



Comprehensive Master Plan



Environment Report 2015



Acknowledgements

This report was prepared by the Environmental Management Division and the Community Planning and Development Services Department with assistance from other City departments and agencies outside the City. In addition to geographic information systems (GIS) data analysis, other sources used to develop the report include adopted strategic plans, master plans and capital improvements programs, as applicable.

For information, contact:

Community Planning and Development Services
City of Rockville
111 Maryland Avenue
Rockville, MD 20850
(240) 314-8200
masterplan@rockvillemd.gov
www.rockvillemd.gov/CPDS

Contents

Introduction	1
Existing Environmental Conditions.....	3
Watersheds and Water Quality	3
Floodplains and Dams.....	6
Soils and Steep Slopes	9
Forests and Trees Canopy.....	11
Wildlife Habitat	15
Environmental Hazards.....	19
Air Quality.....	24
Implications for the Master Plan	27
Watersheds and Water Quality	27
Floodplains and Dams.....	27
Soils and Steep Slopes	28
Forests and Tree Canopy	28
Wildlife Habitat	28
Environmental Hazards.....	29
Air Quality.....	29
Additional Environmental Opportunities	31
Climate Change and Adaptation.....	31
Energy	33
Green Buildings	37
Conclusion	40
List of Resources	41
Appendix A - Rockville's Environmental Milestones.....	45

Figures

Figure 1: Chesapeake Bay Watershed.....	3
Figure 2: Watersheds, Streams and Wetlands	4
Figure 3: Floodplains and Dams	8
Figure 4: Erodible and Hydric Soils.....	9
Figure 5: Steep Slopes.....	10
Figure 6: Hydrological Soil Types.....	10
Figure 7: Tree Canopy and City Parks	12
Figure 8: Tree Canopy and Forest Protection	14
Figure 9: Forest Interior Dwelling Species Habitat.....	16
Figure 10: Maryland GreenPrint Hubs and Corridors.....	16
Figure 11: Priority Wildlife Habitats and Protected Lands	18
Figure 12: Hazardous Waste and Vulnerable Facilities	20
Figure 13: Weather hazards in Rockville	22
Figure 14: Air Quality in the Washington Region	24
Figure 15: Chesapeake Bay Airshed.....	25
Figure 16: Community Building Energy Consumption.....	34
Figure 17: City of Rockville Budgeted Energy Expenses	34
Figure 18: Annual Net Meter Solar Unit Installations	35
Figure 19: Renewable Energy and Green Buildings in Rockville.....	38

Tables

Table 1: Impervious Surface by Watershed	5
Table 2: Water Quality Impairments in Rockville	6
Table 3: Flood Risk Zones	7
Table 4: Potential Soils of Concern.....	10
Table 5: Hydrologic Soil Types.....	11
Table 6: Tree Canopy and Forest Protection	13
Table 7: Potential Rare, Threatened or Endangered Species	16
Table 8: Potential Wildlife Habitat	19
Table 9: Presidential Disasters and Emergency Declarations in Montgomery County	21
Table 10: Projected Climate Change Impacts in the National Capital Region	31
Table 11: Rockville Greenhouse Gas Emissions Inventory	32

Introduction

This report serves as a facts and trends base for the community to assist in the process of setting goals, policies, and priorities in Rockville's updated Comprehensive Master Plan (CMP). It presents an inventory of Rockville's current environmental resources and summarizes the management frameworks currently in place for each resource. It then discusses their implications and challenges as they pertain to the CMP update, currently underway, through the Rockville 2040 initiative. Also discussed are broader environmental sustainability aspects of the Rockville community that may have implications and solutions beyond the immediate scope of the City of Rockville.

The State of Maryland Land Use Article requires that local jurisdictions develop, routinely review (every 10 years) and, where deemed necessary, update their Comprehensive Master Plan to integrate environmental protection with plans for physical growth and development. This enables the Comprehensive Master Plan to create an overall vision for the City's future and guide development, conservation and capital improvement projects to improve the quality of life in the community.

A broad range of topics are covered in this report, all of which address State, regional and/or local planning requirements, as well as the city's own environmental and sustainability commitments. Topics include:

- Watersheds, streams, wetlands and water quality
- Floodplains and dams
- Soils and steep slopes
- Forests and tree canopy
- Wildlife habitat
- Environmental hazards
- Air quality
- Climate change
- Energy efficiency and generation
- Green buildings

Many of these topics are important to Rockville for the environmental benefits they provide to residents, workers and visitors, including water infiltration and erosion control, shade and wildlife habitat, and personal enjoyment. The City provides a range of municipal services that support

these natural environmental resources, as well, including: drinking water, sewer, and stormwater management, construction permitting and inspections, snow removal, leaf collection, street maintenance, land use planning, public park maintenance, recreation programs and municipal facility management. It is at the intersection of the City's natural resource demands and its municipal services that the City is most effective.

Given that the Comprehensive Master Plan has a long-term 25-year vision, the scope of this document includes existing City boundaries (as of November 2015) as well as, where relevant, areas encompassed by the City's Maximum Expansion Limits (MEL) as adopted within the 2010 Municipal Growth Element. This scope provides an opportunity to integrate existing and potential environmental resources into planning and management as the City grows.

The City of Rockville is located 12 miles northwest of Washington D.C. and is the third largest incorporated municipality in Maryland by population. Despite its history as a small agricultural community and County crossroads, Rockville today is developed primarily as residential neighborhoods, commercial corridors, and a vibrant town center, with few remaining tracts of vacant, developable land. Some population and employment growth is anticipated in Rockville's future, however, through redevelopment of existing sites and potential annexation of areas identified in the City's Municipal Growth Element of the Comprehensive Master Plan. Between 2010 and 2030, Rockville's population is projected to increase from 61,209 to 75,305. During this time, the number of Rockville households is projected to increase from 25,199 to 31,803.

It is important to recognize that management of one resource can reinforce or conflict with other resources or City goals (e.g., land use, transportation, environment, housing, open space, preservation, economic development, etc.). A good and useful, Comprehensive Master Plan helps set priorities in the effort to achieve and, where necessary, balance the City's multiple environmental and community goals. The goal of this document and the discussion that follows its release is to help to establish the areas within the environmental arena that are part of that setting of goals and priorities.

Existing Environmental Conditions

The following sections provide an overview of Rockville's current environmental conditions. They provide a setting for issues and policies that can be addressed in the Rockville 2040 Comprehensive Master Plan update, as well as other City goals and policies that seek to protect and enhance Rockville's natural environment.

Watersheds and Water Quality

Rockville is situated in the Piedmont plateau region between the Atlantic Coastal Plain and the Appalachian Mountains and is crossed by three tributaries of the Potomac River: Watts Branch, Cabin John Creek, and Rock Creek. The City covers approximately 13.5 square miles within the 14,670 square mile Potomac River basin, which is situated within the larger 64,000 square mile Chesapeake Bay watershed¹ (see Figure 1). From a watershed planning perspective, Rockville is situated within four subwatersheds of the Middle Potomac River watershed: two that are the headwaters of Cabin John Creek and Watts Branch Creek, one that drains out of the city to the Middle Rock Creek subwatershed, and one small area in the north of the city that is part of the Muddy Branch subwatershed. Figure 2 shows the delineation of these subwatersheds.

Watts Branch is not only the City's largest watershed; it is also of particular importance due to the fact that the confluence of Watts Branch and the Potomac River is just upstream from major drinking water intake facilities serving suburban Maryland, including the City of Rockville. Consequently, the water quality of Watts Branch can have a significant impact on the level of treatment required at these drinking water plants.

As an active steward of the environment, the City is responsible for watershed management within its corporate city limits. This includes water carried by streams, pipes, driveways, rooftops, roads, parking lots, and drainage ways. Overall, Rockville is responsible for protecting and managing a variety of features in its watershed network, including about 32 miles of streams, 106 acres of non-tidal wetlands, 732 publicly and privately maintained stormwater management

facilities (not including flow splitters), and approximately 102 miles of public storm drains and 2,560 stormwater inlets.

Wetland protection is critical to the health of Rockville's watersheds due to the ability of wetlands to filter pollutants, minimize flood damage by slowing and storing floodwaters, and provide habitat for birds and wildlife. However, urbanized areas like Rockville that developed rapidly between the 1940s and 1970s typically have few natural wetland areas remaining due to the absence of policies and regulations for wetland preservation prior to the enactment of the Clean Water Act in 1972.

Data from 1989 National Wetlands Inventory (NWI) maps prepared by the U.S. Fish and Wildlife Service provide a general approximation of the City's current wetlands. Given that Rockville's land use and hydrology has changed since 1989, where possible, staff has corrected this data for obvious changes for the purposes of analysis. In addition to the watershed areas and streams within Rockville, Figure 2 depicts the location of wetlands within the city limits and its adopted Maximum Expansion Limits (MEL).

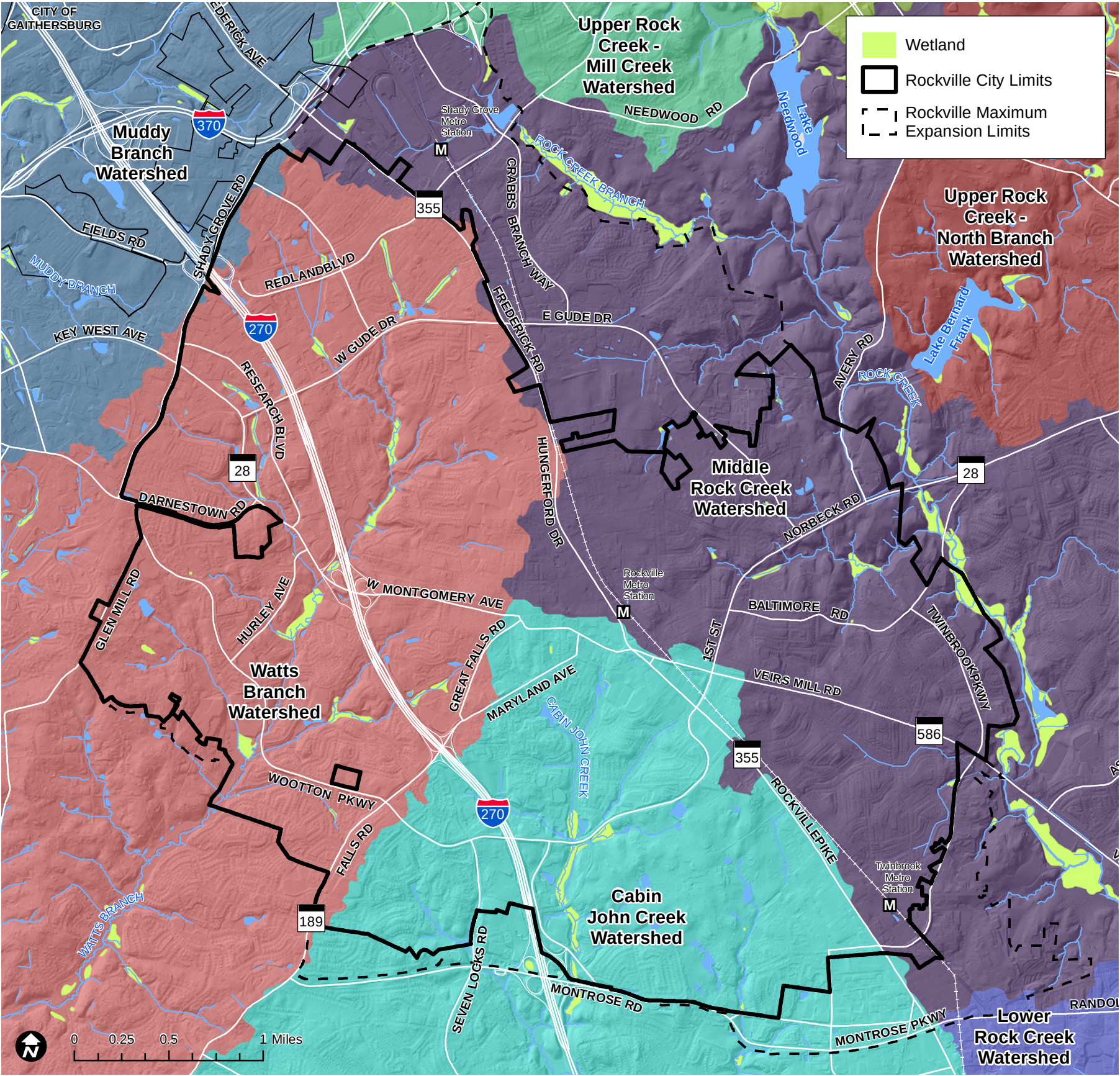
Figure 1: Chesapeake Bay Watershed



Credit: Chesapeake Bay Program

¹ A watershed is generally defined as the area of land where all of the water that falls on it drains to a common point, such as a stream, river, lake or bay.

