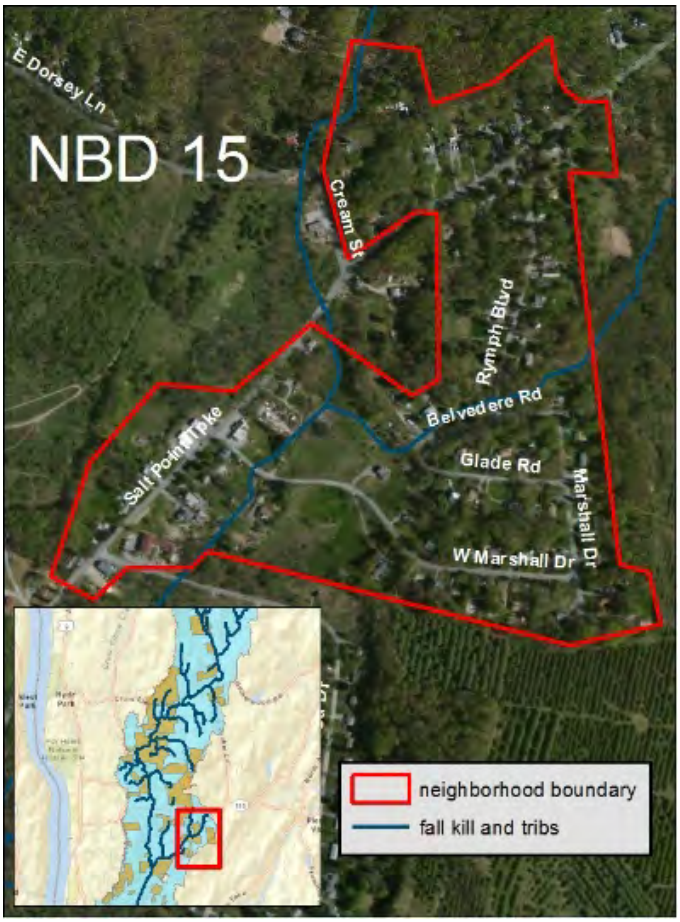
Algae in the large pond

Canada geese in the large pond

Creek on the south end

Typical home, neighborhood 14

Neighborhood 15 – Marshall Dr.



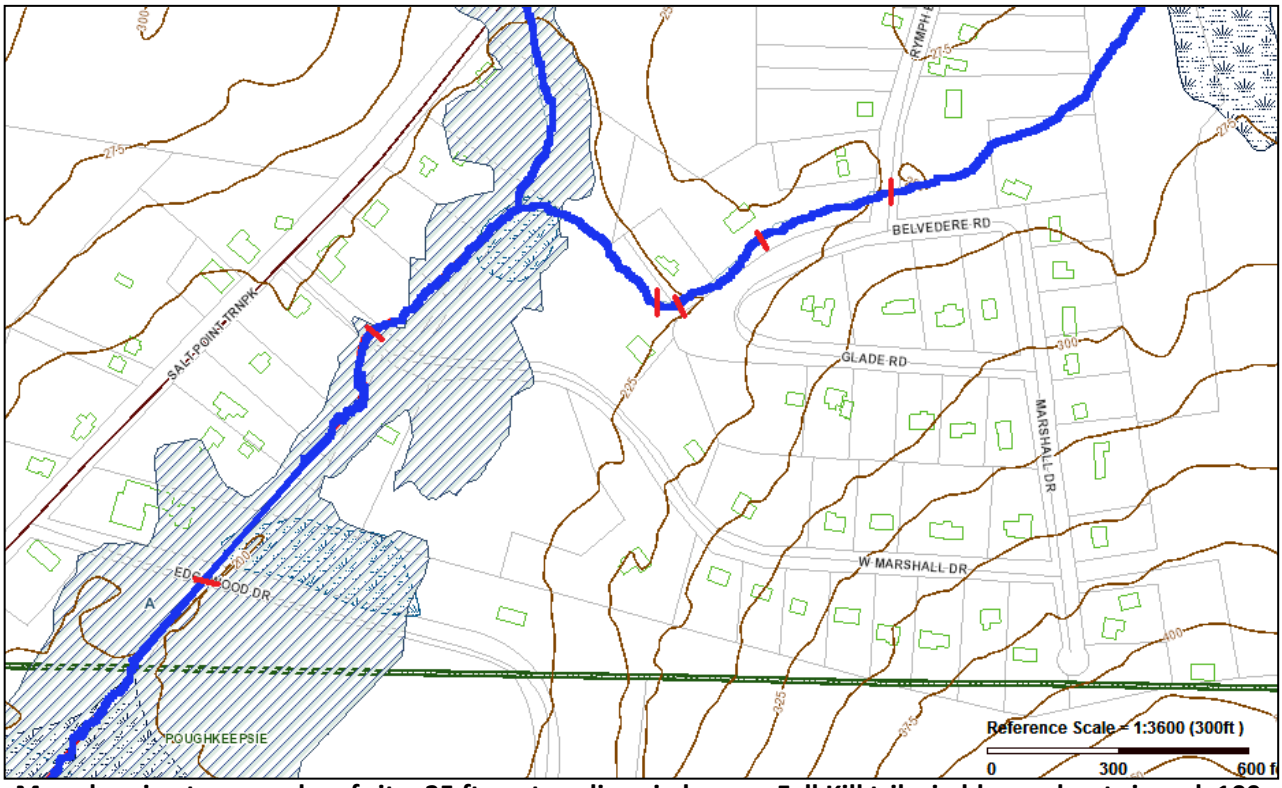
This neighborhood consists of approximately 100 parcels in the southeast corner of the Town of Hyde Park, with the Town of Poughkeepsie municipal border to the south. Salt Point Turnpike/Route 115 provides the west-northwest boundary, while Marshall Drive and Rymph Boulevard run north-south on the east end of the neighborhood.

Homes in this neighborhood were built anywhere from the 1930s to the 1960s, with a few newer homes scattered throughout, and were built in bungalow or ranch style. Most lots are ¼ acre to ½ acre, with a few 1-2 acre lots here and there. Water service consists of private wells and septic systems.

The zoning for the neighborhood is Green Belt (GB), which according the Town of Hyde Park zoning code seeks to promote low-density residential use and preserve open space.

Neighborhood 15		
Attribute	**Score**	**Comments**
% lot with impervious cover	20%	
% lot with grass cover	75%	Med. management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	5%	
% downspouts drain to pervious	95%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Not stenciled, drain to tribs.
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	Organic matter, trash/litter present
Pollution Potential	Moderate	Turf management and flooding issues.
Restoration Potential	High	Drainage work to prevent flooding.

This neighborhood is very much defined by its topography, with Peach Hill rising to the southeast, and the confluence of two first order tributaries at the heart of the site. Most of the residences are built either on the steep slope, or in the path of the tributaries and their floodplains. In addition, the roads and driveways crisscross the streams at least 6 times, forcing the stream into culverts.

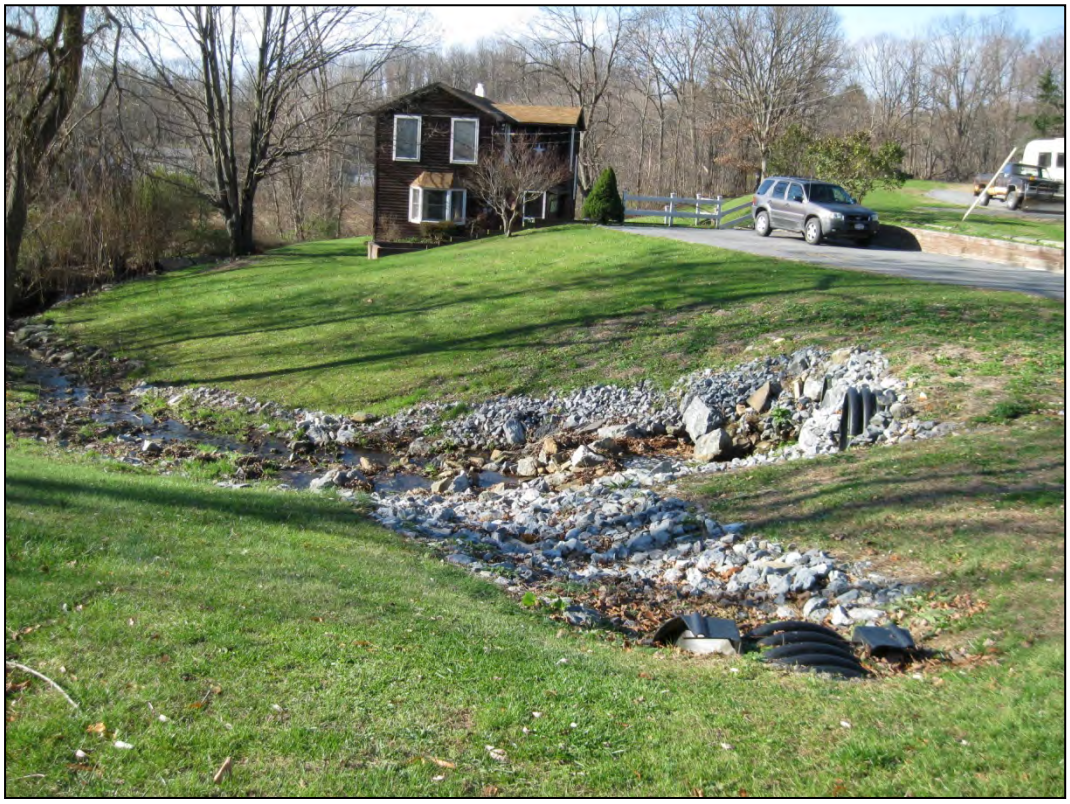


Map showing topography of site: 25 ft contour lines in brown, Fall Kill tribs in blue, culverts in red, 100 year floodplain in blue hashed area. (Source: Dutchess County GeoAccess V2)

This combination of factors causes problems with erosion, sedimentation, and flooding throughout the neighborhood, and poses challenges to residents, particularly along Belvedere Rd., and Edgewater Dr., as seen in the pictures below.

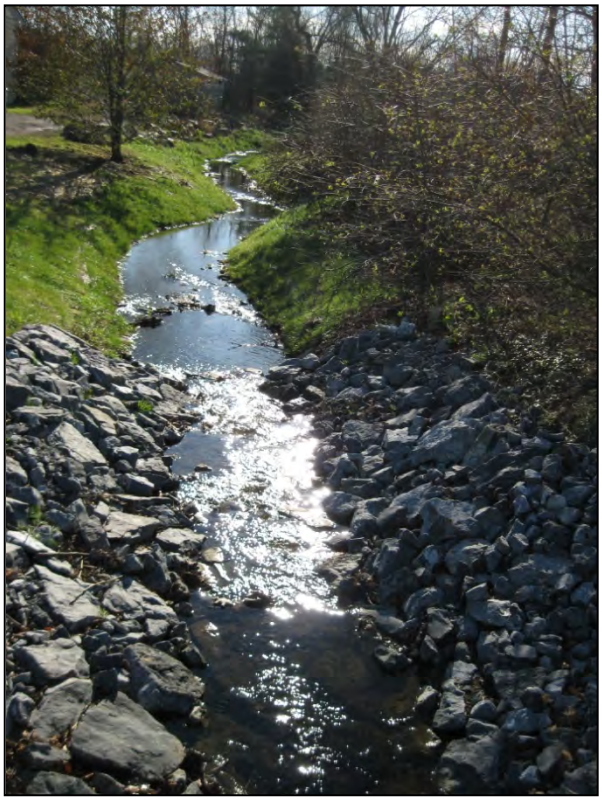
Infrastructure improvements, such as installing bigger culverts, are likely the only way to alleviate some of these issues, since there doesn't appear to be a lot of "excess" stormwater entering the streams. The majority of homes drain to pervious surfaces on their property, for instance. One exception is routing stormwater out of the storm drain system on Marshall Dr., which runs downhill and dumps into the tributary just upstream of the crossing of Rymph Blvd., likely at large volumes in storm events.

The culmination of these factors can be clearly seen at the most downstream portion of the neighborhood at the crossing of Edgewood Dr., where recent infrastructure improvements have taken place.



This residence on Belvedere Rd appears to experience the worst flooding and erosion, where the tributary meanders north.

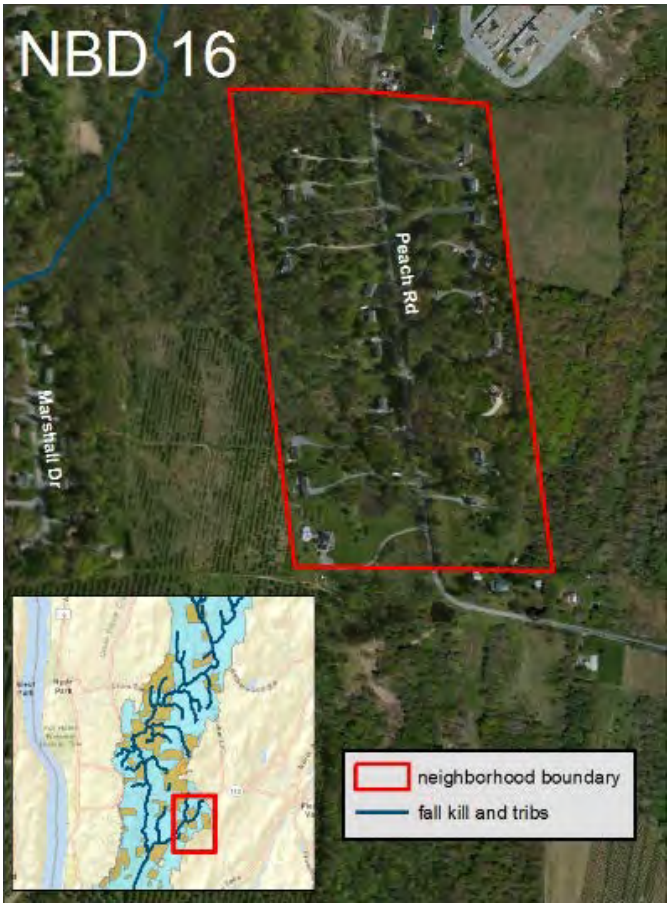
Culvert at Edgewater Dr, looking upstream.



Culvert at Edgewater Dr, looking downstream.

Looking west on Edgewater towards Salt Pt., notice relatively new trench culverts and geotextile.

Neighborhood 16 – Peach Road



This neighborhood consists of approximately 20 parcels located in the southeast corner of the Town of Hyde Park. The Town of Poughkeepsie municipal border provides the southern boundary while large farm acreages border to the west and east. Peach Road runs north-south through the neighborhood. Homes to the west of Peach Road were built in 1988 and are roughly 1.6-2.5 acre lots, with a few larger parcels. Homes to the east of Peach Road were built in the mid 2000s on 1.6-2.8 acre lots, with a few larger parcels. Water service is private, i.e. wells and septic systems.

The zoning for the neighborhood is Green Belt (GB), which according the Town of Hyde Park zoning code seeks to promote low-density residential use and preserve open space.

Stormwater in this neighborhood flows downhill (north), and is directed to two storm drains around the property of 78 Peach Road (see photo). Water is then culverted to the west side of the road into a small wetland (see photos). Stormwater is appropriately managed in this low-density neighborhood. The pollution potential for this neighborhood is low, as is the restoration potential.