Figure 2: Watersheds, Streams and Wetlands



In addition to the natural features of Rockville’s watersheds, an important part of the environmental landscape is the physical infrastructure put in place to help manage stormwater.² Due to development that has occurred over Rockville’s history, stormwater facilities are now a critical element in the city’s environment that helps support the natural streams and ponds that once served this function alone. There are currently 177 miles of storm drains in the City of Rockville (102 miles of which are publicly managed) with 732 stormwater management facilities feeding into them. Of the stormwater facilities, 200 are city-owned and the remaining 532 are privately-owned and managed. For more in-depth discussion of water utility infrastructure in Rockville, see the Water Resources and Community Facilities reports that support the Comprehensive Master Plan update.

Impervious surfaces, such as buildings, paved roads and parking lots, and even highly compacted soil or gravel, causes stormwater to “run off” into storm drain pipes and streams. As the water runs over land, it picks up pollutants like oil, fertilizer, pesticides, pet waste and sediment. Without effective water quality treatment, these pollutants can significantly impact stream water quality. In addition to debris and other pollutants entering storm drains, fast-flowing water can also cause stream banks to erode, adding sediment into waterways. Table 1, summarizes the City’s impervious surface area by watershed, accounting for the driveways, sidewalks, roads, parking lots, paths, and buildings that cover the city.

Table 1: Impervious Surface by Watershed³

	City Boundary		Maximum Expansion Limits	
	Acres	%	Acres	%
Citywide	3,057	35%	994	42%
Watts Branch	1,348	36%	17	20%
Cabin John	723	32%	170	42%
Rock Creek	960	38%	806	43%
Muddy Branch	26	57%	1	56%

Based upon the Impervious Cover Model, developed by the

2 Stormwater is the excess precipitation that fails to soak into the ground or is not absorbed by trees and plants.

3 This table is calculated based on the most recent available data as of the writing of this report and may not match impervious surface calculations presented in each of the individual watershed assessment reports conducted previously by the City.

Center for Watershed Protection, watersheds between 25 and 60 percent impervious cover are characterized as “non-supporting,” meaning they are unable to adequately support aquatic life and provide habitat. These watersheds are also characterized by fair to poor water quality, unstable channels, and severe erosion. Each of the City’s four watersheds fall into this category. On average, approximately 35 percent of the City’s total land area is covered by impervious surface.

As in many urban areas, the health of Rockville’s streams and waterways is impaired due to the extensive impervious surface of the city’s watersheds, consistent with research and studies that predict stream quality in terms of impervious cover. All states are required, under section 303(d) of the federal Clean Water Act, to maintain and update a list of impaired⁴ and threatened waters (i.e., stream segments) and submit this list to the U.S. Environmental Protection Agency (EPA) for approval every two years. When streams, lakes, and other bodies of water are impaired, a total maximum daily load (TMDL) or ‘pollution diet’ is created, which is a detailed investigation to verify the impairment and to identify the causes and solutions for the impairment. The TMDL establishes the maximum amount of a pollutant that a waterbody can receive to meet Federal water quality standards and allocates that available load among the various sources of that pollutant (e.g., point and non-point sources).

Table 2 summarizes the impaired waterways in Rockville that currently have EPA-approved TMDLs to reduce pollutant loading. While the State of Maryland has identified several impairments to Rockville’s waterways absent from this table, additional data and analysis is needed before TMDLs are developed and approved by EPA to establish allocations for them as well as reduction strategies.

Requirements to reduce target water pollutants are incorporated in the City’s National Pollutant Discharge and Elimination System (NPDES) municipal separate storm sewer system (MS4) permit, issued by the Maryland Department of the Environment (MDE). Due to its population size, Rockville is designated as a Phase II NPDES MS4 community. Under its current permit and anticipated future permits, the City is committed to carrying out activities that will reduce TMDL target contaminants. According to MDE, the next permit may impose a requirement to retrofit 20% of untreated impervious

4 Waterbodies are considered impaired if they do not meet federally-approved water quality standards.

surface of the City with stormwater treatment, a standard that future development regulations must address.

Table 2: Water Quality Impairments in Rockville

Impairment Source or Pollution	Watershed				
	Entire Chesapeake Bay	Watts Branch*	Cabin John	Rock Creek	Muddy Branch
Fecal Bacteria	-	-	Impaired, TMDL approved (2007)	Impaired, TMDL approved (2007)	-
Nutrients: phosphorus and nitrogen	Impaired, TMDL approved (2010)	-	-	Impaired, TMDL approved (2013)	-
Sediment	Impaired, TMDL approved (2010)	Impaired, TMDL approved (2012)	Impaired, TMDL approved (2011)	Impaired, TMDL approved (2011)	Impaired, TMDL approved (2012)
* Included in TMDL for the Potomac River-Montgomery County Watershed					

In terms of watershed impacts from the built environment, the expanding sustainability and green building movement have facilitated changes in Federal, State and local development regulations in recent years. Therefore, new development and recent redevelopment is now seen to have less environmental impact in Rockville today than the predominant 1960-era Rockville development that exists today. Evidence of this can be seen in the City’s adoption of both site design and building design standards, such as Environmental Site Design (ESD) projects, sediment controls, micro- and bio-retention facilities.

Regulatory Framework and Initiatives

Federal and State regulatory requirements drive watershed management to improve water quality and ecosystem health. Most notably, both the Clean Water Act’s (CWA) TMDL program and NPDES permit, which are administered through the U.S. Environmental Protection Agency (EPA) and implemented by the Maryland Department of the Environment (MDE), are a major part of the City’s regulatory environment.

The Maryland Department of the Environment coordinates with Federal and State agencies and local governments on other regulations that affect water resources and land development, including but not limited to:

- Erosion and Sediment Control Program (Maryland

Environment Article, Title 4, Subtitle 1)

- Stormwater Management Program (Maryland Environment Article, Title 4, Subtitle 2)
- Wetlands and waterways regulations of the federal Clean Water Act Section 404, Maryland Non-tidal Wetlands Act (Environment Article Title 5, Subtitle 5-901 through 5-911; Annotated Code of Maryland), and Waterway and 100-Year Floodplain Construction Regulations (Environment Article Title 5, Subtitle 5-501 through 5-514)

The City has a comprehensive program which includes extensive watershed protection and restoration planning, enforcement of water quality protection ordinances, Capital Improvement Program (CIP) projects, outreach and education, monitoring, and infrastructure inspection and maintenance. The Water Resources Element of the Comprehensive Plan, adopted in 2010, provides a comprehensive analysis of the City’s drinking water, wastewater disposal, and storm water management requirements, programs, operations and future needs. The following provides a summary of the City’s key initiatives that affect watersheds, streams, wetlands, storm water, sediment and erosion control, and riparian buffers:

- Water Quality Protection Ordinance (City Code Chapter 23.5); adopted 2007
- Sediment Control and Stormwater Management Ordinance (City Code Chapter 19); adopted 1978, updated 2010 (stormwater management) and 2012 (erosion and sediment control)
- Stormwater Management Utility Fee; adopted 2008
- Environmental Guidelines; adopted 1999
- Watershed Assessments and Management Plans; updated periodically
- Rockville Capital Improvements Program (CIP); updated periodically
- Inspection and Maintenance Program for Private and Private Stormwater Systems; initiated 2009
- RainScapes Rewards Program; initiated 2009
- Building Code (City Code Chapter 5); last amended 2015 to incorporate ‘green’ provisions

Floodplains and Dams

According to the Federal Emergency Management Agency (FEMA), flooding is the nation’s most common natural disaster. Local flooding can occur as a result of hurricanes,

overtopped dams, outdated or obstructed drainage systems, or rapid or prolonged accumulation of rainfall. Floodplain and dam safety management are necessary to minimize threats to public safety, property and infrastructure. Adequate floodplain protection and restoration in Rockville is critical to provide temporary storage for floodwaters, regularize peak flood flow, maintain water quality, recharge groundwater, prevent erosion, provide wildlife habitat, offer recreational opportunities, and foster aesthetic quality.

The City of Rockville participates in FEMA’s National Flood Insurance Program (NFIP). As part of this program, FEMA identifies a community’s flood risk by conducting a Flood Insurance Study (FIS) that creates a Flood Insurance Rate Map (FIRM). The FIRM illustrates the extent of flood hazards in a community by depicting flood risk zones. The FIRM is used in conjunction with the FIS report to determine the floodplain development regulations that apply in each flood risk zone and who must buy flood insurance for their property. Rockville’s current effective FIS and FIRMs were last updated on September 29, 2006.

Montgomery County was one of the first county-wide maps updated in FEMA Region III during the FIRM modernization process; however, it is one of the few counties in the state without complete model-supported A zones. Table 3 and Figure 3 indicate the area for each flood zone in Rockville. It is interesting to note that nearly all flood zones are located within protected stream valleys and other areas protected from development by the City’s various development regulations.

Table 3: Flood Risk Zones

	City Boundary		Maximum Expansion Limits	
	Acres	%	Acres	%
Total City Area	8,670	100%	2,354	100%
Total Flood Zone Areas	246	2.8%	63	2.7%
A - 1% flood risk zone (base flood elevation not determined)	136	1.6%	1	0.0%
AE - 1% flood risk zone (base flood elevation determined)	85	1.0%	46	2.0%
X - 0.2% flood risk zone	24	0.3%	16	0.7%

Generally, structures are not permitted to be built within designated flood zones in Rockville in order to reduce flooding hazards to the community. A small number of structures in Rockville are located within existing FEMA-delineated flood zones, though, and as these structures are altered or replaced, they must be relocated to non-flood zone areas.

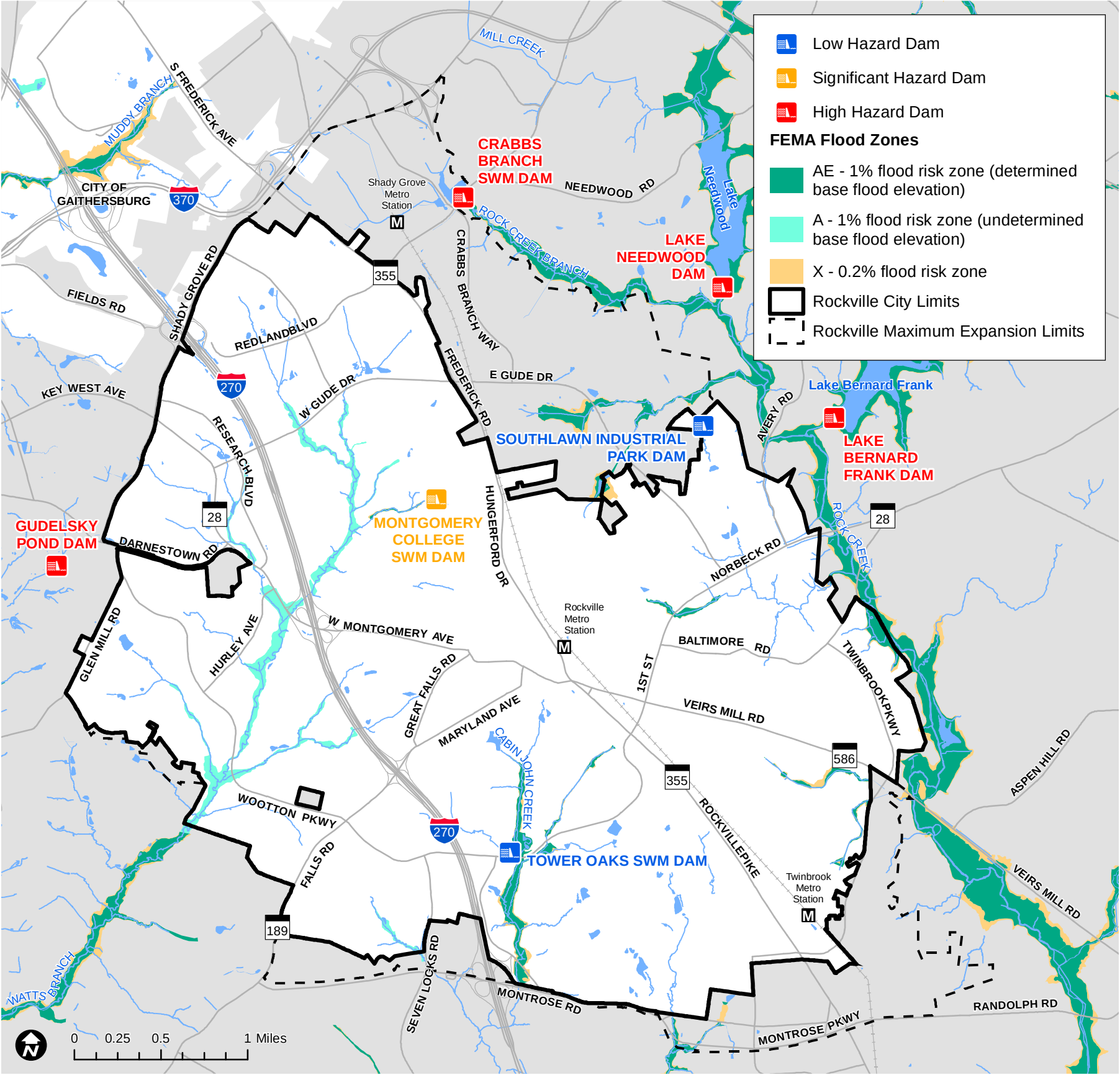
In 2014, FEMA informed the City that a RiskMAP watershed study was in progress that may update the floodplains of the City of Rockville to include improved hydrology and model-backed ‘type A’ flood zones with structure survey data (bridges, culverts, dams, etc.) incorporated into the modelling. Once the study is complete, the City will conduct an analysis of any new flood zones for their implications on existing or planned structures or vulnerable land uses in their vicinity.

Another dimension of flood control are dams.⁵ Most of the dams in Montgomery County, as in Rockville, consist of an earthen embankment in combination with spillways; a majority of these dams are built as stormwater management structures rather than recreational or drinking water supply. Dam failures may occur when spillway capacity is inadequate and excess flow overtops the dam or when internal erosion occurs through dam outflow pipes or foundations. Dam failures are localized hazards that are the greatest risk to the people who live below the dam in the area designated as the “inundation area.” Discharge from the dam breach, under worst-case conditions, could be several times the 1-percent annual chance flood; therefore, typical flood studies are of limited use in estimating flooding from these events.

There are three (3) dams within the City of Rockville, all of which are low-head dams holding stormwater management ponds. The locations of dams in the Rockville vicinity with their hazard classifications are shown in Figure 3. Inundation areas for each dam are not shown here due to national security reasons, but are on file with Montgomery County Office of Emergency Management and Homeland Security (OEMHS). Each owner of a high or significant hazard dam has developed, with the County, an evacuation plan that specifies emergency procedures for evacuation, control and re-entry of areas at risk for dam inundation. Depending on their proximity and topography, properties in the eastern

⁵ A dam is a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water.

Figure 3: Floodplains and Dams



most portion of Rockville situated above Rock Creek may be located nearby or within the dam inundation zone for Lake Needwood and/or Lake Bernard Frank.

Regulatory Framework and Initiatives

Floodplains and dams are managed by a variety of entities, including Rockville, the Maryland Department of the Environment, the U.S. Army Corps of Engineers, and the Federal Emergency Management Agency. For any development to take place in the City of Rockville, all necessary permits must be obtained to verify safety from flooding and dam and levee failures, which may include Federal and State permits, as well as locally applicable permits. Development here is defined to include any man-made change to land, including grading, filling, clearing, dredging, extraction, storage, subdivision of land, and construction and improvement of structures and buildings.

Two city initiatives serve as the key mechanisms to protect the Rockville community from flood and dam hazards:

- Floodplain Management Ordinance (City Code Chapter 10); adopted 1977, amended 1992
- Environmental Guidelines, adopted 1999

The City’s Floodplain Management Ordinance was originally adopted in 1977 to satisfy the requirements of the National Flood Insurance Program (NFIP) so property owners within the City would qualify for flood insurance. The ordinance was amended in 1992 and is anticipated to be amended in 2016 to comply with new Federal and State mandates in response to a recent audit by FEMA and the State of Maryland, which found the ordinance inadequate.

Soils and Steep Slopes

The physical characteristics of soils and topography are important considerations for land use and development as they impact the rate of erosion and sedimentation, level of infiltration, ability to filter nutrients and pollution, and the ability to safely support buildings and infrastructure. Proper management of steep slopes and erodible soils along stream valleys and other water resources is particularly important to protect sensitive natural resources and to prevent flooding, soil erosion, off-site sedimentation, water quality deterioration, aquatic system damage, and downstream

impacts that can damage public and private property.

While erosion and sedimentation are natural processes that shape the landscape, construction and development can greatly accelerate these processes and cause environmental degradation and costly problems. When excessive erosion and sedimentation occurs in stream channels or ponds, water quality can become degraded, channels can become unstable, and the functional storage volumes of stormwater management structures can be reduced. Consequently, excessive sediment is identified as a significant pollutant in Rockville and the U.S. Environmental Protection Agency has approved total daily maximum load (TDML) limits, or pollution diets, for sediment in all of the City’s waterways (see Table 2 in the Watersheds and Water Quality section).

Several factors affect soil erosion and sedimentation. For instance, the determination of a soil’s erodibility (an estimate of a soil’s ability to resist erosion) is a complex process that considers four principal factors: soil type and texture, vegetative cover, topography, and climate. Chapter 19 of the City Code (Sediment Control and Stormwater Management Ordinance) defines highly erodible soils as those soils with

Figure 4: Erodible and Hydric Soils

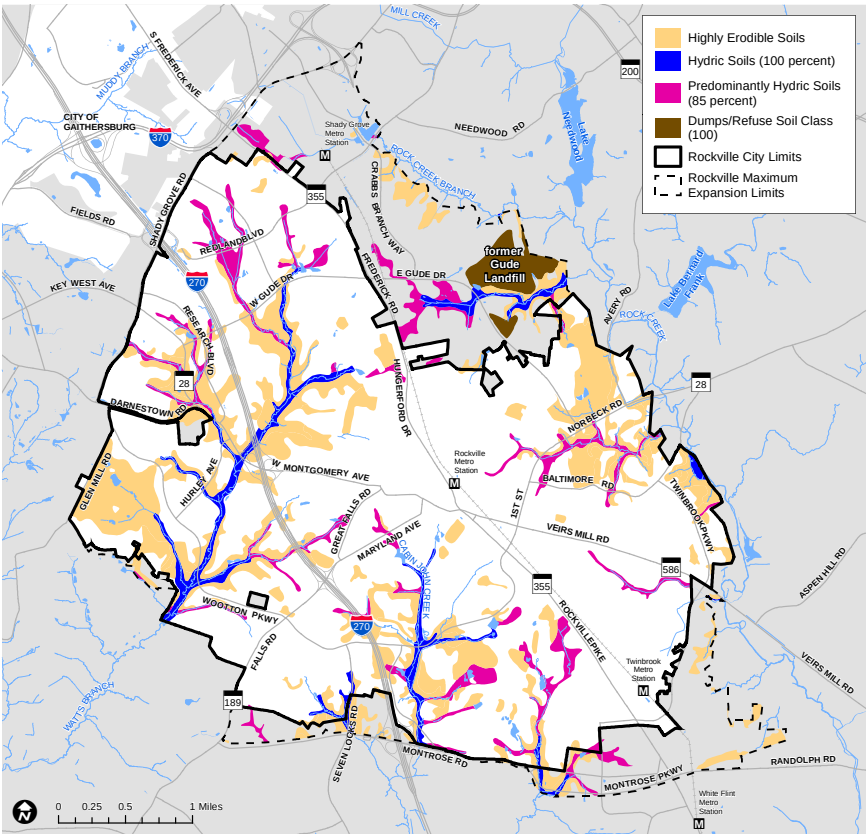
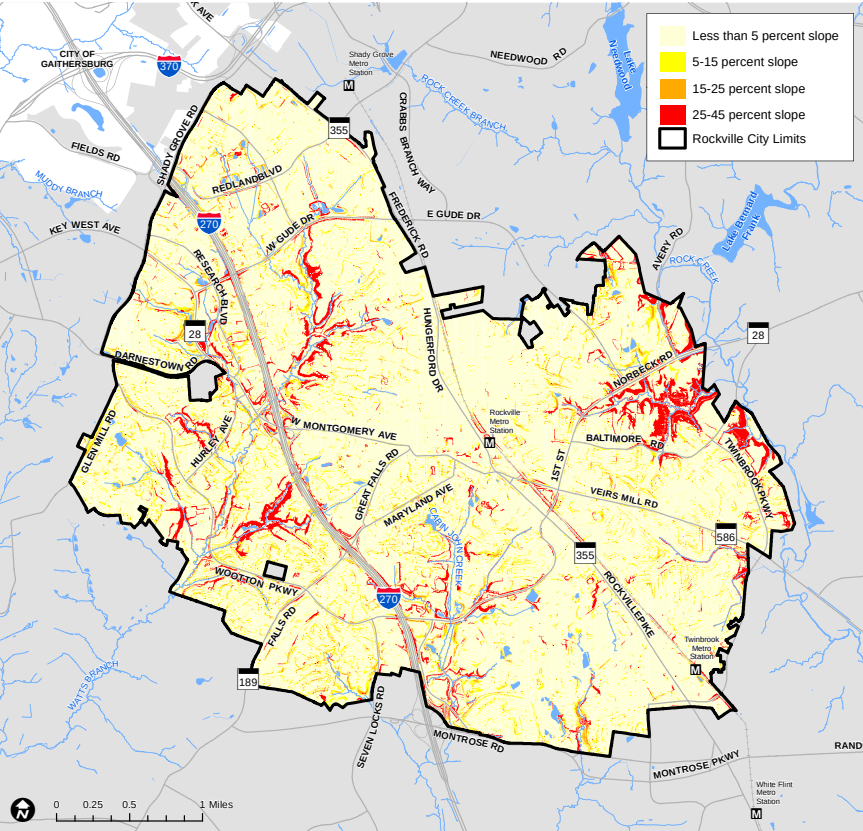


Figure 5: Steep Slopes



a slope greater than fifteen (15) percent or those soils with a soil erodibility factor or K value greater than 0.35 and with slopes greater than five (5) percent.