Neighborhood 16		
Attribute	**Score**	**Comments**
% lot with impervious cover	15%	
% lot with grass cover	80%	medium management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	0%	
% downspouts drain to pervious	100%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Only two storm drains
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	Stormwater well managed
Restoration Potential	Low	

16Culvert at 78 Peach Road

Typical Home.

Stormwater directed to wetland

Neighborhood 17 – Edgewood Drive

This neighborhood consists of approximately 40 parcels in the Town of Poughkeepsie, near the Hyde Park border. The majority of homes are ranch style built between the late 1950s and the mid 1980s. Lot sizes range from 1/3 acre to ½ acre, with a few homes on the southeast portion of the neighborhood having 2+ acres. Edgewood Drive and Patricia Road serve as interior roads. The neighborhood has Town water, but sewer service is private, i.e. septic systems, according to Dutchess County parcel data.

The zoning for this neighborhood is Single-Family 20,000 Square Feet (R-20) District. According to the Town of Poughkeepsie zoning ordinance, "[t]his district recognizes and is intended to preserve the principally single-family residential development pattern within the Town's established neighborhoods by promoting continuing opportunity for single-family residential and smaller-scale community facility uses within these neighborhoods consistent with their established character. To the extent undeveloped land within this district is available for major subdivision, the use of open space preservation techniques such as clustering of homes is encouraged in order to establish links to existing open spaces."

Neighborhood 17		
Attribute	**Score**	**Comments**
% lot with impervious cover	30%	
% lot with grass cover	65%	Med. to high management intensity
% lot with forest canopy	30%	
% downspouts drain to impervious	10%	
% downspouts drain to pervious	90%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

(Photo and map from Dutchess County Parcel Access)

Neighborhood 17 is generally not considered to be a high contributor to pollution in the watershed. Some homes appear to have more intense lawn management practices than others, suggesting the possibility of fertilizer use and resultant nutrient loading within nearby tributaries. As this neighborhood is on the eastern boundary of the watershed, rainwater flows west toward the unnamed tributaries and wetlands of the Fallkill on the large open parcel on the western edge of the neighborhood (see map). The wetlands likely do a good job of filtering pollutants and mitigating pollution severity.

There appears to be several homes with swimming pools, which can also contribute to water quality problems in the watershed in the form of chlorine contamination.

Restoration opportunities are low within the neighborhood. However, two opportunities are 1) Education concerning fertilizer use and nutrients could be useful, and 2) Each parcel appears to have capacity for rain barrels or rain gardens, which could reduce stormwater runoff to the tributary system.

Neighborhood 18 – Bircher Avenue

This neighborhood consists of approximately 50 parcels in the southern portion of the Town of Hyde Park. The neighborhood is located to the east of Violet Avenue/Route 9G, with Bircher Avenue and Pells Court serving as interior roads.

The area is a mix of housing styles and ages, ranging from ranches and bungalows built between the 1930s and the 1950s to a mobile home park on 3.5 acres to multi-purpose structures containing business and residential on Violet Avenue. Lot sizes range from 1/3 of an acre to 1+ acres, with a couple of larger lots interspersed. Parcel Access data from Dutchess County lists nearly all properties as having private water, however, the Town of Hyde Park Water and Sewer Map lists this area as being served by Greenbush Town Water. Sewer service appears to be private.

The zoning for this neighborhood is Neighborhood (N), which according to the Town of Hyde Park Zoning Ordinance seeks to "reinforce the historic pattern of limited mixed-use development in these districts of the Town. [. . .] The Neighborhood Districts have minimum to moderate constraints on development that can support greater density and are suitable for expansion and infill."

Neighborhood 18		
Attribute	**Score**	**Comments**
% lot with impervious cover	10-20%	
% lot with grass cover	50-75%	Medium management intensity
% lot with forest canopy	5-10%	35-55% including street trees
% downspouts drain to impervious	25%	
% downspouts drain to pervious	75%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Organic matter/sediment present
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Moderate	Mobile home park leach field
Restoration Potential	Moderate	

The assessment for Neighborhood 18 was conducted on a day with moderately heavy rainfall, and standing water was observed in several locations, notably on the western end of Bircher Avenue around 13 Bircher Avenue (see photo). Stormwater was also observed running south to north along Pells Court toward Bircher Avenue. An asphalt berm was constructed along a good portion of Pells Court to direct the storm water down the street rather than into yards and homes (see photo).

This neighborhood's topographic characteristics ensure that rainwater will run downhill from south to north and either pool on the road, pool in ditches on the side of the road, or enter the stormwater drains which empty into ditches along Bircher Avenue.

Residents at 34 Bircher Avenue say they have experienced considerable flooding during heavy rainfall events. This property is situated in a location that receives stormwater from the east, west, and south. Water is culverted from the ditch on the north side of Bircher Avenue and discharges into an open stream at 34 Bircher Avenue, which extends for approximately twenty feet (see photo). Water then enters another culvert, which runs along the eastern edge of the property line, and is deposited into a depression at the rear (north) of the property. As water pools it is once again culverted and ultimately directed off the property toward the north. The residents say that the system can sometimes be overwhelmed, resulting in water overflowing into their yard.

34 Bircher Avenue is located directly across the street from the Valley Forge Community, a mobile home park on 3.5 acres. Stormwater in this mobile home park is directed toward impervious surfaces, which drains downhill (north) and into storm drains. However, storm drains in the street were covered with plywood and marked by orange cones (see photo), resulting in water continuing to flow down the street toward Bircher Avenue.

Also notable, the Valley Forge mobile home park has a community sewer system that drains into a large leach field on the south side of Bircher Avenue (see photo) next to 34 Bircher Avenue – the property that experiences periodic flooding – ultimately into an unnamed stream per SPDES permit renewed in February 2012. The siting of a leach field for a mobile home community in an area prone to flooding seems problematic and a potential health hazard.

Neighborhood 18, typical of many in the Town of Hyde Park, lacks a basic uniformity that lends itself to quantifying pollution potential, however the combination of factors described above indicates moderate risks, but also moderate potential for restoration. The neighborhood should be a priority for infrastructure improvements by the town, to at a minimum reduce burdens to residents along Bircher Ave.

Standing water on Bircher Ave.

Asphalt berm on Pells Court

Stormwater stream at 34 Bircher Ave.

Leach field for mobile home park

Storm drain with no cover

Neighborhood 19 – The Gables

This neighborhood, known as The Gables, is a mobile home park with approximately 200 sites on 87 acres located off of Salt Point Turnpike in the Town of Poughkeepsie. The mobile homes are newer, built in the early to mid 2000s, and new sites are currently being added. Water and sewer are publicly provided.

This mobile home park is zoned R-MH (Residential Mobile Home), which according to the Town of Poughkeepsie zoning code is designed "for areas in which mobile homes are to be concentrated at a medium-high density. The R-MH Mobile Home District is intended to be located in areas where community facilities and utilities, the transportation network and the availability of shopping and office facilities are appropriate to the density."

The Fall Kill Creek runs along the Western border of the neighborhood and becomes a third order stream at the southwest corner.

Neighborhood 19		
Attribute	**Score**	**Comments**
% lot with impervious cover	50%	
% lot with grass cover	45%	High management intensity
% lot with forest canopy	5%	
% downspouts drain to impervious	40%	
% downspouts drain to pervious	40%	
% downspouts direct to storm or sanitary	20%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	Yes	3 vegetated ponds, good condition
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	Likely use of fertilizer on yards
Restoration Potential	Low	

This neighborhood, being newly constructed, does a good job of routing stormwater into either constructed wetlands or detention ponds. The wetland on the western edge of the development in particular prevents stormwater from running directly into the Fall Kill Creek.

Potential problems in the neighborhood are a probable high usage of fertilizer based on lawn condition, likely non-targeted irrigation, and the lack of mature trees. The latter encourages residents to use sprinkler systems and fertilizer to maintain green lawns due to a lack of sun shading that mature trees typically provide.

Also notable about this neighborhood is that a considerable portion of the land owned by the developer is being prepared for more residences. The entire southern portion of the lot already contains stormwater infrastructure, fire hydrants, and natural gas utilities.

The biggest restoration opportunity would be to plant more street trees, which would hopefully lead to less need for fertilizer use. Otherwise, stormwater appears to be well managed in this neighborhood.

Detention pond.

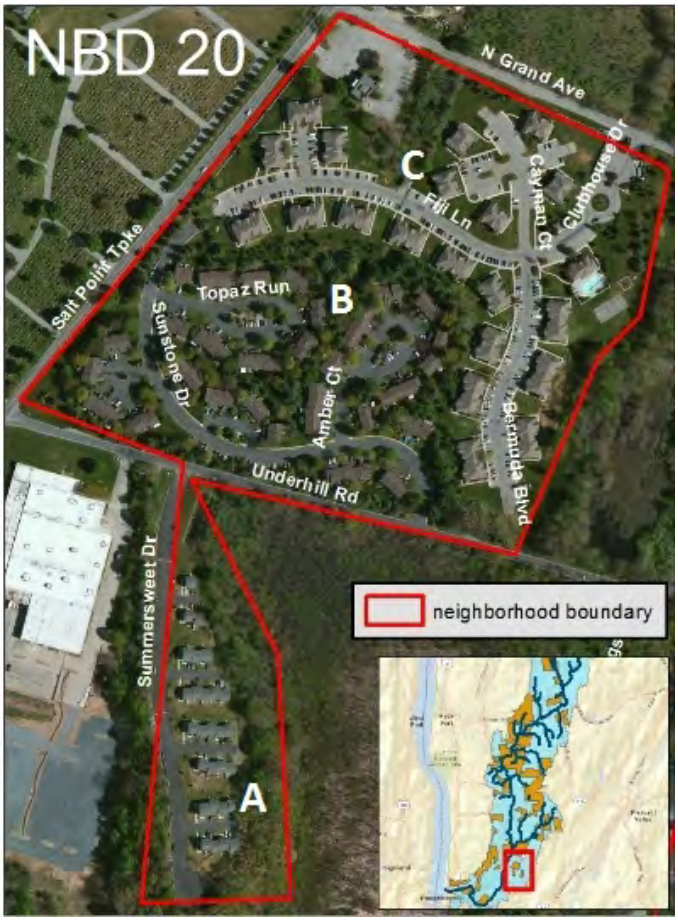
Storm sewer outfall to wetland.

Typical homes.

Downspout directed to driveway.

Construction debris, southern portion of development.

Neighborhood 20 – Underhill Road



Neighborhood 20 is a collection of smaller townhomes and condominium complexes in close proximity to each other in the Town of Poughkeepsie. Bordered by Salt Point Turnpike/Route 115, Underhill Road, and North Grand Avenue, are a pair of town home/condominium complexes. Grand Point Park Apartments (site C) is a complex of approximately 20 buildings that appears to have built in the late 1990s. Directly adjacent to the Grand Point Park apartments is a townhome complex (site B) of approximately 100 individually owned town homes built in the mid to late 1980s.

Both complexes are served by public water and sewer and are in the R-M (Residence-Multifamily) zoning district. According to the Town of Poughkeepsie the "district recognizes established areas of higher-density multifamily development and is intended to promote low- to mid-rise multiunit residential development in those locations."

Lastly is an apartment complex built in 2003 located off of Summersweet Drive (site A), a cul-de-sac. This complex is comprised of 29 units and is surrounded by nearly forty acres of open space between North Grand Avenue and Underhill Road. Water and sewer are public. The zoning district for this complex is R-20 (Residential-20,000 Square Foot). According to the Town of Poughkeepsie, "[t]o the extent undeveloped land within this district is available for major subdivision, the use of open space preservation techniques such as clustering of homes is encouraged in order to establish links to existing open space areas."

These complexes as a whole do not represent a significant pollution threat. However, a few restoration opportunities are possible. The complex on Summersweet Drive (A) has considerable impervious ground cover, yet stormwater appears to be effectively directed downhill (north) to a wet stormwater detention area near the intersection of Summersweet Drive and Underhill Road. The open lawns between the buildings represent the greatest restoration opportunity at this site, simply because of the lack of trees.

Neighborhood 20A		
Attribute	**Score**	**Comments**
% lot with impervious cover	55%	The complex as a whole
% lot with grass cover	40%	Medium management intensity
% lot with forest canopy	5%	
% downspouts drain to impervious	0%	
% downspouts drain to pervious	0%	
% downspouts direct to storm or sanitary	100%	All likely drain to storm pond
Storm drains present?	Yes	
Stormwater detention areas present?	Yes	
Sidewalks present?	Yes	In front of each building
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	Opportunity for more tree plantings

Neighborhood 20B		
Attribute	**Score**	**Comments**
% lot with impervious cover	40%	The complex as a whole
% lot with grass cover	40%	Medium management intensity
% lot with forest canopy	40%	Well treed property
% downspouts drain to impervious	60%	
% downspouts drain to pervious	10%	
% downspouts direct to storm or sanitary	30%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	
Pollution Potential	Low	
Restoration Potential	Low	Redirect downspouts to pervious

Neighborhood 20C		
Attribute	**Score**	**Comments**
% lot with impervious cover	65%	
% lot with grass cover	30%	Medium management intensity
% lot with forest canopy	10%	
% downspouts drain to impervious	5%	
% downspouts drain to pervious	95%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	Yes	In front of and around buildings
Curb and gutter present?	Yes	
Pollution Potential	Low	
Restoration Potential	Low	

Stormwater pond, site A, Summersweet Dr.

Typical townhome, site A, Summersweet Dr.

Crystal Glen Apartments (B), to the north of site A, is a surprisingly well treed complex, especially considering its neighbors to the north and south. The biggest restoration opportunity at this site would be to redirect the downspouts to pervious areas. More than half of the downspouts were observed to be directed to driveways and other impervious surfaces, increasing the chance for nonpoint source pollution such as oil or grease and nutrients to enter the waterway. However, it should be noted that the complex is bordered to the east by a large wetland area, which is the probable recipient Crystal Glen's stormwater and likely traps and filters pollutants before they enter the stream system. Nevertheless there is ample yard space to which downspouts could be directed.

Example of roof rainwater directed to impervious surface, site B

Example of well-treed Crystal Glen Apartments

Typical building, Grand Point Park Apartments

Grand Point Park Apartments (C), the northern most site in Neighborhood 20, also represents relatively low pollution potential. While roughly two-thirds of the complex is impervious, nearly all roof rainwater is directed to pervious lawn areas. The greatest restoration opportunity would be to plant more trees around the complex, particularly areas next to the road on Fiji Lane and grassy islands around Cayman Court. Tree canopy can help capture and evapotranspirate rainwater, preventing it from entering the stormwater system.

Numerous tree planting opportunities along Fiji Ln. and Cayman Ct., site C, Grand Point Park Apts

Neighborhood 21 – School Street

This small neighborhood consists of close to 20 parcels located off of Violet Avenue/Route 9G in the Town of Poughkeepsie. Parcels are mostly single family residences, but there is a two-family lot and an apartment building as well. Homes are mostly ranch or colonial style built anywhere between 1910 and 1945, with a few newer homes. Water and sewer are public and the zoning district is R-20 (Residential-20,000 Square Foot). Homes in this neighborhood are clearly non-conforming, judging from the year they were built.