Steep slopes also present challenges for soil erosion and development. Maryland’s 2011 Standards and Specifications for Soil Erosion and Sediment Control define steep slopes as those with gradients of 20 percent or greater and also require concept plans to map slopes 15 percent or steeper (Figure 5).

An additional soil characteristic that describes the suitability and impacts of development and human activity on the health of watersheds is hydric soil. Hydric soils are those that are permanently or seasonally saturated by water, resulting in anaerobic conditions⁶, and are typically found in wetlands.

Steep slopes and hydric soils do not pose significant limitations to land development in Rockville since the majority of the city’s land area falls below steep slope and hydric soil limits. Where sensitive soil characteristics do exist, they tend to be located in stream valleys and other city parkland where the City has already instituted strong stream buffer protection measures or restrictions from development. Highly erodible soils, however, pose the greatest threat to sedimentation of the City’s streams.

Figure 6: Hydrological Soil Types

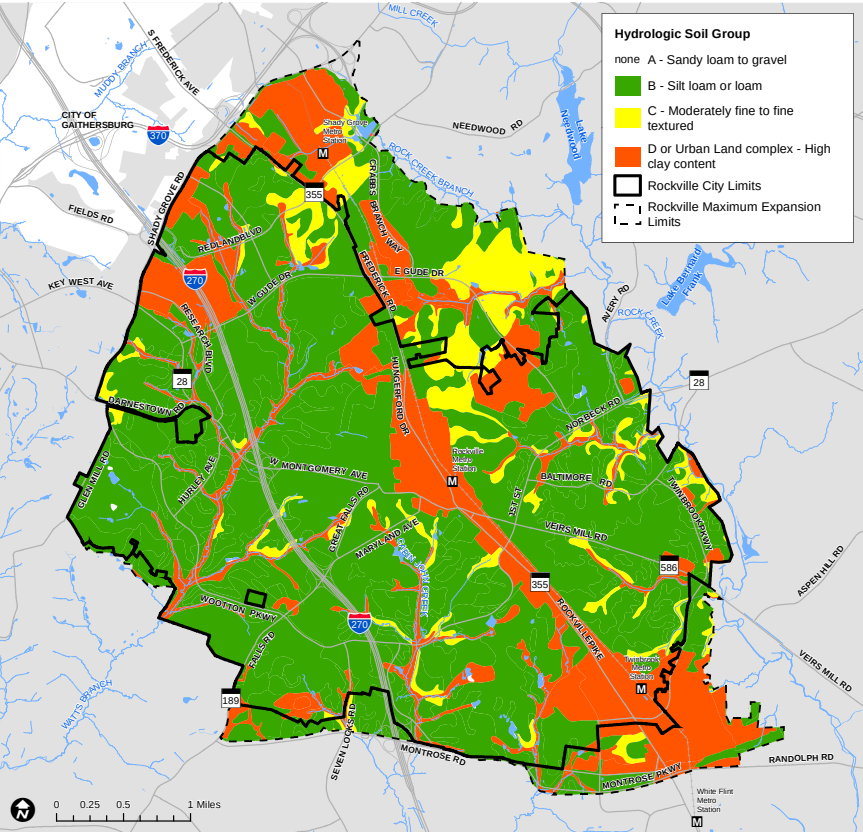


Table 4: Potential Soils of Concern⁷

	City Boundary		Maximum Expansion Limits	
	Acres	%	Acres	%
Total City Area	8,670	100%	2,354	100%
Highly erodible soils	1,557	18%	245	10%
Hydric soils (100% hydric)	226	2.6%	58	2.5%
Predominantly hydric (85% hydric)	388	4.5%	1.5	4.5%
Steep slopes ($\geq 25\%$ grade)	477	5.5%	-	-
Moderate slopes (15% to 25% grade)	181	2.1%	-	-
Dump/Refuse Soil	-	-	125	5.3%

Table 4 lists each of the soil characteristics discussed above as they are understood as potential soils of concern. Figure 4 shows where these soils can be found throughout the city.

⁶ Anaerobic decomposition is a process where microorganisms break down biodegradable material in the absence of oxygen.

⁷ Based on definitions of potential soils of concern from the Web Soil Survey (WSS), operated by the USDA Natural Resources Conservation Service (NRCS)

It should be noted that, while the Class 100 (Dumps/Refuse) soil type is identified in Table 4 as a soil of concern in the Rockville MEL due in large part to its history as the former Gude Landfill, it is highly unlikely that the City of Rockville would annex this area into its municipal borders, thereby assuming responsibility for it.

Understanding soil infiltration, or the ability of soil to absorb water, is also critical for managing stormwater. Soil infiltration rates, which measure the rate at which water enters the soils, play a critical role in the location of stormwater management facilities that are necessary for development and redevelopment.

Table 5: Hydrologic Soil Types

	Infiltration Rate	City Boundary		Maximum Expansion Limits	
		Acres	%	Acres	%
Total City Area	-	8,670	100%	2,354	100%
A - Sandy loam to gravel	High	-	-	-	-
B - Silt loam or loam	Moderate	6,453	74%	1,025	44%
C - Moderately fine to fine textured	Low	459	5%	404	17%
D - High clay content	Very low	1,736	20%	918	39%
Not Rated (water bodies)	n/a	22	0.3%	7	0.3%
Urban land complex (treated as D Group)	Very low	831	10%	631	27%

Soils are classified by the Natural Resource Conservation Service (NRCS) into four Hydrologic Soil Groups (HSG) based on the soil’s runoff potential and infiltration rate. Type A soils are sandy with high infiltration rates and the least runoff potential, Type B and C soils have less infiltration potential, whereas Type D soils have high clay content with the lowest water infiltration potential, therefore generating the greatest amount of stormwater runoff. It is important to note that the NRCS soil survey is a broad tool for assessing infiltration rates and development and impervious surfaces can significantly modify soil characteristics and reduce infiltration rates.

Figure 6 and Table 5 show the extent of hydrologic soil types in the City of Rockville and its Maximum Expansion Limits. The majority of the very-low infiltrating Type D soils are classified as Urban Land Complex soils and are located primarily

along the City’s commercial corridors, where the majority of the city’s future land disturbance would be expected as redevelopment. As a general rule, higher infiltrating Type B soils provide greater performance for Environmental Site Design (ESD), or stormwater management techniques such as bioswales, rain gardens, and porous concrete.

Regulatory Framework and Initiatives

Highly erodible soils, steep slopes and other sensitive lands require careful management to avoid erosion problems, sediment transport to streams and storm sewer systems, unstable conditions, and costly infrastructure. Consequently, the State of Maryland provides standards to mitigate and manage development through forest conservation, sediment control, and stormwater laws. These include:

- Maryland’s Forest Conservation Act (Natural Resources Article Section 5-1601 to 5-1613)
- Maryland’s Erosion Control Law
- Maryland’s Stormwater Management Act

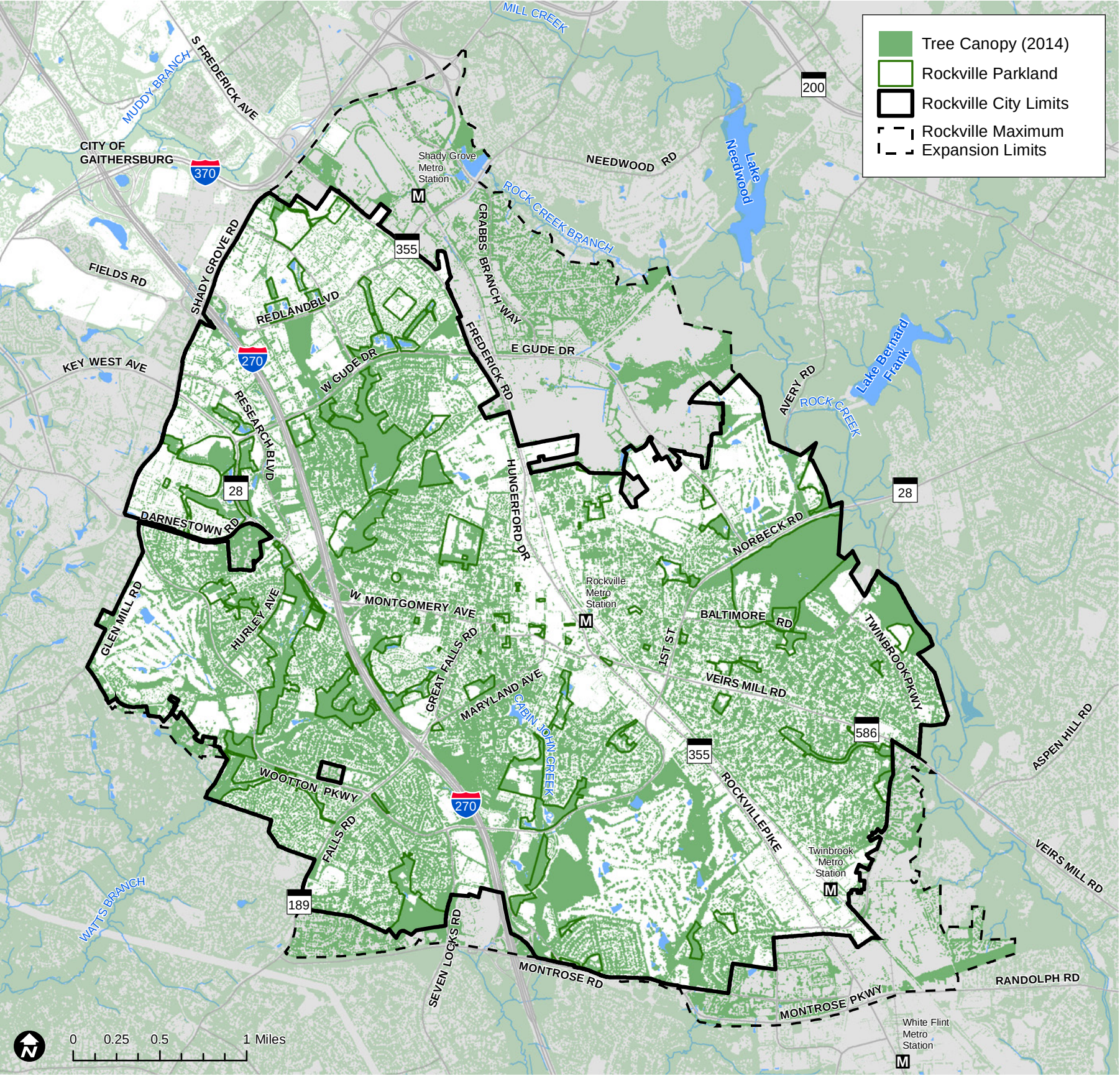
Rockville has adopted several ordinance and guidelines, occasionally with their own distinct definitions, that incorporate measures to protect highly erodible soils, hydric soils, and steep slopes during development.