Generally, this neighborhood is not considered to be a high pollutant contributing area. This is also considered to be a low restoration opportunity area. However, there are some lots on School Street (see photos) where additional tree planting is possible in the front yard. But the neighborhood as a whole is generally well treed.

Neighborhood 21		
Attribute	**Score**	**Comments**
% lot with impervious cover	20%	
% lot with grass cover	75%	Med. to high management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	10%	
% downspouts drain to pervious	90%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	Some tree planting opportunities

Front yard tree planting opportunity at 17 School Street

Tree planting opportunity

Neighborhood 22 – Pine Echo Drive

This subdivision consists of 56 parcels off of Creek Road in the Town of Poughkeepsie. Interior roads that serve the neighborhood include Pine Echo Drive and Corine Drive. Homes are mostly built in ranch or cape cod style between the 1950s and 1960s and sit on ¼ acre lots, with a few lots that are closer to 1 acre. Water and sewer are public and the zoning for the area is R-20 (Residential 20,000 Square Foot). Since most lots are only slightly more than 11,000 sq ft., this neighborhood likely predates the zoning district and is therefore nonconforming.

This neighborhood is generally not a high pollution contributor. While stormwater runoff appears to be directed to the creek on the east side of the neighborhood, residential behaviors such as intensely managed lawns or outside storage of hazardous materials appears to be minimal.

The creek is fairly well buffered from the neighborhood, likely because the neighborhood abuts the 100 year floodplain (see photo).

Neighborhood 22		
Attribute	**Score**	**Comments**
% lot with impervious cover	25%	
% lot with grass cover	60%	Medium management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	5%	
% downspouts drain to pervious	95%	
% downspouts direct to storm or sanitary	0%	
Storm drains present?	Some	Clean, newer drains inlets were stenciled, older ones not
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	bioretention locations possible

One interesting feature of the neighborhood is an open space area (highlighted in map) that bisects the neighborhood from north to south (see map). A storm drain was observed to the west of 8 Corine Drive, which perhaps was installed to deal with flooding issues and appeared to be connected to a culvert that extends for some length south, judging from the depression in the ground (see photo). This may be a good location for some type of bioretention area, which could help trap and filter any pollutants from stormwater runoff that are enter the system and discharge into the creek.

Another recommendation would be to stencil all storm drain inlets to inform residents that drains discharge into the creek.

Storm drain inlet and flow direction north, with 100 year flood plain to the east

Possible location for bioretention area, near 8 Corine Drive

Example of good riparian buffer, eastern edge of neighborhood

Neighborhood 23 – Violet Avenue

Neighborhood 23 is a group of neighborhoods in the more densely developed portion of the Town of Poughkeepsie, near the City of Poughkeepsie border. A small portion of Neighborhood 23 is located in the City, on the southern extent of the map. The neighborhoods cascade along the southwestern boundary of the watershed as it enters the City's municipal jurisdiction. Violet Avenue/Route 9G courses through this neighborhood with other major streets including Fairview Avenue, Buckingham Avenue, and Oakdale Avenue.

The northern most neighborhood on the map, including Peter Cooper Drive, Stuyvesant Drive, and Van Wyck Drive (all to the east of Violet Avenue) and Lakeview Avenue and portions of Fulton Street and Spring Street (to the west of Violet Avenue) is a subdivision built in the mid 1950s and consists mostly of ranch-style homes on ¼ acre lots. Water and sewer are provided by the Town. Notably, this subdivision is adjacent to Dutchess County Community College. The zoning in this area is R-20 (Residential 20,000 Square Foot).

Neighborhood 23		
Attribute	**Score**	**Comments**
% lot with impervious cover	25%	
% lot with grass cover	70%	Medium management intensity
% lot with forest canopy	30%	
% downspouts drain to impervious	25%	
% downspouts drain to pervious	70%	
% downspouts direct to storm or sanitary	5%	
Storm drains present?	Yes	Organic matter, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	Yes	Except for Chestnut/Amato area
Curb and gutter present?	Yes	Except for Chestnut/Amato area
Pollution Potential	Low	
Restoration Potential	Low	

To the southwest is another neighborhood located between Violet Avenue and Oakdale Avenue, with Chestnut Street running east-west through the heart of the subdivision. Most homes here are on ¼ to ½ acre lots and are built in the ranch style between the 1950s and 1980s. Water and sewer are public, and the zoning for this area is R-20.

Further to the southwest, the last in this series of neighborhoods is located between Fairview Avenue and Oakdale Avenue, and from Wilmar Terrace to the Dutchess County Rail Trail (formerly New York Central Lines). The southern portion of this neighborhood is actually within the City of Poughkeepsie boundary. The housing stock here is older, mostly two-story frame houses and bungalows built between the 1920s and the 1940s on smaller lots – 1/10 of an acre roughly. Water and sewer here is public. The zoning is R-20 in the Town and R-4 (Residential 4 Family) in the City.

Neighborhood 23 as a whole is considered to have low pollution potential and low restoration potential. The neighborhood feels fully built out in terms of density and is generally well treed, although some of the northern streets have room for potential street trees, particularly around Peter Cooper and Van Wyck Drives (see photo).

Water flow from storm drain to wetland off Sophia's Way

Stormwater appears to be well managed, with nothing extraordinary standing out. The exception to this would be on Oakdale Avenue where stormwater is directed via curb cut to a storm drain and then culverted from the west side of the street (see photo), between 103 and 91 Oakdale Avenue, under the street to what appears to be an intermittent stream (see photo). The stream channel cuts between 102 and 92 Oakdale Avenue and heads east to a wooded area. Water from this wooded area likely flows south to a wetland (see photo) which can be accessed at the end of Sophia's Way.

Curb cut/storm drain west side of Oakdale Ave

Stream bed east side of Oakdale Ave.

Wetland off of Sophia's Way

Tree planting opportunities in the northern section of the neighborhood along Peter Cooper Drive

Neighborhood 24 – Colonial Manor

This almost ten acre parcel in the Town of Poughkeepsie west of Creek Road contains the Colonial Manor Apartments – 15 buildings built in 1986. Water and sewer are public, and the zoning is R-M (Residence-Multifamily). According to the Town of Poughkeepsie the "district recognizes established areas of higher-density multifamily development and is intended to promote low- to mid-rise multiunit residential development in those locations."

This complex, which seems to be an effective use of space in terms of density, appears to handle stormwater onsite rather than directing to a waterway. Most roof leaders drain to pervious areas, and stormwater from the parking lots drains to storm drains with deep catch basins, which may act as dry wells; no discharge area from any storm drain could be observed.

The pollution potential is low in this neighborhood, as is the restoration potential.

Neighborhood 24		
Attribute	**Score**	**Comments**
% lot with impervious cover	50%	
% lot with grass cover	50%	Med. to high management intensity
% lot with forest canopy	20%	
% downspouts drain to impervious	5%	
% downspouts drain to pervious	90%	
% downspouts direct to storm or sanitary	5%	
Storm drains present?	Yes	Not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	No	
Curb and gutter present?	No	
Pollution Potential	Low	
Restoration Potential	Low	

Parking lot and storm drain, Colonial Manor

Colonial Manor, Neighborhood 24

Neighborhood 25 – Taylor Ave/Albany Street

This neighborhood, located in the northern section of the City of Poughkeepsie, is more like two neighborhoods: Taylor Avenue running to the east of Washington Street and Vernon Terrace/Bain Avenue to the west of Washington Street (one could also consider Delafield Street/Talmadge Street as a separate neighborhood). Homes along Taylor Avenue are mostly two-story frame houses that are one and two-family homes built in the early 1900s on smaller, 5-6,000 sq ft lots. Water and sewer are provided by the City, and the zoning is R-3A (Central Medium Density District). According to the City of Poughkeepsie, the purpose of this zoning district is "to provide areas for several types of housing at a density commensurate with the scale and characteristics of the city's older neighborhoods."

To the west of Washington Street, homes along Vernon Terrace and Bain Avenue are also one and two-family homes, built in the early 1900s on smaller, 5-6,000 sq ft lots. Water and sewer are provided by the City, and the zoning for this area is R-4 (Medium High Density Residential District)

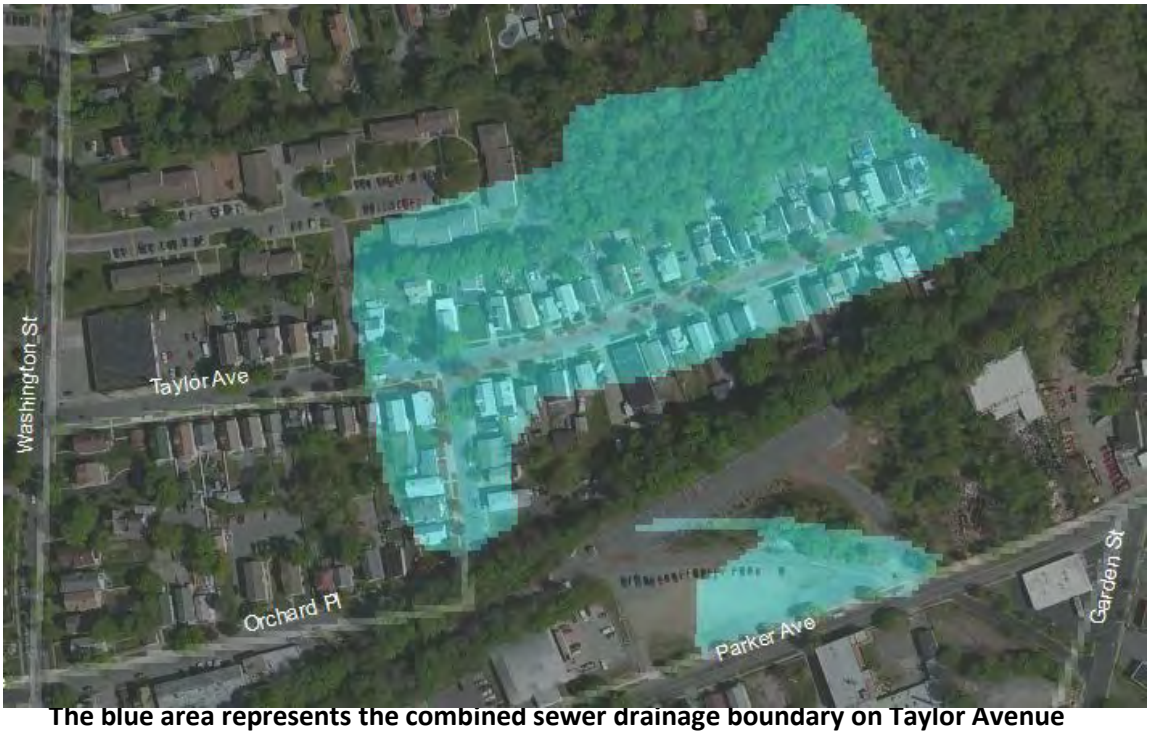
Neighborhood 25		
Attribute	**Score**	**Comments**
% lot with impervious cover	75%	
% lot with grass cover	20%	Med. to low management intensity
% lot with forest canopy	0-50%	Varies, some lots are all building, others have mature street trees
% downspouts drain to impervious	30%	
% downspouts drain to pervious	10%	
% downspouts direct to storm or sanitary	60%	
Storm drains present?	Yes	About half were stenciled
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	Organic matter, trash/litter present
Pollution Potential	High	
Restoration Potential	Low	

The purpose of the R-4 district is to "provide areas for a broad range of housing types with opportunity for appropriate nonresidential uses at a fairly high density commensurate with the scale and characteristics of the city's older neighborhoods; these are areas with access to major transportation arteries and a range of community services."
Homes along Delafield and Talmadge Streets are also mostly one and two family homes on smaller lots (4-5,000 sq ft) in the early 1900s. Water and sewer are public, and the zoning is also R-4.

Notably, many homes in these neighborhoods serve as student housing for Marist College students. Also worthy of consideration, not all parcels delineated here are residential. Schools and businesses are located throughout, but the primary land use is residential.

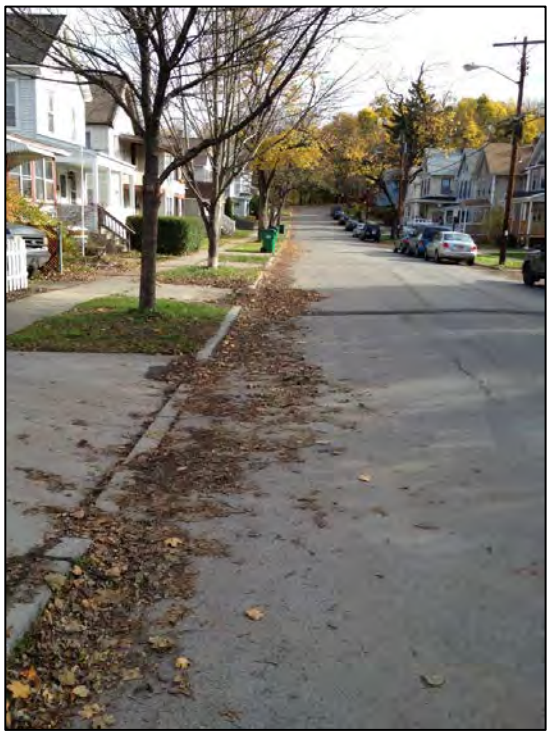
Overall, many streets, including Winnefield, Taylor, Duane, and others, have good sized common areas between the curb and sidewalk that would allow for tree planting opportunities (see photos) and/or curb cuts to direct stormwater to a right-of-way bioswale (see appendix for ROW swale BMPs). In terms of other restoration opportunities, most lots are too small for rain gardens but do have back and/or side yards that might be suitable for rain barrels.

Capturing as much stormwater before it enters storm drain inlets is particularly important in the eastern portion of the neighborhood, especially on Taylor Avenue, since this is one of the City of Poughkeepsie's known combined sewer locations (see map). Combined systems carry both stormwater and sanitary waste, and during wet weather events can quickly become overwhelmed and discharge untreated wastewater into the Fall Kill Creek.



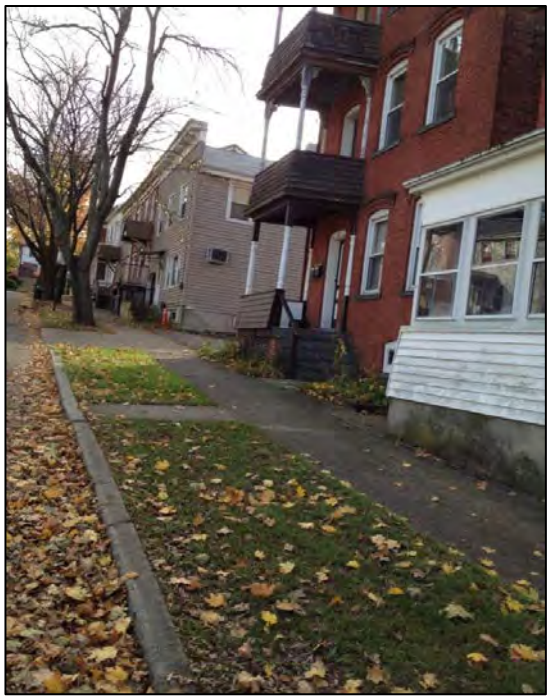
The blue area represents the combined sewer drainage boundary on Taylor Avenue

Other recommendations include stenciling all storm drains within the neighborhood. Storm drains west of Washington Street, which tend to be newer, are all stenciled (see photo), however, east of Washington Street, especially Taylor Avenue, are not stenciled. All storm drains had varying amounts of organic matter (mostly Fall foliage debris) and some amount of litter.