- Sediment Control & Stormwater Management Ordinance (City Code Chapter 19); adopted 1978, updated 2010 and 2012
- Forest and Tree Protection Ordinance (City Code Chapter 10.5); adopted 1992, amended 2000, 2006, 2007
- Environmental Guidelines; adopted 1999

Forests and Trees Canopy

Forest and tree preservation provides several community benefits, including improving water quality, reducing air pollution, protecting stream banks from erosion, reducing stormwater runoff, cooling ambient temperatures by providing shade, removing greenhouse gases, enhancing property values, and providing wildlife habitat and aesthetic benefits. Tree preservation presents an important example as a natural resource with overlapping community goals. Locations where significant trees are desired to be maintained or added by some offer opportunities for more intensive use of land along commercial corridors or adjacent to transit stations for others.

Figure 7: Tree Canopy and City Parks



Rockville’s urban tree canopy network can be understood as six general categories:

1. Forested parkland, including protected stream valleys;
2. Non-forested parkland (i.e., individual trees and landscaped areas on parkland);
3. Street trees along Rockville’s public right-of-ways, roads, parkways and boulevards;
4. Trees and forest stands on other public property (such as Montgomery County public schools and other property);
5. Trees and forest stands on private property (such as residential and commercial lands, common areas within neighborhoods, stormwater management areas, cemeteries, etc.); and
6. Trees in and around public and privately-owned stormwater management facilities.

Rockville’s Recreation and Parks Department is responsible for the management of the first three categories and implementing the provisions of the Forest and Tree Protection Ordinance that regulates forest and tree removal and requires tree planting on certain development sites in the fourth and fifth category. The sixth category is generally the responsibility of the Public Works Department.

Urban tree canopy (UTC) is a common measure used to assess a community’s urban forestry network.⁸ Existing UTC can be estimated from aerial or satellite imagery and is used to assess current conditions and track progress, as well as establish benchmarks against other communities. In the year 2000, the average UTC within the United States was 27% in urban areas and 33% in metropolitan areas.⁹ American Forests, a non-profit conservation organization, recommends a target of forty (40) percent tree cover for urban areas. In 2013, Maryland established “no net forest loss” policy with a goal to maintain an average of forty (40) percent tree canopy statewide, as well.

Based on analysis from the Maryland Department of Natural Resources (DNR) and University of Vermont Spatial Analysis Laboratory, about 50% of the city’s land area was covered by tree canopy during the summer of 2014, while about 33% (775

acres) of the City’s MEL was covered by tree canopy. This is an increase from the estimated 43% tree canopy in the City of Rockville from an identical study conducted in 2009.¹⁰ Table 6 and Figure 7 summarize tree canopy in the City and MEL as of 2014 while Figure 8 shows areas protected under forest preserves and forest conservation easements that coincide with this tree canopy.

Table 6: Tree Canopy and Forest Protection

	City Limits	
	Acres	%
Total Area	8,670	100%
City-owned parcels	1,094	13%
Forest Preserves	335	4%
Forest Conservation Easements	222	3%
Tree Canopy (2014)	4,301	50%
In City-owned property	759	18%
In Forest Preserves	323	7%
In Forest Conservation Easements	195	5%
All other tree canopy*	3,418	79%
*Subtotals do not add up to 100% since some tree canopy on city-owned parcels may also be counted as Preserve or Easement area		

Forest Preserves are designated areas within City-owned parkland, open space parcels, and wooded areas set aside from disturbance for the promotion of environmental and wildlife preservation and education. A Forest Preserve may comprise an entire park area or just its forested portion. Recognizing that forest areas are one of the most significant natural resources within the City, the Mayor and Council has so far designated twelve (12) Forest Preserves totaling about 335 acres, protecting approximately seven (7) percent of the City’s urban tree canopy. As Figure 8 indicates, the City’s forest preserves are primarily located along stream valleys of the main stem and tributaries of Watts Branch, Rock Creek, and Cabin John.

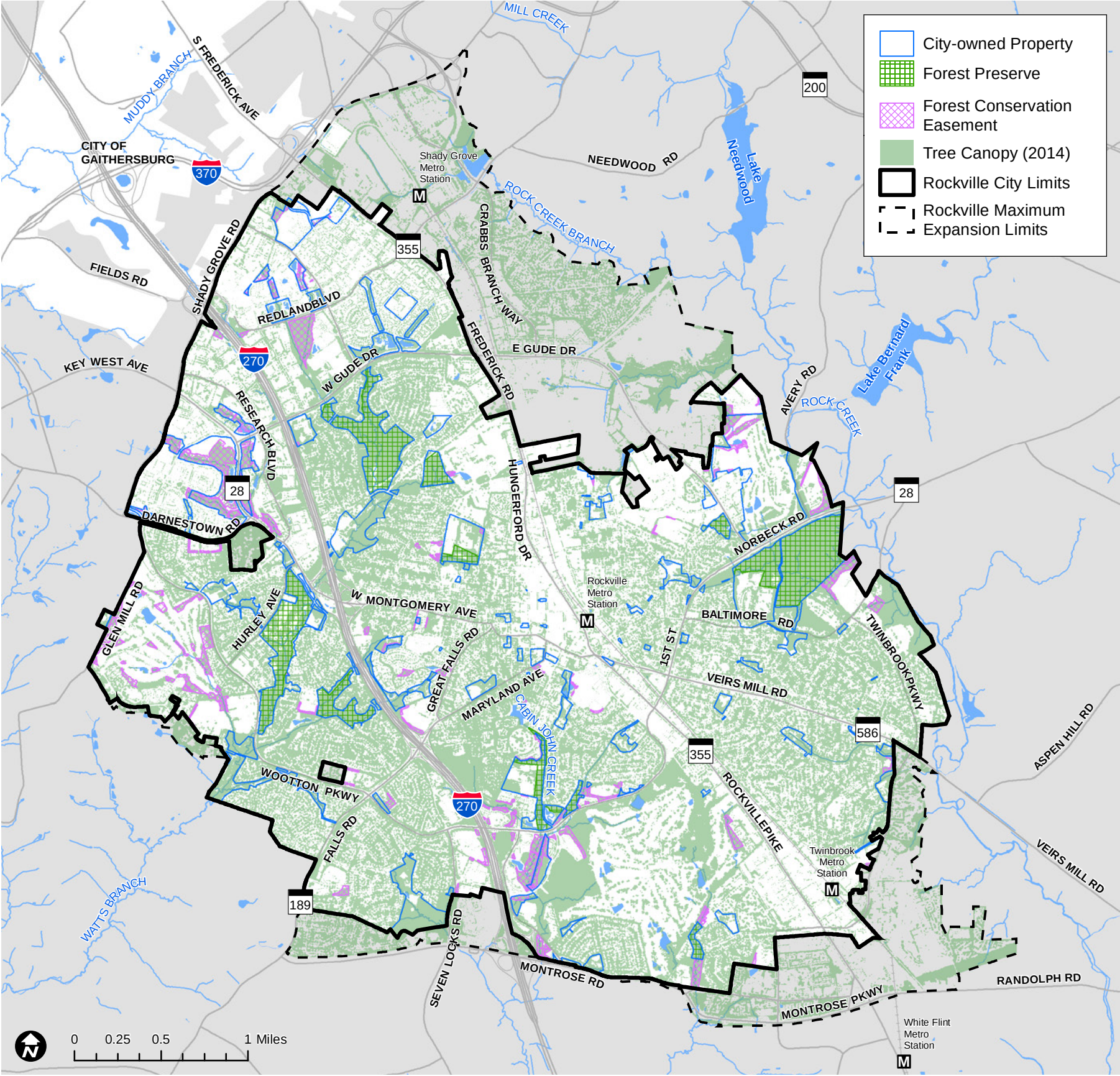
Forest Conservation Easements (FCEs) are an integral part of the City’s forest and tree protection strategy that protect forests and/or trees on private land. Easements are generally created as part of a forest conservation plan required during the development approval process. The City has protected

8 UTC is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above and includes trees in all of the five tree canopy network categories.

9 USDA-Forest Service. Sustaining America’s Urban Trees and Forests. 2010.

10 It should be noted that comparing the 2009 and 2014 tree canopy assessments is inexact since methodology and aerial image quality could account for some of the difference. However, within the 5-year timeframe, natural growth in tree canopy from existing trees would be expected to increase tree canopy despite the losses in individual trees due to damage, disease, development, etc.

Figure 8: Tree Canopy and Forest Protection



approximately 195 acres (or 5 percent) of the City's urban tree canopy under Forest Conservation Easements (see Figure 8). Additionally, many private properties in Rockville contain FCEs for individual trees, which are not reflected in these totals.

Privately owned trees comprise approximately 80 percent of the remaining tree canopy in Rockville. By ownership type, the largest percentage of these trees are found in single-family residential neighborhoods, where tree canopy is unprotected by any laws or easements.

Protecting and restoring tree canopy coverage along riparian buffers¹¹ (e.g., along streams and ponds) is a priority for improving water quality, protecting stream health, and providing wildlife habitat. In 1999, Rockville's Environmental Guidelines established special protection for riparian stream buffers that are dependent on the percent of slope and other environmental features. Stream buffer provisions are set out in the City's Water Quality Protection Ordinance (City Code Chapter 23.5) and the City's watershed studies and management plans identify more specific stream reach locations with potential riparian buffer enhancement opportunities. Tree removal is also regulated in the City of Rockville within Local Historic Districts and along known street tree corridors.

Regulatory Framework and Initiatives

The Maryland Department of Natural Resources Forest Service focuses on restoring, managing and protecting Maryland's forests and forested ecosystems. Maryland has a robust suite of laws for protecting forests, from the Forest Conservation Act, Sustainable Forestry Act of 2009, the Forest Preservation Act of 2013, to local government comprehensive plan requirements.

- Maryland's Forest Conservation Act (Natural Resources Article Section 5-1601 to 5-1613)
- Maryland's Roadside Tree Law
- Maryland's Sustainable Forestry Act of 2009
- The Forest Preservation Act of 2013
- The Chesapeake Bay Program

¹¹ Riparian or stream buffers include land 125 feet from stream centerlines (or bank edges where available), wetlands, 25-foot wetland buffers, 40-foot wetland buffers for wetlands adjacent to 1st and 2nd order streams, steep slopes of greater than 25% within 100 feet of wetlands.

Tree preservation programs play a critical part in many facets of environmental protection including stream bank protection, erosion control, climate control, and enhancing wildlife habitat and aesthetics. The City has adopted a number of policy documents related to the protection and enhancement of Rockville's forests and trees, including, but not limited to:

- Forest and Tree Preservation Ordinance (City Code Chapter 10.5); adopted 1992, amended 2000, 2006, 2007
- Street Tree Master Plan
- Rainscape Rewards Program
- Environmental Guidelines; adopted 1999
- Landscape, Screening and Development Manual; adopted 2008, amended 2009, 2015
- Review of tree removals in Local Historic Districts

Wildlife Habitat

Although Maryland harbors a rich variety of plants, fish and wildlife, the populations of many species in the state have declined in recent years. Maintaining healthy species diversity and abundance provides a variety of benefits, and Maryland's plant, fish and wildlife resources face a number of serious threats, including human population growth, development, point and non-point source pollution, rising sea levels, habitat loss and fragmentation, and a proliferation of invasive species that may adversely affect native species.

Rockville is home to a wide array of wildlife common to urban areas, including white-tailed deer, beaver, Canada geese, raccoon, red fox, Virginia opossum, skunk, eastern cottontail rabbit, eastern gray squirrel, brown bat, and assorted bird species. Widespread habitat modifications and the lack of natural predators have created challenges with white tailed deer, beaver, Canada geese, and coyote populations. For example, overabundance of white-tailed deer have resulted in an increase in deer-auto collisions, adverse impacts to forest ecosystems, and damage to gardens and landscaping. Beaver activity has increased in stream valleys, leading to tree damage, altered stream channels, and damage and repairs to stormwater management infrastructure. Canada geese also present problems with territorial behavior, goose droppings harboring bacteria, and a decline in water quality. Monitoring and regional management of these species requires coordination with other interested State, County and third party organizations.

Figure 9: Forest Interior Dwelling Species Habitat

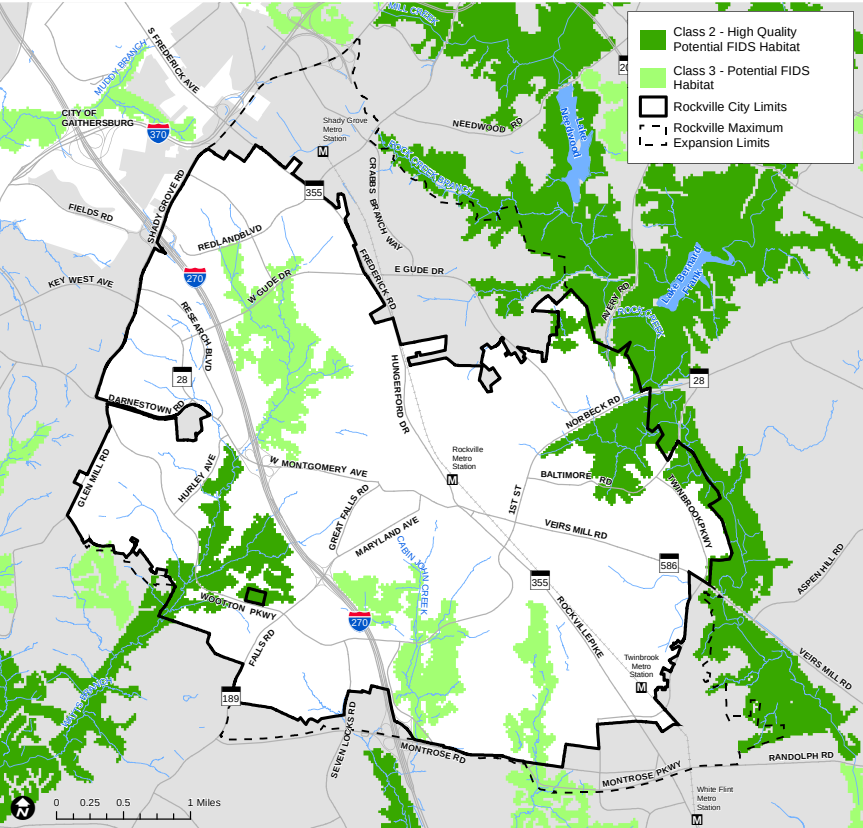


Figure 10: Maryland GreenPrint Hubs and Corridors

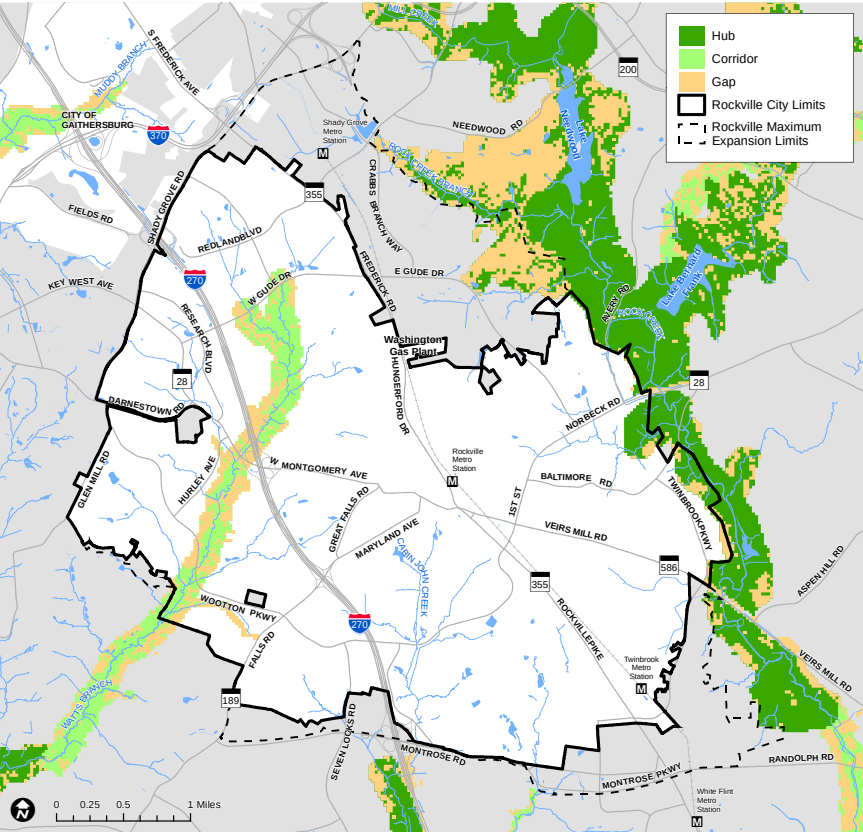


Table 7: Potential Rare, Threatened or Endangered Species

Scientific Name: *Cistothorus platensis*
Common Name: Sedge Wren
State Status: Endangered
Last Observation Date: 1991
Habitat Type: Marshes, wet meadow, sedge meadow
Photo Credit: Ian Davies, Cornell Lab of Ornithology



Scientific Name: *Goodyera tessellata*
Common Name: Tesselated Rattlesnake Plantain
State Status: Endangered/Extirpated
Habitat Type: Dry to moist woods
Last Observation Date: 1942
Photo Credit: Jacqueline Donnelly



Scientific Name: *Platanthera peramoena*
Common Name: Purple Fringeless Orchid
State Status: Threatened
Habitat Type: Moist soil and swampy woods
Last Observation Date: 1928
Photo Credit: Robert H. Mohlenbrock, hosted by the USDA-NRCS PLANTS Database



Scientific Name: *Calystegia spithamea*
Common Name: Low False Bindweed
State Status: Rare
Habitat Type: Dry, sandy or rocky woods and fields
Last Observation Date: 1951
Photo Credit: Janice Stiefel, UW-System WisFlora. 2015



Scientific Name: *Mustela nivalis*
Common Name: Least Weasel
State Status: In Need of Conservation
Habitat Type: Open woods, fields, marshes
Last Observation Date: 1974
Photo Credit: Minnesota DNR



Maryland's Wildlife Conservation Plan recognizes wildlife species in greatest conservation need (GCN) and their key habitats. GCN Species include rare, threatened and endangered species (RTE), as well as many other species whose populations are of concern in the State. Habitats of RTE plant, fish and animal species are determined and listed by the Maryland Department of Natural Resources (DNR) Wildlife and Heritage Service. While Rockville is a largely urbanized area with few remaining tracts of undeveloped land, DNR's 2014 review of the Wildlife and Heritage Service's Natural Heritage database identified potential habitats in Rockville for five species currently listed as rare, threatened or endangered plant and animal species (Table 7).

Maryland DNR advises that some forested areas in Rockville and its maximum expansion limits (MEL) could contain potential Forest Interior Dwelling Species (FIDS) habitat. Forest interior dwelling species, particularly birds, require significant forest interior habitat to survive.¹² These species are extremely vulnerable to the fragmentation of woodland areas. Consequently, special protection measures are needed to ensure the quantity and quality of their habitat. The conservation of this habitat is strongly encouraged by DNR. Figure 9 shows potential FIDS habitat in Rockville.

Maryland's Green Infrastructure Assessment ('GreenPrint') areas are derived from a tool that identifies and prioritizes those areas of greatest statewide ecological importance, as well as those at greatest risk of loss to development. The tool defines large contiguous blocks of natural land (Hubs) and smaller natural areas connecting them (Corridors) that allow animal and plant dispersal and migration. The tool also identifies human-disturbed areas (Gaps) within these hubs and corridors as prioritized areas for restoration efforts. Most of Rockville's ecological hubs and corridors follow stream corridors that are connected to larger regional parks and watershed networks, such as Rock Creek, Watts Branch and Cabin John (see Figure 10). As Table 8 indicates, of the 653 acres of 'hubs' and 'corridors' within the City of Rockville, there are approximately 242 acres of 'gaps' in Rockville that could be evaluated for restoration potential. Potential habitat areas within the City's maximum expansion limits are primarily located in a portion of Rock Creek Park situated northeast of East Gude Drive.

¹² Forest interior is defined as existing forest with trees larger than 5-inch diameter at breast height and at least 100 acres in size, with high area to edge ratio and a forested buffer of at least 300 feet width around the entire interior.

While the exact locations of species designated as RTE and FIDS are not reported within the City of Rockville, DNR has implemented several studies and analyses to identify potential ecological priority areas for land conservation across the state that represent potential habitat areas for such species. Figure 11 displays the potential priority habitat areas defined by the combination of FIDS habitat area and the state's GreenPrint tool, described above, and identifies those areas protected through public ownership or forest conservation easements. Gaps where habitat areas are not protected may be evaluated in the future for priority protection and restoration areas.

Combining the areas discussed above, about 2,000 acres, or nearly one-quarter of the city, could be considered Potential Priority Wildlife Habitat. Just under 700 acres of that area (or 35%) is currently under some sort of habitat protection (e.g., conservation easement, forest preserve, floodplain, wetland, etc.) with about 1,300 of the remaining acres (or 65%) unprotected. Table 8 summarizes these potential priority, protected and unprotected wildlife lands and their constituent parts.

Regulatory Framework and Initiatives

The Federal Endangered Species Act (ESA) defines programs for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agency for implementing ESA is the U.S. Fish and Wildlife Service (FWS). The FWS maintains a worldwide list of endangered species. The law requires federal agencies, in consultation with the U.S. Fish and Wildlife Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species.