Typical homes, east of Washington Street

Combined drain, Taylor Avenue

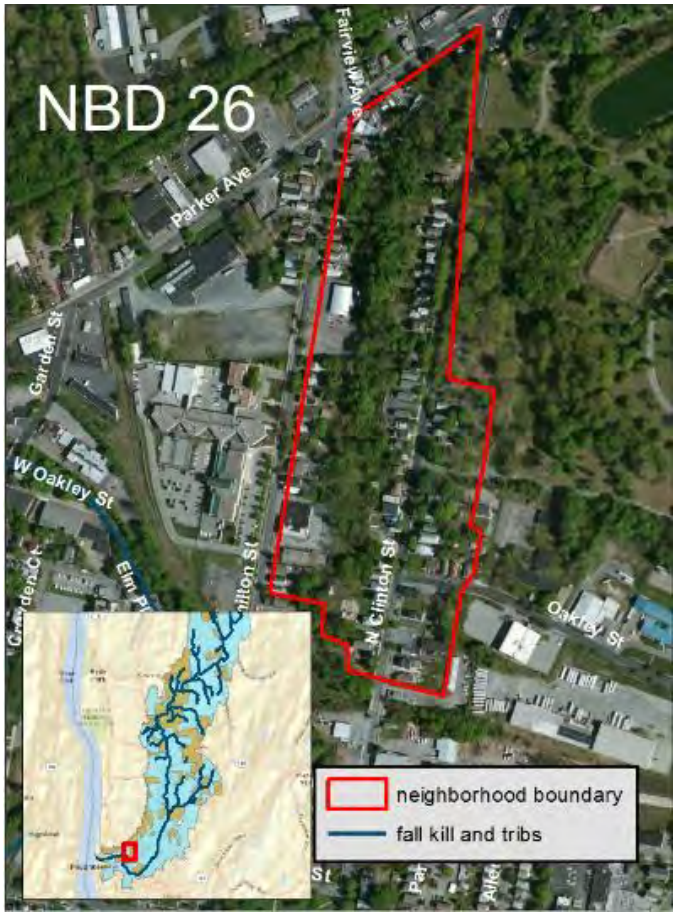


Room for more street trees.

Direct connect to combined sewer.

Storm drain west of Washington Street with "Drains to Waterway" decal

Neighborhood 26 – Hamilton and Clinton



This neighborhood, which is located between North Hamilton Street and North Clinton Street in the City of Poughkeepsie, consists of one and two-family homes, multifamily homes, and apartments. While not all land uses are residential, residential is the primary use for this neighborhood. Homes were constructed between the early 1900s and the 1920s, mostly in two-story frame or colonial styles and are sited on approximately 10,000 square foot lots. Water and sewer are public, and the zoning for this area is R-3A (Central Medium Density District). According to the City of Poughkeepsie, the purpose of this zoning district is "to provide areas for several types of housing at a density commensurate with the scale and characteristics of the city's older neighborhoods."

Notable about this neighborhood is that it is located directly adjacent (to the west) to College Hill Park, and there is a considerable slope from the park west to North Hamilton Street, creating conditions for significant stormwater runoff down to the nearby Fall Kill Creek.

Neighborhood 26		
Attribute	**Score**	**Comments**
% lot with impervious cover	30%	
% lot with grass cover	65%	Med. to high management intensity
% lot with forest canopy	40%	
% downspouts drain to impervious	10%	
% downspouts drain to pervious	80%	
% downspouts direct to storm or sanitary	10%	
Storm drains present?	Yes	Clean, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	
Pollution Potential	Moderate	Runoff from golf course
Restoration Potential	Moderate	Street trees or ROW swales

College Hill Park contains the eighteen-hole College Hill Golf Course. Golf courses are notorious contributors to water quality issues in streams due to high fertilizer use. Given the southwesterly trajectory of stormwater following the topography of the neighborhood, contaminants from the golf course could possibly pass through the neighborhood toward Garden Street and ultimately the Fall Kill.

The golf course represents a restoration opportunity. Right-of-way bioswales, either enhanced tree pits or streetside infiltration swales, could be installed to capture and either detain or allow to infiltrate stormwater generated from within the neighborhood and without. (see appendix for ROW swale BMPs)

Typical homes, Neighborhood 26.

Typical multifamily home, North Hamilton Street.

Neighborhood 27 – Winnikee Avenue

This neighborhood, located in the northeastern portion of the City, contains mainly one and two-family and multifamily homes built in the early 1900s on smaller lots, although there are schools, religious institutions, and businesses found throughout. The neighborhood is bordered by Smith Street to the west and Winnikee Avenue to the east, which curves along with the Fall Kill Creek. Water and sewer are public, and the zoning is R-4 (Medium High Density Residence District), which according to the City of Poughkeepsie is designed to "provide areas for a broad range of housing types with opportunity for appropriate nonresidential uses at a fairly high density commensurate with the scale and characteristics of the city's older neighborhoods; these are areas with access to major transportation arteries and a range of community services."

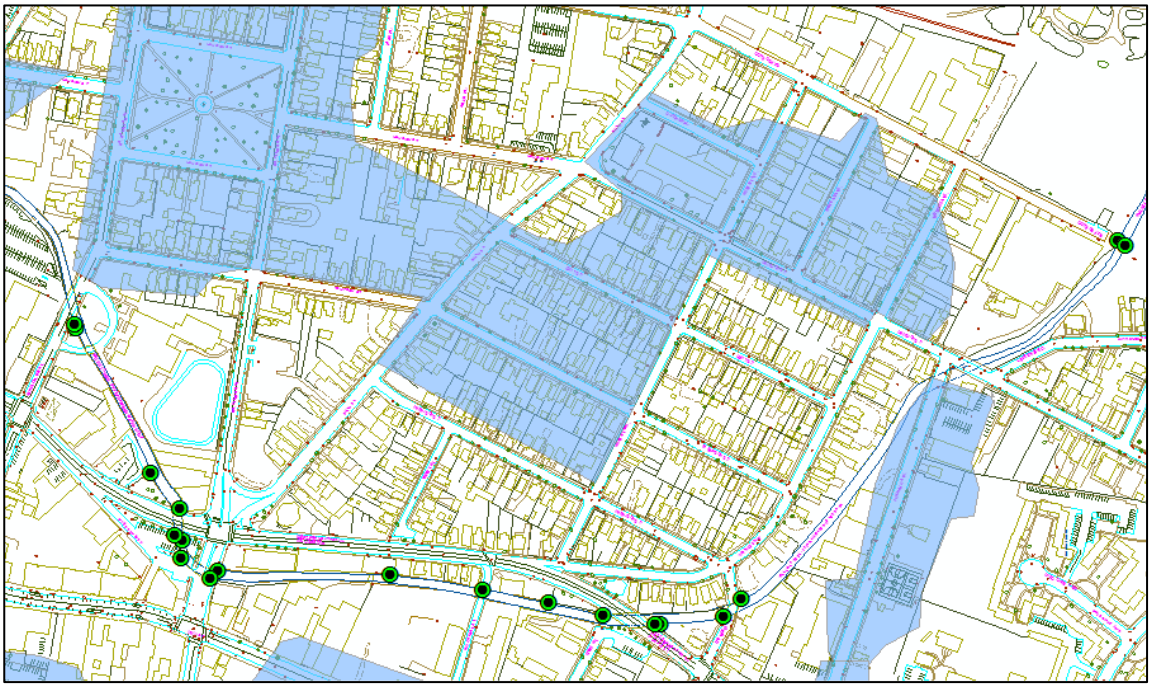
According to research done for the 2006 *Management Plan*, this neighborhood is known to be a hotspot contributor to water quality impairment along the Fall Kill Creek. Illegal dumping and stormwater runoff should be important considerations in this area.

Neighborhood 27		
Attribute	**Score**	**Comments**
% lot with impervious cover	75%	
% lot with grass cover	20%	Low management intensity
% lot with forest canopy	15%	Including street trees
% downspouts drain to impervious	40%	
% downspouts drain to pervious	40%	
% downspouts direct to storm or sanitary	20%	
Storm drains present?	Yes	Seasonal organic debris present, not stenciled
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	Long-term street parking
Pollution Potential	High	Illicit dumping, stormwater runoff
Restoration Potential	Moderate	Street trees, ROW bioswales

Neighborhood 27 is defined in important ways by its relationship and proximity to the Fall Kill Creek. The eastern and southern borders of the neighborhood are located adjacent to the creek, and much of the neighborhood is prone to flooding, notably demonstrated during Hurricane Irene.

The image at right depicts the pre-Irene 100 year flood zone for the neighborhood, and the image below depicts FEMA's "DFIRM" map with the new 100 year flood zone established in 2012. A considerably larger portion of the neighborhood is now within the 100 year flood zone.

The northern and western sections define the neighborhood's other major relationship to the creek because these are known combined sewers areas, which means that both sanitary and storm waste water drain in combined sewer pipes. During dry weather, both sanitary and storm waste water is transported to the waste water treatment plant (WWTP) without issue, but during wet weather the system can become overwhelmed. To protect against damage to the WWTP or sewer backups, both sanitary and storm waste water is discharged directly into the Fall Kill Creek and Hudson River untreated. This is known as a combined sewer overflow event or CSO. Below are two maps, one shows the combined sewer drainage boundaries and the other shows the stormwater outfalls along the creek in the neighborhood.



Green points are outfalls along the Fallkill Creek and blue areas represent CSO drainage basins

The pollution potential for neighborhood 27 is high, mostly because of its proximity to the creek and because a large portion of the neighborhood contains combined sewers. Most lots in the neighborhood have high impervious land cover and 60% of properties either directly connect roof downspouts to the sewer system or drain to impervious surfaces, which for an urbanized setting such as this, means that roof rainwater that drains to impervious will most likely end up in the sewer system, too. Therefore, one major restoration opportunity would be to disconnect all direct-connect downspouts and drain them to pervious surfaces, preferably to the property's yard. Downspouts directed to impervious surfaces should likewise be directed to pervious surfaces such as a side or rear yard.

While the neighborhood has smaller lot sizes, most properties have sufficient space for rain barrels and possibly even rain gardens. These would also aid in taking more stormwater out of the sewer system, helping to prevent CSO events. Another restoration opportunity would be to install Streetside Infiltration Swales or Enhanced Tree Pits, which are typically installed in the right-of-way (ROW) along sidewalks and have the ability to detain large amounts of stormwater, either slowly releasing the water into the sewer system or allowing direct infiltration into the ground. These urban stormwater systems are being tested in larger cities such as Seattle, Portland, New York, and Philadelphia, and have shown promising results (see appendix for BMPs regarding ROW swales).

Finally, other restoration opportunities include greater enforcement of no-dumping rules in order to combat illicit garbage disposal into the creek, and stenciling existing stormwater catch basins to inform local residents that what enters the storm drain will ultimately end up in the creek.

Residents on flooded Winnikee Avenue after Hurricane Irene in 2011.

Typical street in neighborhood 27, with room for street trees or ROW swales

One of many outfalls along the Fallkill Creek in neighborhood 27

Neighborhood 28 – Mansion St. Churches

This small neighborhood - located between High Street and Mansion Street, and between North Hamilton and Catherine Street – contains mostly one and two family homes on small lots built between 1890 and 1920. While the zoning for this area is R-4 (Medium High Density Residence District), there are religious institutions, businesses, and parking lots located in this neighborhood. Water and sewer in this area are provided by the City.

The neighborhood is as much defined by the presence of the two well-attended churches, Beulah Baptist Church and St. Paul's Episcopal Church, as it is by its residences. In addition, the Morse Young Child Magnet School, a public elementary school, and Malcom X Park, a public park owned by the City School District, are adjacent to the neighborhood.

Neighborhood 28		
Attribute	**Score**	**Comments**
% lot with impervious cover	90%	
% lot with grass cover	10%	Low management intensity
% lot with forest canopy	30%	
% downspouts drain to impervious	50%	
% downspouts drain to pervious	40%	
% downspouts direct to storm or sanitary	10%	
Storm drains present?	Yes	Not stenciled, litter present.
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	Organic matter, trash/litter present
Pollution Potential	Moderate	Direct discharge to Fall Kill.
Restoration Potential	High	Common areas, churches, and schools have highest potential.

This older neighborhood lacks much in the way of municipal stormwater infrastructure, except for a storm drain at a low point at the bend of Catharine St., which drains directly to the Fall Kill (Green line and OF-17 below). The N. Hamilton St. portion of the neighborhood is the western edge of a large combined sewer area. As part of the city's plan to manage CSO's, separate storm sewer lines are proposed to direct stormwater from N. Hamilton, Mansion St., Cottage St. and N. Clinton St. into OF-17, as seen by the dashed orange line below.

City of Poughkeepsie Stormwater Basemap: Blue area indicates combined sewer drainage area, with proposed storm drains in dotted orange. Solid green lines indicate existing storm drains, ending at outfalls numbered in white text. Note that Catharine St. is not complete on this map.

The residential lots in the neighborhood are small and contain predominately impervious surface, but surprisingly a large percentage of homes have their downspouts routed to pervious areas, such as side lots and the backyard, which limits their pollution potential. For the remaining homes downspout disconnection to rain barrels could be advantageous, in particular for the homes on N. Hamilton St. that are connected to the sewer system.

The common areas between the street and sidewalk have a few street trees, but have enough space to accommodate additional trees or curb cuts to right-of-way bioswales. In addition, more frequent storm drain maintenance and street cleaning may be needed in this area, as there was notably more litter than in other nearby neighborhoods.

Streetview showing average home, street conditions, and potential for street trees.

Note the downspout: Even with small lots, about 40% of downspouts are directed to pervious.

The lot at Beulah Baptist is a dominant feature in the landscape, and offers opportunity for enhancement.

Stormdrains in the area were typically clogged with organic matter and litter.

In addition, Malcolm X Park, situated between Beulah Baptist Church and Morse School, has potential to be better utilized as an active public park that can both provide stormwater mitigation services and serve as a recreational green space for the public. At present, the park is not well used, in a dilapidated state, and a hot spot for illegal activity, and thus cut off by a fence from Morse School. In 2012 Clearwater, Inc. and a host of partners developed designs for this space, published in The Fall Kill Plan, available at http://fallkill.org.

Proposed park with basketball court, bridge to Morse School including a learning area, board walk and toddler play area, and constructed wetland habitat.

Perspective showing play area in foreground, and bridge to Morse school in background.