The primary State law that allows and governs the listing of endangered species is the Nongame and Endangered Species Conservation Act (Annotated Code of Maryland 10-2A-01). This Act is supported by regulations (Code of Maryland Regulations [COMAR] 08.03.08) which contain the official State Threatened and Endangered Species list. State status is the legal protection status of a species as determined by the Maryland Department of Natural Resources.

While Rockville does not have regulations solely focused on wildlife preservation, several regulations and programs include measures that protect and enhance wildlife habitat.

- Community Wildlife Habitat program
- Croydon Creek Nature Center education and outreach programs and activities
- Environmental Guidelines; adopted 1999
- Parks and Open Space (PROS) Plan; approved 2009
- Forest and Tree Protection Ordinance (City Code Chapter 10.5); adopted 1992, amended 2000, 2006, 2007
- RainScapes Rewards program; initiated 2009

Table 8: Potential Wildlife Habitat

	City Boundary		Maximum Expansion Limit	
	Acres	%	Acres	%
Total Area	8,670	100%	2,354	100%
Potential Priority Wildlife Habitat Areas				
Total Area	2,006	23%	475	20%
Forest Interior Dwelling Species (FIDS) Habitat				
Total FIDS Habitat area	1,406	16%	210	9%
Class 1	0	-	0	-
Class 2	610	7%	175	7%
Class 3	796	9%	35	2%
FIDS habitat protected by Forest Easement or Forest Preserve	384	27%	0	-
'Unprotected' FIDS habitat	1,022	73%	132	62%
Maryland GreenPrint Areas				
Hub	126	15%	188	8%
Corridor	527	6%	0.4	0%
Gap*	242	3%	133	6%
Other Environmentally Sensitive Areas				
Stream Buffers**	986	11%	220	9%
Floodplains	246	3%	63	3%
Wetlands	106	1%	8	0.3%
Protected Potential Priority Wildlife Habitat Areas				
Total Area***	695	35%	171	36%
In Private Forest Conservation Easement	140	2%	0	-
In Public Stream Valley Parks, Open Space and Forest Preserves	325	4%	171	7%
Unprotected Potential Priority Wildlife Habitat Areas				
Total Area***	1,311	65%	304	64%
* Gaps in the Maryland Greenprint Areas are inclusive of Hub and Corridor calculated area ** Stream buffer area includes 125 feet from stream centerline (or bank edges where available), wetlands, 25-foot wetland buffers, 40-foot wetland buffers for wetlands adjacent to 1st and 2nd order streams, steep slopes of greater than 25% within 100 feet of wetlands, erodible soils within 100 feet of wetlands and 100-year floodplains. *** Total Area percentage calculated based on total Potential Priority Wildlife Habitat Areas				

- Wildlife management policies (e.g., White-Tailed Deer Task Force, Beaver Control Policy, and the Coyotes in Rockville Policy)

Environmental Hazards

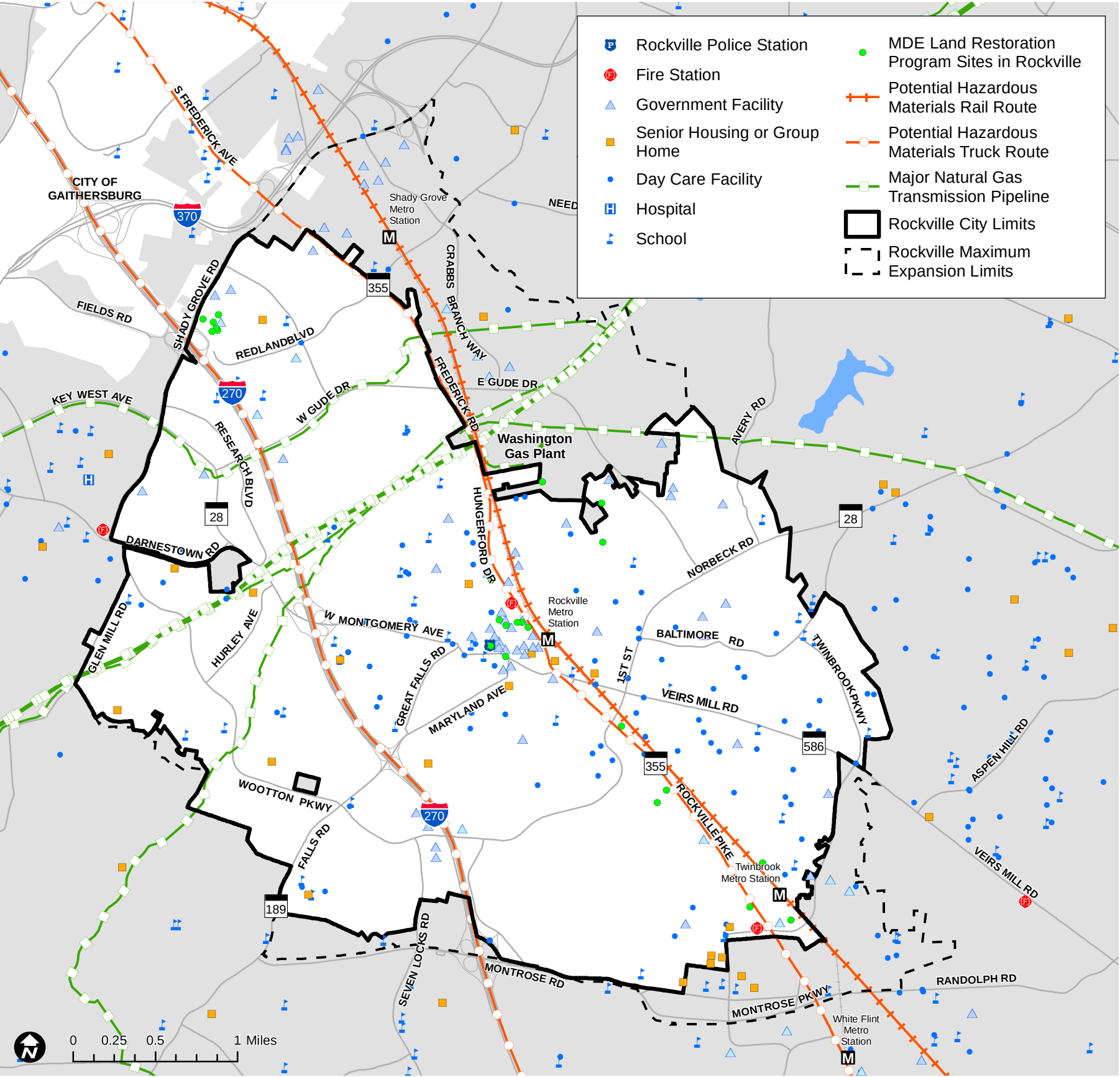
Environmental hazards are events or physical conditions that have the potential to cause fatalities, injuries, property damage, infrastructure damage, damage to the environment, interruption of business, or other types of harm or loss. Understanding environmental hazards in Rockville requires attention to technological hazards, such as hazardous material storage, transportation and disposal, landfill contamination, and dam and levee failures, as well as natural hazards, such as extreme weather events, fire, flooding, water shortages/droughts, and earthquakes. This section draws heavily from the 2013 Montgomery County Multi-Jurisdictional Hazard Mitigation Plan due to the regional nature of the content.

Hazardous Waste When uncontrolled hazardous waste, or its resulting contamination, is found on a site the State of Maryland Department of the Environment (MDE) is responsible for the investigation, assessment, and cleanup of these sites through their Land Restoration Program (LRP). Sites known or reported to be contaminated by hazardous waste are listed on the State's Brownfield Master Inventory. Property owners of sites with hazardous waste can apply to participate in the State's Voluntary Cleanup Program (VCP), which encourages voluntary cleanup and redevelopment of contaminated properties through a streamlined cleanup process that enables eligible purchasers of property to limit liability for past contamination before purchasing property. a few sites on the State's Brownfield Master Inventory are located within the City of Rockville (see Figure 12). Most of these sites are a participant in the state's Voluntary Cleanup Program.

At the Federal level, the Environmental Protection Agency's Superfund program is responsible for cleaning up the nation's most contaminated land and responding to environmental emergencies, oil spills and natural disasters. There are no Superfund sites located within the City of Rockville.

Hazardous material incidents are typically accidental events that arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. The U.S. Environmental Protection Agency's Toxic Release

Figure 12: Hazardous Waste and Vulnerable Facilities



Inventory (TRI) program, tracks hazardous materials release and disposal data for U.S. counties and states. Since 1994, there have been no significant TRI-reported releases in Montgomery County.

Montgomery County’s 2013 Hazard Mitigation Plan conducted a Hazardous Materials Commodity Flow Survey to assist the County and the Local Emergency Planning Committee in understanding what hazardous commodities are shipped near or through the County. Results of the Survey identified potential risk areas (PRAs) for known and perceived problem areas and the overall critical infrastructure within Montgomery County. The most common types of hazardous materials identified during the Survey included corrosive materials (acids and bases), hazardous gases (carbon dioxide, methane and ammonia), and flammable substances in liquid or gas form (gasoline and diesel fuel, pesticides, cleaning agents, and various paint solvents).

Several of the roads and transportation routes deemed a PRA in Montgomery County travel through the City of Rockville: Interstate 270, Maryland State Route 355 and the CSX Mainline (see Figure 12). Interstate 270 was noted as a thoroughfare actively used to transport hazardous materials. Maryland State Road 355 is a major roadway in the County and the greater Washington D.C. metropolitan region that provides access to neighboring jurisdictions as well as to industrial parks within the County. The CSX Mainline through Rockville is the only railway operating within Montgomery County that has been deemed a PRA due to the lack of information regarding the precise amount of hazardous materials transported.

Several gas pipelines and the Washington Gas-Rockville Station, located at 7301 Westmore Road, traverse the city and are critical to the natural gas distribution system. They are shown in Figure 12 and are considered potential risk areas (PRAs).

Also as part of the Hazardous Materials Commodity Flow Survey, the County identified places and points along the major traffic routes that are at a higher level of risk in the event of an accident. These vulnerable facilities are shown in Figure 12 and include schools, day/childcare centers, senior housing, community centers, medical facilities, dense population centers, and public gathering points. Additional points of interest are emergency response facility locations,

including fire stations, emergency medical facilities, and police stations since, if an incident occurred, there would play a pivotal role in the evacuation and support of these vulnerable facilities.

In addition to technological hazards, Rockville faces natural environmental hazards, as well. The following sections summarize some of these and their relationships to the Rockville community and its vulnerable populations.

In order to understand extreme weather events in Rockville, it is useful to review the federal disasters and emergency declarations that have occurred in Montgomery County in the recent past. Table 9 presents the foundation for identifying what hazards pose the greatest risk in the City in the future; hurricanes and winter storms are the predominant weather-based hazards over the last half century.