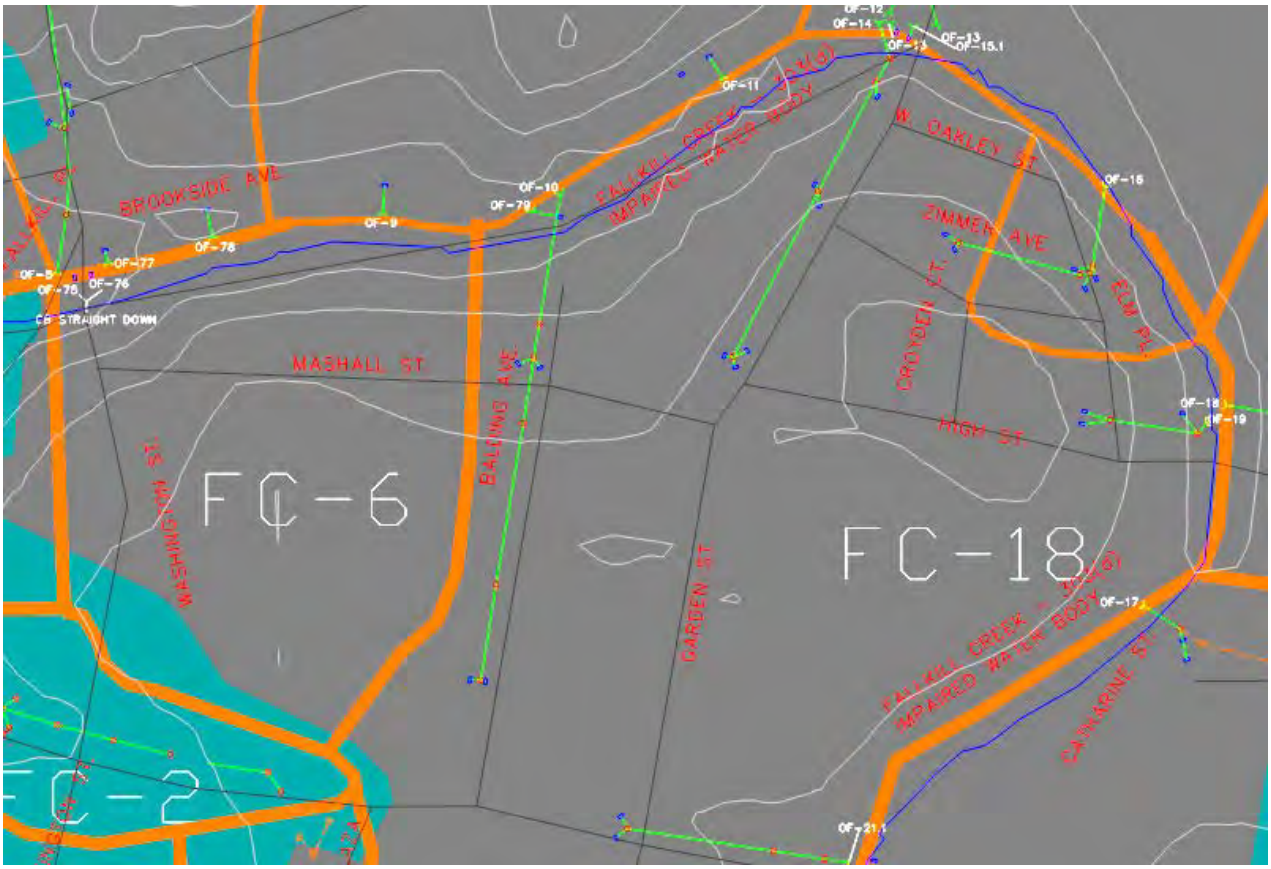
Neighborhood 29 – Garden St.

This neighborhood, bordered by Washington Street to the west, Brookside Avenue to the north, and Mansion Street to the south, has the Fall Kill Creek snaking throughout. While the primary land use is residential – mainly one and two-family homes – there is a healthy mix of other uses, including religious, educational, and professional buildings. The housing stock is older, particularly between Garden Street and Balding Avenue and along High Street, where homes were built between 1860 and 1890. Homes along the North side of Marshall Street were built in the 1920s and 1930s and have the Fall Kill in their backyard.

Water and sewer are public, and the zoning for the area is comprised of R-2A (Central Low Density District), R3A (Central Medium Density Residence District), and R4 (Medium High Density District)

Neighborhood 29		
Attribute	**Score**	**Comments**
% lot with impervious cover	75%	
% lot with grass cover	20%	Medium management intensity
% lot with forest canopy	35%	
% downspouts drain to impervious	10%	
% downspouts drain to pervious	80%	
% downspouts direct to storm or sanitary	10%	
Storm drains present?	Yes	Not stenciled, mostly clean.
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	Organic matter, trash/litter present
Pollution Potential	Low	High pervious cover.
Restoration Potential	Moderate	Direct discharge could be limited though green infrastructure.

This neighborhood is very unique both in community character and stormwater infrastructure, both influenced by its connection to a meandering section of the Fall Kill. As seen below, stormwater is primarily routed to the Fall Kill through storm drains (green lines) on Balding Ave. and Garden St., and a few smaller systems off of West Oakley St. Stormwater at the west end of the neighborhood naturally flows downhill on Marshall St. to Washington St., where it dumps into the Fall Kill at the intersection of Brookside Ave.



City of Poughkeepsie Stormwater Basemap: Blue area indicates combined sewer drainage area, with proposed storm drains in dotted orange. Solid green lines indicate existing storm drains, ending at outfalls numbered in white text.

While these direct discharges of urban runoff into the Fall Kill would normally indicate a high pollution potential, the severity is partially mitigated in this case due to a high percentage of downspouts discharging to pervious area, and a healthy canopy cover and presence of street trees. These features work in tandem to limit the amount of untreated stormwater from reaching the Fall Kill in storm events. An exception, however, is the west end of the neighborhood on Washington St., which has more impervious cover and less trees.

Also, a small industrial/commercial corridor on the eastern edge of the neighborhood that includes the main County Office Building offers an opportunity for a trail or new access point; although at present the site is a hot spot for dumping.

Typical lot with adequate pervious cover.

Example street showing common areas and presence of street trees.

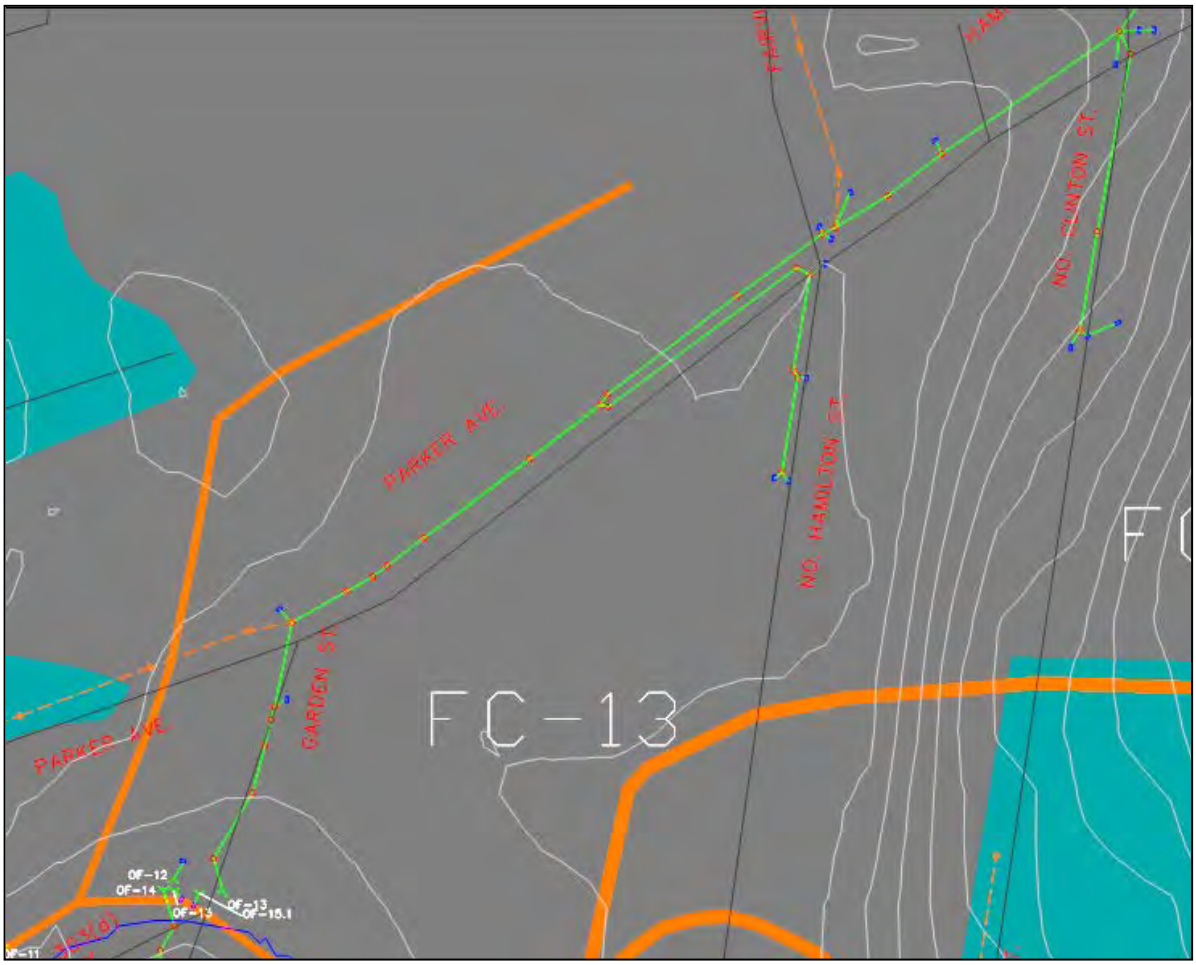
Signage alerting residents to pick up after their pets.

Most drains were clean, however some were partially clogged with litter and debris.

Industrial area on the eastern portion of the neighborhood.

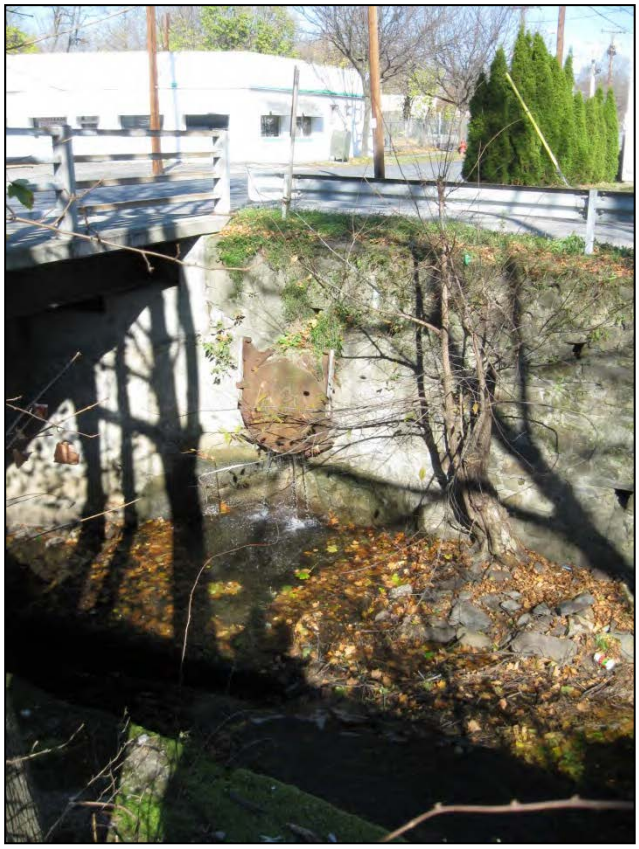
Recent dumping in industrial area.

While this neighborhood's pollution potential is fairly low relative to other areas in the City, it is home to a major stormwater discharge hotspot; the Garden St. outfall. However, although it is home to this hotspot, the stormwater comes from outside the neighborhood. As seen below, the outfall is the end point of a system that drains a long stretch of Parker Ave., and parts of North Clinton, and North Hamilton Streets (See Neighborhood 26 for further discussion).



The Garden St Outfall, labeled in white at the bottom left, is the end point of a system that drains a heavily trafficked commercial area on Parker Ave., as well parts of North Hamilton and North Clinton.

The stretch of Parker Ave. that feeds this outfall is heavily trafficked, and includes commercial facilities such as a car wash and an auto repair/salvage facility. So in addition to a large water quantity coming from the drainage area (see below), there is also the possibility of contamination. The area is also home to a parking area for the Walkway Over the Hudson New York State Historic Park. Walkway could potentially partner with the City and local partners to provide the resources and space needed to install a bioswale, curb-cut, street trees, or mix of other green infrastructure practices to help mitigate this issue.



Garden St outfall in dry weather.

Garden St. outfall in moderate rainfall.

Neighborhood 30 – Verrazano Blvd.

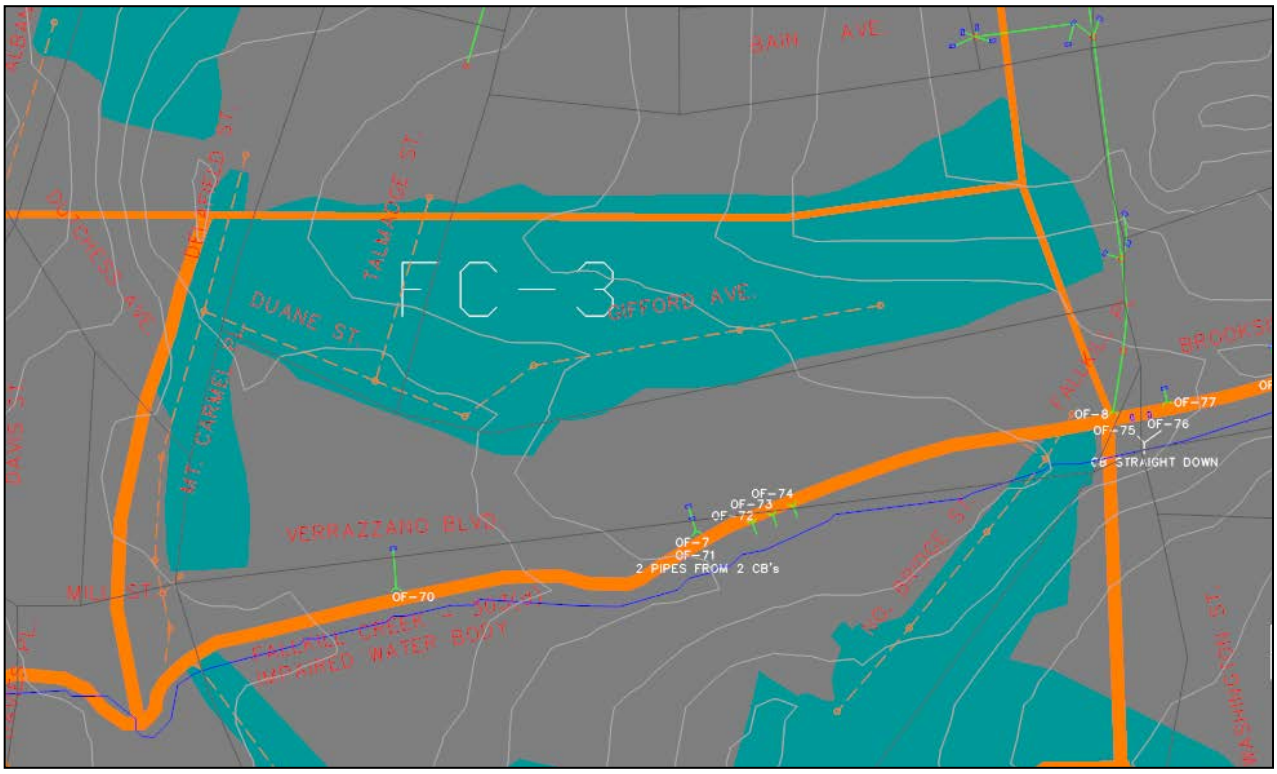
This neighborhood, west of Washington Street, is located between Gifford Avenue and Verrazano Boulevard in the City of Poughkeepsie. The Fall Kill Creek runs parallel to the south of the neighborhood along Verrazano Blvd.

Homes along Gifford Avenue are mostly two and three-family residences built in the late 1890s. Verrazano Blvd contains a number of apartment buildings built between the 1950s and the 1980s.

Water and sewer are public, and the zoning for the area is R4 (Medium High Density Residence District), which according to the City is designed to "provide areas for a broad range of housing types with opportunity for appropriate nonresidential uses at a fairly high density commensurate with the scale and characteristics of the city's older neighborhoods; these are areas with access to major transportation arteries and a range of community services."

Neighborhood 30		
Attribute	**Score**	**Comments**
% lot with impervious cover	75%	
% lot with grass cover	20%	Med. to low management intensity
% lot with forest canopy	45%	
% downspouts drain to impervious	90%	
% downspouts drain to pervious	5%	
% downspouts direct to storm or sanitary	5%	
Storm drains present?	Yes	Some stenciled, most dirty.
Stormwater detention areas present?	No	
Sidewalks present?	Yes	
Curb and gutter present?	Yes	Organic matter, trash/litter present
Pollution Potential	High	
Restoration Potential	Moderate	

This neighborhood, although only covering a small area, is actually more like two distinct neighborhoods, both in community character and stormwater infrastructure. Gifford Ave. is one of several areas in the City that uses a combined sewer system, while stormwater from Verrazano Blvd is directed to the Fall Kill.

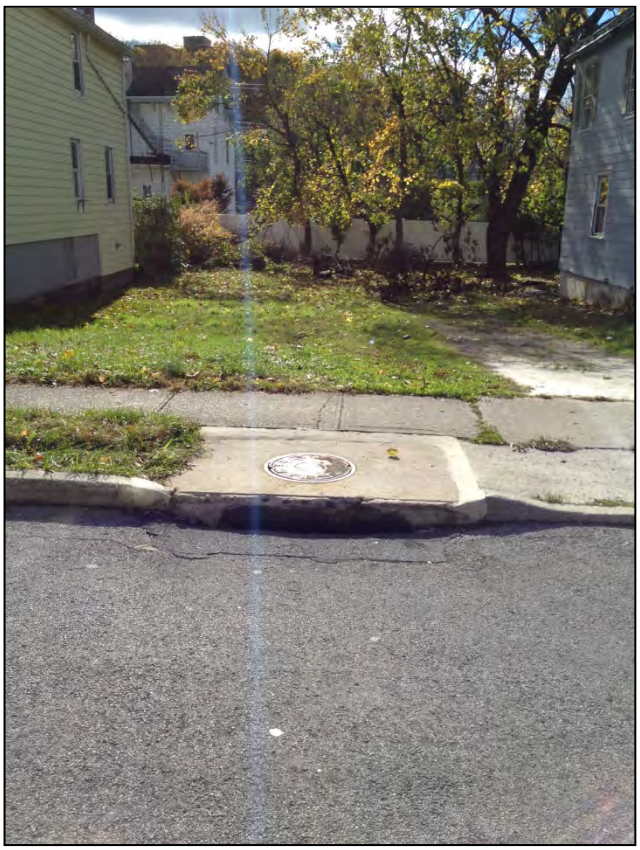


City of Poughkeepsie Stormwater Basemap: Blue area indicates combined sewer drainage area, with proposed storm drains in dotted orange. Solid green lines indicate existing storm drains, ending at outfalls numbered in white text.

Gifford Ave. has many vacant lots and abandoned buildings, along with about 30 private residences on small lots. Of these residences, many are presumed to be occupied by renters. Due to the small size of the lots and economic condition of the neighborhood, private restoration practices such as downspout disconnection to rain gardens are probably not feasible, although a rain barrel program could have merit.

However, the presence of vacant lots and abandoned buildings provides an excellent opportunity to transform burdens on the community that are diminishing property value into an asset that will help control stormwater and provide green space. In places such as Flint, MI and Philadelphia, PA, local leaders have implemented programs to turn vacant lots into bioretention areas, with amenities such as benches and playground equipment, with great success (See Appendix). A similar program could be considered for Gifford Ave.

In addition, since there are good sized common areas between the curb and sidewalk, a street tree planting and/or right-of-way bioswale program could be implemented.



Example of a vacant lot with restoration potential, with storm sewer in foreground.

View of Gifford Ave. showing potetial for street trees and curb cuts.

Verrazano Blvd. is quite different than Gifford Ave., with a couple large apartment buildings and very few single family homes, sidewalks present on only one side of the street, and stormwater infrastructure that drains to the Fall Kill.

The apartment buildings offer opportunity for green infrastructure practices, as noted in the photo below in an example from the Baxter Building Corp property. In this case, stormwater from the rooftops and parking lot is routed to a series of drains that end up discharging directly to the Fall Kill, but there is opportunity to divert some of that stormwater into rain barrels and bioretention areas (see below).

In addition, the south end of this neighborhood, which is a long riparian strip along the creek, has potential to be better utilized as a linear space that can both provide stormwater mitigation services and serve as a recreational green space for the public. In 2012 Clearwater, Inc. and a host of partners developed designs for this space, published in The Fall Kill Plan, available at http://fallkill.org.

Downspout from Baxter apartment building connected to drain.

Same drainage system, collecting water from large driveway.

The drains above end at this PVC pipe that dumps into the Fall Kill.

Stenciled storm drain leading to the Fall Kill.

Proposed linear park pilot site at Verrazano Blvd from the Fall Kill Plan. http://fallkill.org

Rendering of the west end of the park showing a picnic area and community garden/plant nursery. An open-air market was also considered in the Plan. http://fallkill.org

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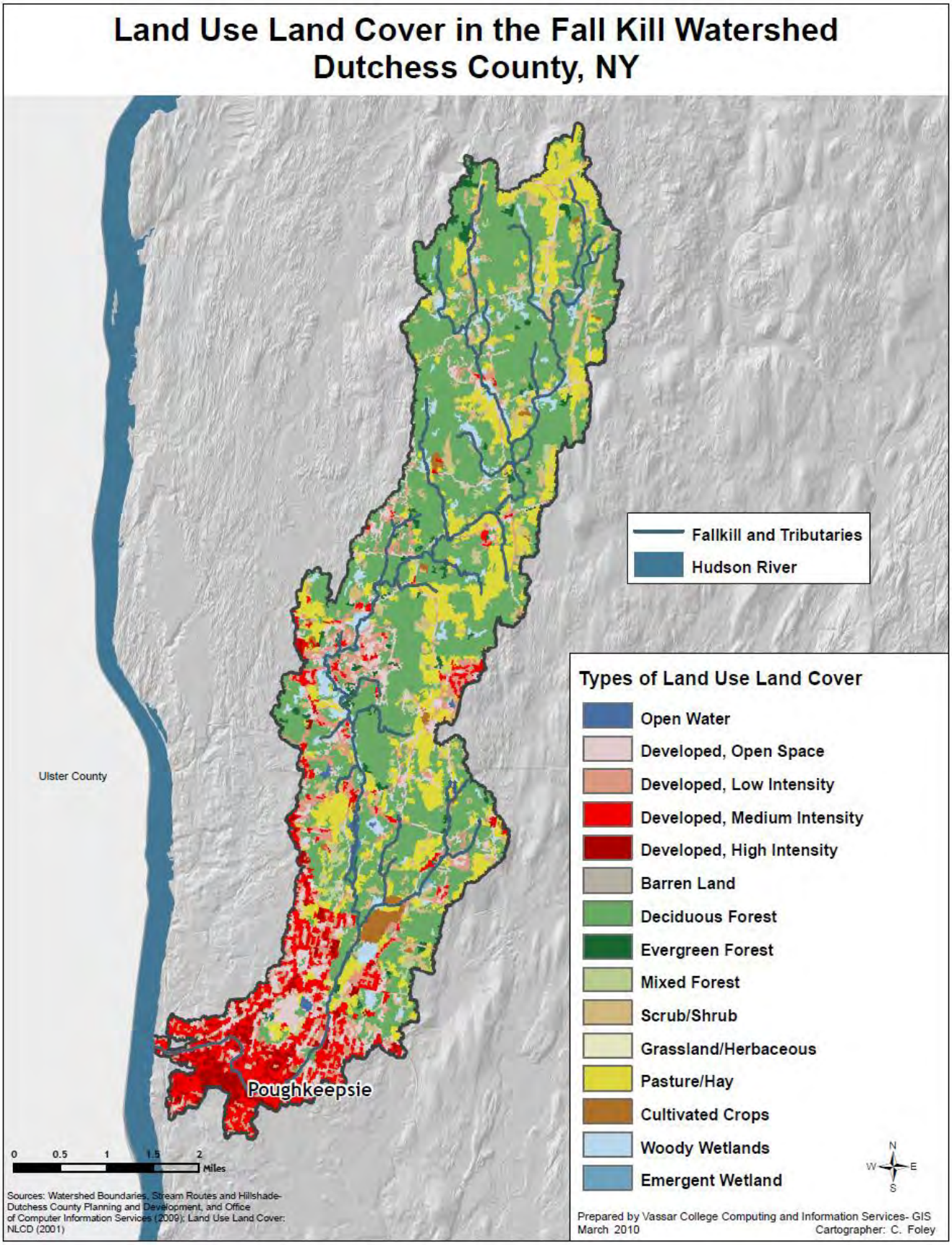
Appendix

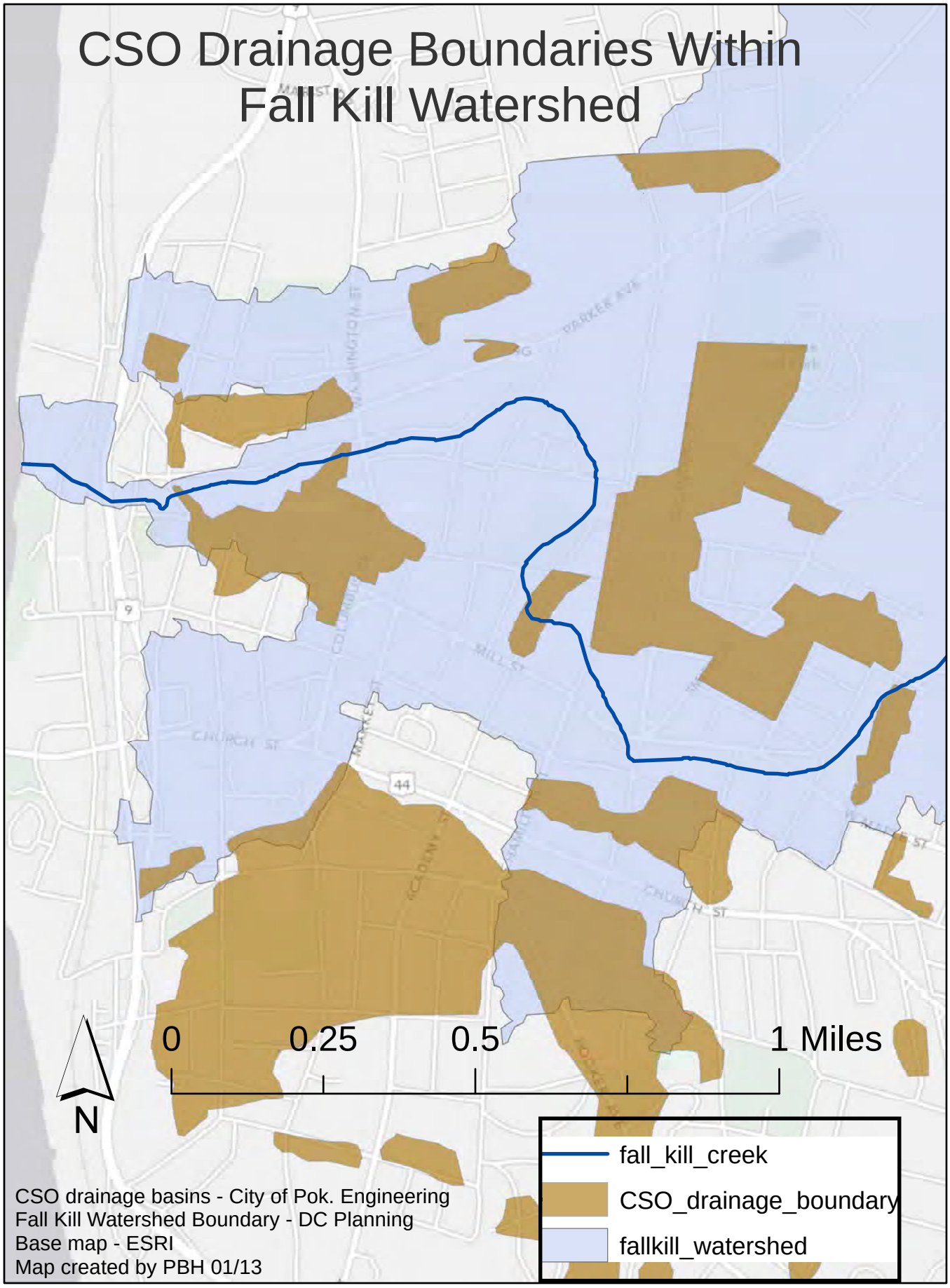
A: Maps

1. Land Use Land Cover in the Fall Kill Watershed
2. CSO Drainage Boundaries in the Fall Kill Watershed

B: Green Infrastructure Best Management Practices

C: Sample NSA Field Sheet


Land Use Land Cover in the Fall Kill Watershed
Dutchess County, NY
Fallkill and Tributaries
Hudson River
Ulster County
Poughkeepsie
Types of Land Use Land Cover
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Scrub/Shrub
Grassland/Herbaceous
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emergent Wetland
0 0.5 1 1.5 2 Miles
N
W
E
S
Sources: Watershed Boundaries, Stream Routes and Hillshade- Dutchess County Planning and Development, and Office of Computer Information Services (2009); Land Use Land Cover: NLCD (2001)
Prepared by Vassar College Computing and Information Services- GIS
March 2010
Cartographer: C. Foley


CSO Drainage Boundaries Within
Fall Kill Watershed
0
0.25
0.5
1 Miles
N
fall_kill_creek
CSO_drainage_boundary
fallkill_watershed
CSO drainage basins - City of Pok. Engineering
Fall Kill Watershed Boundary - DC Planning
Base map - ESRI
Map created by PBH 01/13

FACT SHEET: Downspout Disconnection

DESCRIPTION

In urban areas, roof runoff flows through gutters and downspouts and out to the storm or combined sewer. Disconnecting downspouts is the process of separating roof downspouts from the sewer system and redirecting roof runoff onto pervious surfaces. This reduces the amount of directly connected impervious area in a drainage area.

For disconnection to be safe and effective, each downspout must discharge into a suitable receiving area. Roof runoff can be redirected to a garden, yard, planter, or a rain barrel or cistern for eventual reuse. Runoff must not flow toward building foundations or onto adjacent property.

A plan for downspout disconnection will work with the existing downspouts on a building assuming there is an adequate receiving area; however, for buildings with internal drainage, disconnecting internal downspouts may be difficult or impractical.

BENEFITS

- Provides supplemental water supply when used in conjunction with capture/reuse systems
- Wide applicability
- Reduces potable water use and water supply costs when used in conjunction with capture/reuse systems
- Related cost savings and environmental benefits
- Reduced runoff volume, CSOs Peak

MAINTENANCE

- Check materials for leaks and defects
- Remove accumulated debris, especially from gutters

COST

- Inexpensive; materials are readily available at hardware store

POTENTIAL LIMITATIONS

- Internal drainage more difficult to disconnect
- Do not disconnect onto adjacent property owner
- Need adequate receiving area

POTENTIAL APPLICATIONS	
Residential	Yes
Commercial	Yes
Ultra Urban	Limited
Industrial	Yes
Retrofit	Limited
Highway/Road	No
Recreational	Yes
Public/Private	N/A

Residential downspout disconnect in Portland Oregon (Source: Portland Stormwater Website)

Residential downspout disconnection in Lancaster, PA

VARIATIONS

- Scuppers
- Drip chains
- Decorative gargoyles

KEY DESIGN FEATURES

- Install splashblock at the end of the extension to prevent erosion
- Roof runoff must be discharged at least 5 feet away from property lines including basements and porches

SITE FACTORS

- Water table to bedrock depth – N/A
- Soils – N/A
- Slope – N/A
- Potential hotspots – Yes (with treatment)
- Maximum drainage area – N/A

STORMWATER QUANTITY FUNCTIONS		STORMWATER QUALITY FUNCTIONS		ADDITIONAL CONSIDERATIONS	
Volume	Medium	TSS	Medium	Capital Cost	Low
Groundwater Recharge	Medium/High	TP	N/A	Maintenance	Low
Peak Rate	Medium	TN	N/A	Winter Performance	High
Erosion Reduction	Medium	Temperature	Medium/High	Fast Track Potential	Low/Medium
Flood Protection	Low			Aesthetics	High

Source: City of Lancaster, PA Green Infrastructure Plan

FACT SHEET: Cistern/Rain Barrel

BENEFITS

- Provides supplemental water supply
- Wide applicability
- Reduces potable water use
- Related cost savings and environmental benefits
- Reduced stormwater runoff impacts

POTENTIAL APPLICATIONS	
Residential	Yes
Commercial	Yes
Ultra Urban	Yes
Industrial	Yes
Retrofit	Yes
Highway/Road	No
Recreational	Yes
Public/Private	Yes/Yes

DESCRIPTION

Cisterns and Rain Barrels are structures designed to intercept and store runoff from rooftops to allow for its reuse, reducing volume and overall water quality impairment. Stormwater is contained in the cistern or rain barrel structure and typically reused for irrigation or other water needs. This GI technology reduces potable water needs while also reducing stormwater discharges.

Rain Barrel – rooftop downspouts are directed to an above-ground (typically) structure that collects rainwater and stores it until needed for a specific use, such as landscape irrigation.

Cistern – Underground (typically) container or tank with a larger storage capacity than a rain barrel, and typically used to supplement greywater needs (i.e. toilet flushing) in a building, as well as irrigation.

Cisterns and rain barrels can be used in urbanized areas where the need for supplemental onsite irrigation or other high water uses is especially

MAINTENANCE

- Discharge before next storm event
- Clean annually and check for loose valves, etc.
- May require flow bypass valves during the winter

COST

- Rain Barrels range from $100 to $300
- Cisterns typically range from $500 to $5000

POTENTIAL LIMITATIONS

- Manages only relatively small storm events which requires additional management and use for the stored water.
- Typically requires additional management of runoff
- Requires a use for the stored water (immigration, gray water, etc.

Source: City of Lancaster, PA Green Infrastructure Plan

VARIATIONS

- Rain barrels
- Cistems, both underground and above ground
- Tanks
- Storage beneath a surface using manufactured products
- Various sizes, materials, shapes, etc.

KEY DESIGN FEATURES

- Small storm events are captured with most structures
- Provide overflow for large storms events
- Discharge water before next storm event
- Consider site topography, placing structure upgradient of planting (if applicable) in order to eliminate pumping needs

SITE FACTORS

- Water table to bedrock depth – N/A (although must be considered for subsurface systems)
- Soils – N/A
- Slope – N/A
- Potential hotspots – yes with treatment
- Maximum drainage area – N/A

Top-left and bottom-left photos: Rain barrels in use in the City of Lancaster (Source: LiveGREEN)

Bottom-right photo: Rain barrel prototype example

STORMWATER QUANTITY FUNCTIONS		STORMWATER QUALITY FUNCTIONS		ADDITIONAL CONSIDERATIONS	
Volume	Low/Medium	TSS	Medium	Capital Cost	Low/Medium
Groundwater Recharge	Low	TP	Medium	Maintenance	Medium
Peak Rate	Low	TN	Medium	Winter Performance	Medium
Erosion Reduction	Low	Temperature	Medium	Fast Track Potential	Medium/High
Flood Protection	Low/Medium			Aesthetics	Low/Medium

Source: City of Lancaster, PA Green Infrastructure Plan

FACT SHEET: Bioretention (Rain Gardens)

Residential rain garden at the Village at Springbrook Farm in Lebanon, PA

Rain garden at Woodlawn Library in Wilmington, DE

DESCRIPTION

Bioretention Areas (often called Rain Gardens) are shallow surface depressions planted with specially selected native vegetation to treat and capture runoff and are sometimes underlain by sand or gravel storage/infiltration bed. Bioretention is a method of managing stormwater by pooling water within a planting area and then allowing the water to infiltrate the garden. In addition to managing runoff volume and mitigating peak discharge rates, this process filters suspended solids and related pollutants from stormwater runoff. Bioretention can be designed into a landscape as a garden feature that helps to improve water quality while reducing runoff quantity. Rain Gardens can be integrated into a site with a high degree of flexibility and can balance nicely with other structural management systems including porous pavement parking lots, infiltration trenches, and other non-structural stormwater BMPs. Bioretention areas typically require little maintenance once established and often replace areas that were intensively landscaped and require high maintenance.

BENEFITS

- Volume control & GW recharge, moderate peak rate control
- Versatile w/ broad applicability
- Enhance site aesthetics and habitat
- Potential air quality & climate benefits

POTENTIAL APPLICATIONS	
Residential	Yes
Commercial	Yes
Ultra Urban	Limited
Industrial	Yes
Retrofit	Yes
Recreational	Yes
Public/Private	Yes
Residential	Yes

MAINTENANCE

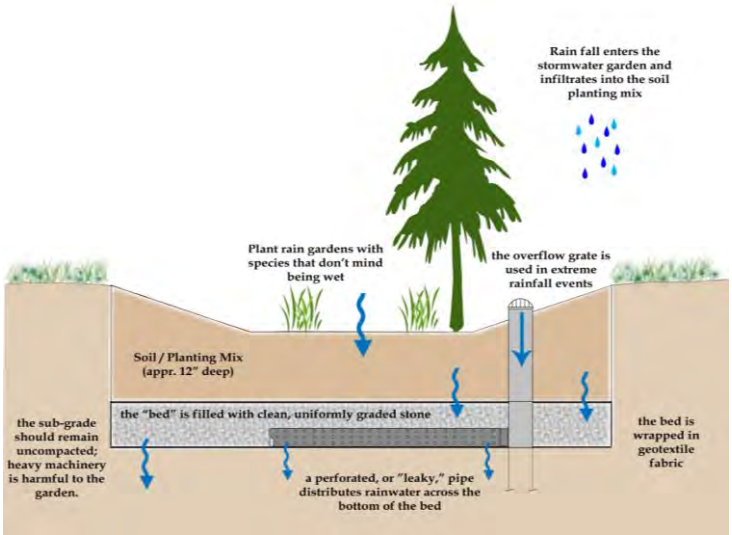
- Watering: 1 time / 2-3 days for first 1-2 months, then as needed
- Spot weeding, pruning, erosion repair, trash removal, and mulch raking: twice during growing season
- As needed, add reinforcement planting to maintain desired density (remove dead plants), remove invasive plants, and stabilize contributing drainage area
- Annual: spring inspection and cleanup, supplement mulch to maintain a 3 inch layer, and prune trees and shrubs
- At least once every 3 years: remove sediment in pre-treatment cells/inflow points and replace the mulch layer
- Maintenance cost is similar to traditional landscaping

COST

- Cost will vary depending on the garden size and the types of vegetation used; typical costs are $10-17 per sq. foot

POTENTIAL LIMITATIONS

- Higher maintenance until vegetation is established
- Limited impervious drainage area to each BMP
- Requires careful selection & establishment of plants



Conceptual diagram showing process of bioretention

Linear bioretention area along roadway
Source: Low Impact Development Center, Inc.

VARIATIONS

- Subsurface storage/infiltration bed
- Use of underdrain
- Use of impervious liner

KEY DESIGN FEATURES

- Flexible in size and configuration
- Ponding depths 6 to 18 inches for drawdown within 48 hours
- Plant selection (native vegetation that is tolerant of hydrologic variability, salts, and environmental stress)
- Amend soil as needed
- Provide positive overflow for extreme storm events
- Stable inflow/outflow conditions

SITE FACTORS

- Water Table/ Bedrock Separation: 2-foot minimum, 4-foot recommended
- Soils: HSG A and B preferred; C & D may require an underdrain
- Feasibility on steeper slopes: medium
- Potential Hotspots: yes with pretreatment and/or impervious liner
- Maximum drainage area: 5:1; not more than 1 acre to one rain garden

STORMWATER QUANTITY FUNCTIONS		STORMWATER QUALITY FUNCTIONS		ADDITIONAL CONSIDERATIONS	
Volume	Medium/High	TSS	High (70-90%)	Capital Cost	Medium
Groundwater Recharge	Medium/High	TP	Medium (60%)	Maintenance	Medium
Peak Rate	Medium	TN	Medium (40-50%)	Winter Performance	Medium
Erosion Reduction	Medium	Temperature	High	Fast Track Potential	Medium
Flood Protection	Low/Medium			Aesthetics	High

FACT SHEET: Tree Trench

Tree trench in urban setting (Viridian Landscape Studio)

DESCRIPTION

Tree trenches perform the same functions that other infiltration practices perform (infiltration, storage, evapotranspiration etc.) but in addition provide an increased tree canopy.

MAINTENANCE

- Water, mulch, treat diseased trees, and remove litter as needed
- Annual inspection for erosion, sediment buildup, vegetative conditions
- Biannual inspection of cleanouts, inlets, outlets, etc.
- Maintenance cost for prefabricated tree pit: $100-$500 per year

COST

- $850 per tree
- $ 10-$15 per square foot
- $8000-$10,000 to purchase one prefabricated tree pit system including filter material, plants, and some maintenance; $1500-$6000 for installation

BENEFITS

- Increased canopy cover
- Enhanced site aesthetics
- Air quality and climate benefits
- Runoff reductions
- Water quality benefits
- High fast track potential
- Enhanced tree health/longevity

POTENTIAL APPLICATIONS	
Residential	Yes
Commercial	Yes
Ultra Urban	Limited
Industrial	Yes
Retrofit	Yes
Highway/Road	Yes
Recreational	Yes
Public/Private	Yes

POTENTIAL LIMITATIONS

- Required careful selection of tree species
- Required appropriate root zone area
- Utility conflicts, including overhead electric wires, posts, signs, etc.
- Conflicts with other structures (basements, foundations, etc.)

VARIATIONS

- Structural soil or alternative (eg. Silva Cell)
- Porous pavers
- Open vegetated tree trench strip (planted with ground cover or grass)
- Tree grates
- Alternate storage media (modular storage units)
- Prefabricated tree pit

KEY DESIGN FEATURES

- Flexible in size and infiltration
- Native Plants
- Quick drawdown
- Linear infiltration/storage trench
- Adequate tree species selection and spacing
- New inlets, curb cuts, or other means to introduce runoff into the trench

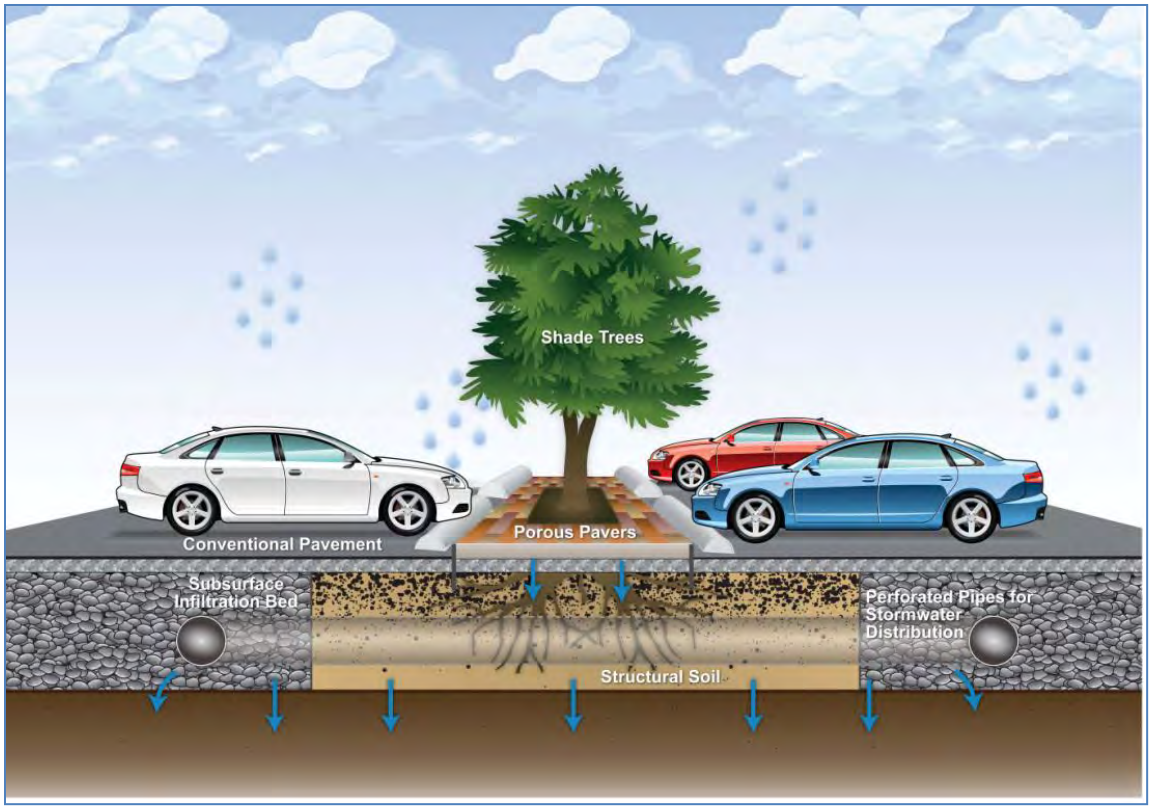
SITE FACTORS

- Overhead clearance; minimize utility conflict
- Root zone
- Water table
- Soil permeability/Limiting zones

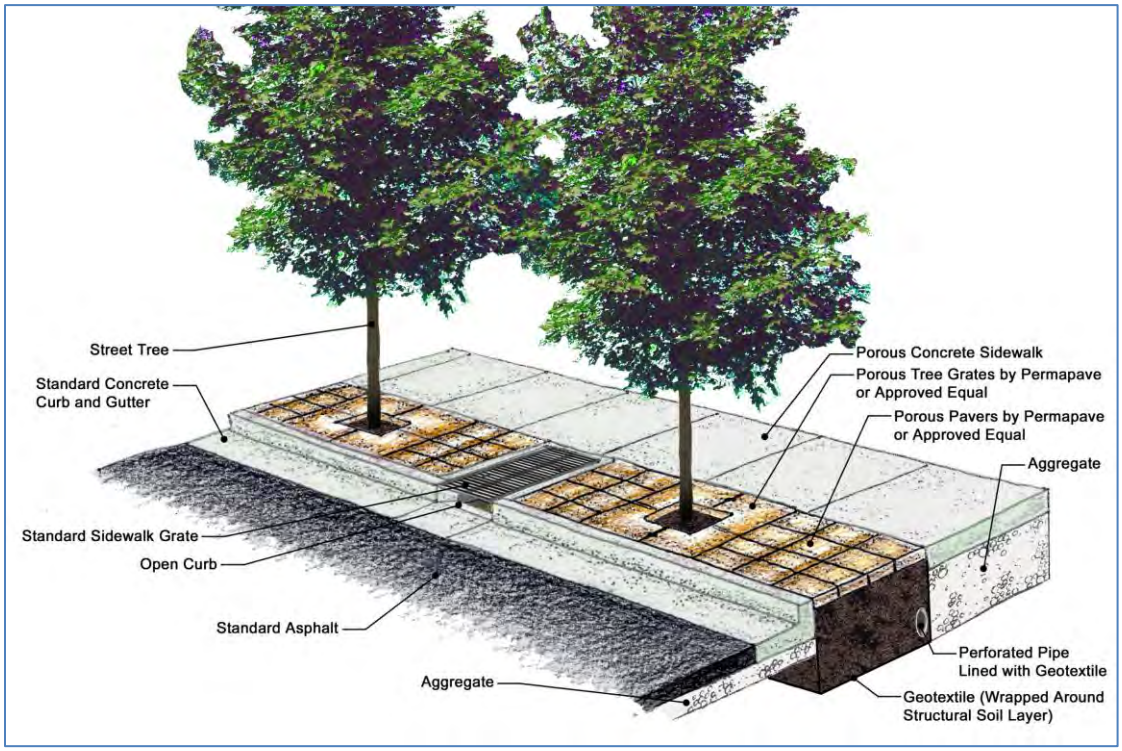
TOP LEFT: Tree trench with porous pavers and subsurface infiltration bed, located in City Lot No. 21, Syracuse, NY
LEFT: Tree trench located at Upper Darby Park outside of Philadelphia, PA

STORMWATER QUANTITY FUNCTIONS		STORMWATER QUALITY FUNCTIONS		ADDITIONAL CONSIDERATIONS	
Volume	Medium	TSS	High (70-90%)	Capital Cost	Medium
Groundwater Recharge	Medium	TP	Medium (60%)	Maintenance	Medium
Peak Rate	Medium	TN	Medium (40-50%)	Winter Performance	High
Erosion Reduction	Medium	Temperature	High	Fast Track Potential	High
Flood Protection	Low/Medium			Aesthetics	High

Source: City of Lancaster, PA Green Infrastructure Plan

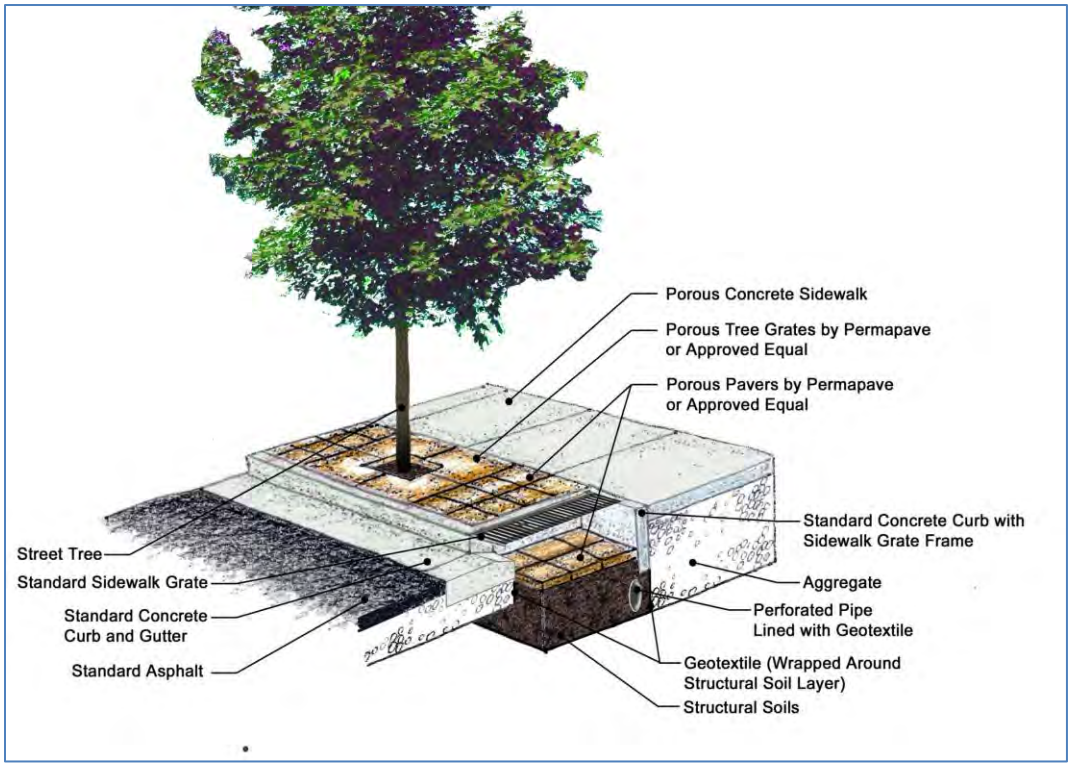


Example of Tree Trench adjacent to a Subsurface Infiltration Bed

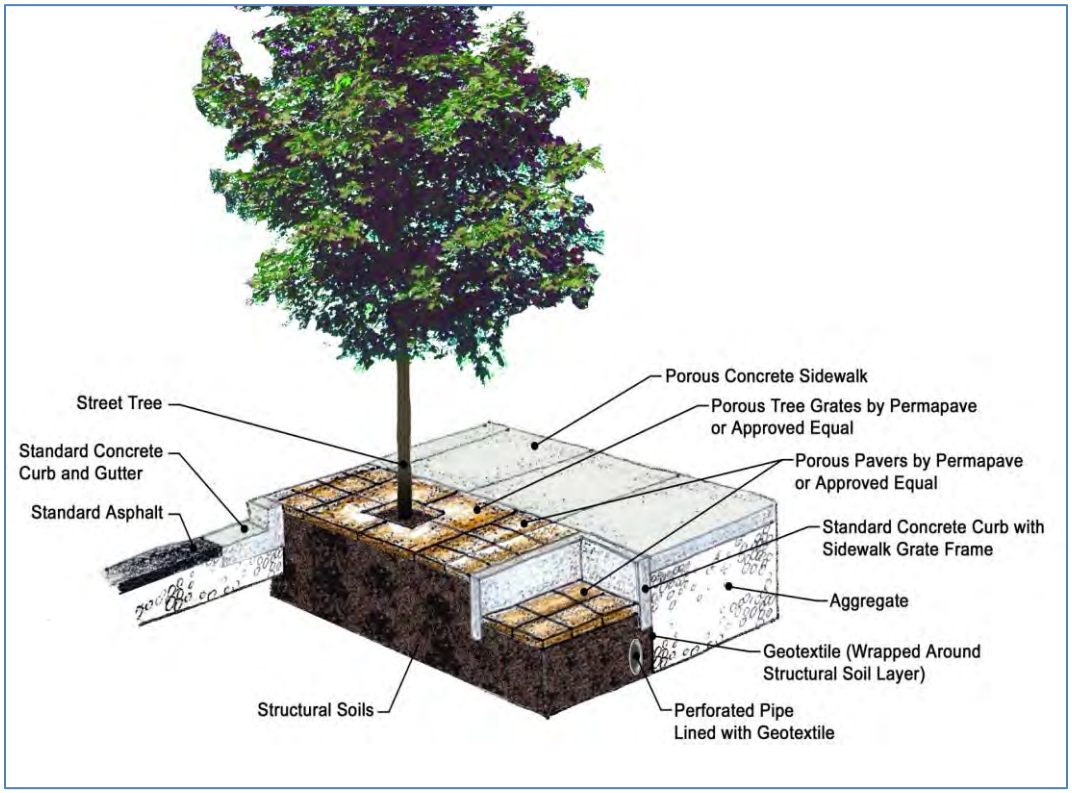


Example of Street Tree Trench with Structural Soil and Adjacent Infiltration Trench – Cross-Section A

Source: City of Lancaster, PA Green Infrastructure Plan



Example of Street Tree Trench with Structural Soil and Adjacent Infiltration Trench – Cross-Section B



Example of Street Tree Trench with Structural Soil and Adjacent Infiltration Trench – Cross-Section C

FACT SHEET: Vegetated Curb Extension

Urban application of a vegetated curb extension in Portland, Oregon (Source: www.artfulstormwater.net)

BENEFITS

- Traffic calming and pedestrian safety
- Enhanced site aesthetics, habitat
- Potential air quality and climate benefits
- Potential combined sewer overflow reductions
- Wide applicability, including in ultra-urban areas
- Reduced runoff, improved water quality

POTENTIAL APPLICATIONS	
Residential	Yes
Commercial	Yes
Ultra Urban	Yes
Industrial	Yes
Retrofit	Yes
Highway/Road	Limited
Recreational	Yes
Private	Yes

DESCRIPTION

Vegetated curb extensions, also called stormwater curb extensions, are landscaped areas within the parking zone of a street that capture stormwater runoff in a depressed planting bed. The landscaped area can be designed similar to a rain garden or vegetated swale, utilizing infiltration and evapotranspiration for stormwater management. They can be planted with groundcover, grasses, shrubs or trees, depending on the site conditions, costs, and design context.

Vegetated curb extensions can be used at a roadway intersection, midblock, or along the length or block of the roadway, and can be combined with pedestrian crosswalks to increase safety along a roadway. Additionally, vegetated curb extensions provide traffic calming opportunities along with stormwater management opportunities. Vegetated curb extensions can be added to existing roadways with minimal disturbance and are very cost effective as retrofit opportunities. They can be used in a variety of land uses, and are a good technique to incorporate along steeply sloping roadways. They are also effective pretreatment (i.e. filtration) practices for runoff entering other Green Street practices, such as infiltration trenches.

MAINTENANCE

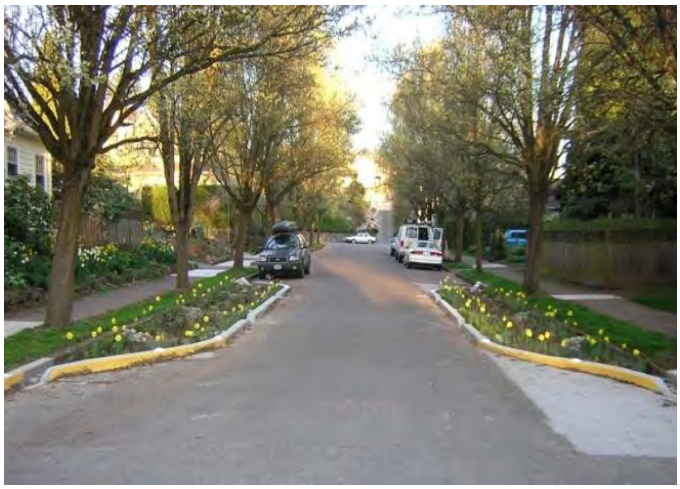
- Remove accumulated debris
- Clean inlets

COST

- Relatively inexpensive to retrofit
- $ 30/square foot for new construction

POTENTIAL LIMITATIONS

- Could require removal of on-street parking
- Conflict with bike lane
- Utility and fire hydrant conflicts



Residential application of a vegetated curb extension in Portland, Oregon (Source: www.artfulstormwater.net)

Vegetated curb extensions in Berwyn, PA
Source: CH2M HILL

VARIATIONS

- Bulb-out; Bump-out
- Stormwater Curb Extension

KEY DESIGN FEATURES

- Design can incorporate existing inlets
- Size to handle runoff from the catchment area
- Infiltration testing required
- Do not infiltrate on compacted soil
- Level storage bed bottoms
- Native vegetation
- Work around existing utilities
- Mark curb cuts highly visible to motorists

SITE FACTORS

- Water Table/Bedrock Separation; 2-foot minimum.
- Soils: HSG A&B preferred; HSG C&D may require underdrains
- Feasibility on steeper slopes: high. Design to include backstop or check dam

STORMWATER QUANTITY FUNCTIONS		STORMWATER QUALITY FUNCTIONS		ADDITIONAL CONSIDERATIONS	
Volume	Medium	TSS	Medium/High	Capital Cost	Low
Groundwater Recharge	Medium	TP	Medium	Maintenance	Low/Medium
Peak Rate	Medium	TN	Medium	Winter Performance	Medium
Erosion Reduction	Medium	Temperature	Medium/High	Fast Track Potential	Low/Medium
Flood Protection	Low/Medium			Aesthetics	High

Neighborhood Source Assessment **NSA**

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE: ___/___/_____	ASSESSED BY:	CAMERA ID:	PIC#:

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: _____ Neighborhood Area (acres) _____

If unknown, address (or streets) surveyed:

_____

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information: _____

Residential *(circle average single family lot size):* _____

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

Estimated Age of Neighborhood: _____ years	Percent of Homes with Garages: _____% With Basements ____%	**INDEX***
Sewer Service? ☐ Y ☐ N		○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%		○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	**Percentage**	**Comments/Notes**	
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover			
B2. % of lot with grass cover			○
B3. % of lot with landscaping (e.g., mulched bed areas)			◇
B4. % of lot with bare soil			○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy			◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: ____		○
	Med: ____		
	Low: ____		
B8. Outdoor swimming pools? ☐Y ☐N ☐ Can't Tell Estimated # ____			○
B9. Junk or trash in yards? ☐ Y ☐ N ☐ Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A			
C2. Driveway Condition ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up			○
C3. Are sidewalks present? ☐ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☐			
☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? _____ ft.			◇
Is pet waste present in this area? ☐ Y ☐ N ☐ N/A			○
C4. Is curb and gutter present? ☐ Y ☐ N If yes, check all that apply:			
☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment			○
☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

Source: Center for Watershed Protection

Neighborhood Source Assessment **NSA**

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface			
D3. Downspouts discharge to pervious area			
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☐N			◇
E. COMMON AREAS			
E1. Storm drain inlets? ☐ Y ☐ N If yes, are they stenciled? ☐ Y ☐ N Condition: ☐ Clean ☐ Dirty			◇
Catch basins inspected? ☐ Y ☐ N If yes, include Unique Site ID from SSD sheet: _____			○
E2. Storm water pond? ☐ Y ☐ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre			◇
E3. Open Space? ☐ Y ☐ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N			○
Buffers/floodplain present: ☐ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N			
F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS			
Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply)* ☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other _____			○

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) _____

Describe Recommended Actions:

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☐ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

NOTES:

Source: Center for Watershed Protection