Table 9: Presidential Disasters and Emergency Declarations in Montgomery County

Declaration	Declaration Date	Event Details
FEMA-EM-3349	October 28, 2012	Hurricane Sandy
FEMA-DR-4075	August 2, 2012	Severe Storms, Winds
FEMA-EM-3335	August 27, 2011	Hurricane Irene
FEMA-DR-1910	May 6, 2010	Winter Storm
FEMA-DR-1875	February 19, 2010	Winter Storm
FEMA-DR-1652	July 2, 2006	Tornadoes, Flooding
FEMA-EM-3251	September 13, 2005	Hurricane Katrina
FEMA-DR-1492	September 13, 2003	Hurricane Isabel
FEMA-EM-3179	March 14, 2003	Snow Storm
FEMA-DR-1324	April 10, 2000	Winter Storm
FEMA-DR-1081	January 11, 1996	Blizzard
FEMA-EM-3100	March 16, 1993	Winter Storm
FEMA-DR-839	August 28, 1989	Severe Storms, Winds
FEMA-DR-524	January 26, 1977	Ice conditions
FEMA-DR-489	October 4, 1975	Flooding
FEMA-DR-341	June 23, 1972	Tropical Storm Agnes
FEMA-DR-309	August 17, 1971	Flooding
FEMA-DR-127	March 9, 1962	Severe Storms, Flooding

Figure 13: Weather hazards in Rockville



Credit: WTOP/Dave Dildine

Credit: City of Rockville



Credit: Gaithersburg Town Courier

Credit: Capital Weather Gang

Severe Storms Aside from official Federal disasters, the most frequent extreme weather events in Rockville are severe storms. Thunderstorms, associated with strong winds, heavy precipitation, and lightning strikes can all be hazardous under the ‘right’ conditions and locations. Hail and tornadoes can also accompany severe thunderstorms, introducing additional hazards beyond the typical passing thunderstorm. Based on past occurrences in the Rockville region, hail sizes greater than 2 inches in diameter are possible and should be accounted for in future planning efforts, according to the 2013 Montgomery County Hazard Mitigation Plan.

Winter Storms Rockville is also subject to severe winter storms, which have the potential to become hazards as a result of cold temperatures, heavy snow or ice and sometimes strong winds. Severe winter storm hazards can cause a range of adverse effects to roadways, utilities, business activities and can cause loss of life, frostbite and freezing conditions. Rockville’s elderly and homeless populations are particularly vulnerable to the impacts of winter storms. The environmental impacts of winter storms often include damage to shrubbery and trees due to heavy snow loading, ice build-up, and/or high winds, which can break limbs or even bring down large trees on structures, power lines or public streets.

Wind Non-tornadic, thunderstorm and non-thunderstorm winds over 100 mph should also be considered a hazard to the community of Rockville. These types of winds can remove roofs, topple trees, take down utility lines, and destroy poorly-built or weak structures. FEMA places the Rockville region in Zone II (155 MPH) for structural wind design.

Extreme Heat Extreme heat is the number-one weather-related killer in the United States, resulting in hundreds of fatalities each year. Rockville’s predominantly urban built environment makes it particularly susceptible to excessive heat due to the urban heat island effect. According to the 2013 Montgomery County Hazard Mitigation Plan, the County has experienced thirteen (13) extreme heat events since 1983. During the summer of 2011, cooling centers were established to provide residents of Rockville refuge from the excessive heat.

Wildfire Since Rockville is a largely urbanized community, the threat of widespread wildfire is relatively low within the City itself. However, large, vegetated open spaces susceptible to wildfires are present within the City limits and surrounding unincorporated areas of Montgomery County. Wildfire season in Montgomery County commences in early spring through late fall every year during the hotter, dryer months. The Montgomery County Hazard Mitigation Plan lists four (4) wildfire occurrences in the Rockville vicinity between 2005 to 2011, three (3) at Lake Needwood Park and one (1) near the intersection of Montrose Road and Seven Locks Road, south of the City’s Potomac Woods Park.

Floods Floods are considered hazards when people and property are affected by heavy rain storms or high tides. According to the Montgomery County Hazard Mitigation Plan, no buildings are estimated to be moderately damaged or completely destroyed under a 100-year flood scenario within the City of Rockville. Thirty-five (35) critical facilities are considered flood prone within the City limits, though none are anticipated to experience total loss of use or even moderate damage due to such an event. For more details on designated floodplain areas in the City of Rockville, refer to the Floodplains and Dams section in this document.

Tornadoes While relatively short-lived, tornadoes are intensely focused and are one of nature’s most violent storms. Tornadoes can occur at any point in the day or

night, but are most frequent during the late afternoon into early evening, the warmest hours of the day, and most likely occur during the spring and early summer months of March through June, often in conjunction with other hazards such as thunderstorms, hail and lightning. According to the Montgomery County Hazard Mitigation Plan, nearly 70 percent of the deaths from tornadoes happen to people located in residential structures. However, of the 22 tornadoes reported by the Tornado History Project in Montgomery County since 1952, no fatalities and only three (3) injuries have occurred as a result of a tornado.

Tropical Cyclones Tropical cyclones, a general term for tropical storms and hurricanes, are low pressure systems that usually form over the tropics. Tropical cyclones are among the most powerful and destructive meteorological systems on earth. Their destructive traits include very high winds, heavy rain, lightning, tornadoes, and storm surge. September is typically the most active month for tropical cyclones in Maryland. Since Rockville is not a coastal community subject to tidal influence, the main hazards tropical cyclones pose to the community are impacts to structures, utilities, and roads from high winds, heavy rain, and lightning after a storm makes land fall. The Montgomery County Hazard Mitigation Plan identifies ten (10) hurricanes or tropical storm tracks that have passed directly through the County since 1955. Due to their large impact area, it is likely that the City of Rockville was impacted in some way from each of these storms and will be from future storms.

Drought The Maryland Department of the Environment applies the U.S. Army Corp of Engineers' definition of drought, which states, "droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow." The most significant impacts associated with drought include wildfire protection, municipal usage, commerce, tourism, recreation, wildlife preservation, and water quality deterioration.

There is no commonly accepted method for defining the risk from drought (such as with a 100-year or 1% annual chance of flood), however, the 2011 Maryland State Hazard Mitigation Plan provides annualized event figures for drought for the State's counties, based on drought events between 1995 and 2010. Montgomery County's annualized event figure was calculated to be 0.88, which correlates to the consistent

occurrence of droughts every two to five years. Future droughts can also be expected due to more frequent extreme heat events as a result of a warming climate.

Compromised Drinking Water Since 1958, Rockville has obtained its drinking water directly from Potomac River withdrawals; groundwater is not generally used to supplement the City's water supply. The City holds a State allocation to withdraw up to 12.1 million gallons of Potomac River water each day. Since the river is the primary water supply for the metropolitan Washington D.C. region, it is extensively monitored for quality and quantity by water utilities including Rockville and the Washington Suburban Sanitary Commission, the U.S. Geological Survey, the Interstate Commission on the Potomac River Basin, the Metropolitan Washington Council of Governments, and the Army Corps of Engineers. If needed, river flow can be augmented by several storage reservoirs located upriver from the City's Potomac River intake facility.

Earthquakes On Tuesday, August 23, 2011, a 5.8 magnitude earthquake occurred 84 miles southwest of Washington, D.C. While earthquakes occur infrequently in the region, they can have devastating impacts. Ground shaking can lead to the collapse of buildings and bridges and disrupt gas, electric, and phone service. Deaths, injuries, and extensive property damage are also possible vulnerabilities. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, and dam failure.

Regulatory Framework and Initiatives

There are numerous existing regulatory and planning mechanisms in place at the Federal, State, County, and municipal levels of government which support hazard mitigation planning efforts. These tools include the State of Maryland Hazard Mitigation Plan, Rockville floodplain management ordinances, the Montgomery County Emergency Operation Plans, and other local ordinances. The Federal Disaster Mitigation Act of 2000 guides many of these efforts and as administered through the Federal Emergency Management Agency. Montgomery County's ECOWISE program assists Rockville as well as businesses and nonprofits in the County generating less than 220 pounds of hazardous waste per month with an inexpensive and convenience way of disposing of hazardous material.

The City of Rockville was a participant in the 2007 and 2013 Montgomery County Hazard Mitigation Plan process, which included sharing data, assisting in the determination of hazards and mitigation approaches, and adopting local mitigation action plans specific to the city. The City has instituted the following planning and regulatory tools recommended under the County Hazard Mitigation Plan:

- Hazard Mitigation Plan (Police)
- Emergency Operations Plan (Police, Public Works)
- Continuity of Operations Plan (Police)
- Debris Management Plan (Police, Public Works, Recreation and Parks)
- Disaster Recovery Plan (Police)
- Comprehensive Land Use Plan (Planning)
- Floodplain Management Plan (Public Works)
- Open Space Management Plan (Recreation and Parks)
- Stormwater Management Plan (Public Works)
- Natural Resource Protection Plan (Recreation and Parks)
- Flood Response Plan (Public Works)
- Capital Improvement Plan (Finance)
- Economic Development Plan (Planning)
- Historic Preservation Plan (Planning)
- Floodplain Regulations (Public Works, Planning)
- Zoning Regulations (Planning)
- Subdivision Regulations (Planning)
- Unified Development Ordinance (Planning)
- Building Code (Inspection Services)
- Fire Code (Fire Marshal)

Air Quality

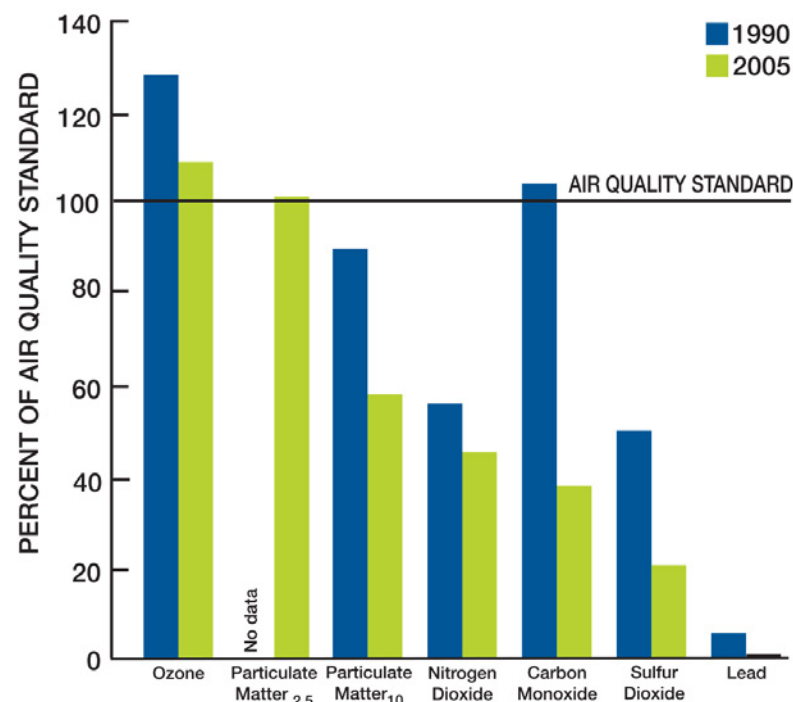
The Washington region's air quality has improved since 1990. However, as Figure 14 indicates, the region remains in nonattainment for the eight-hour ground-level ozone (O₃) and fine particulate matter (PM_{2.5}) standards; meaning that the concentration of these criteria pollutants exceed Federal health standards.

While ozone in the upper atmosphere shields the Earth from harmful ultraviolet rays, ground-level ozone is a harmful pollutant and the primary constituent of smog. Unhealthy

¹³ PM_{2.5} refers to a complex mixture of fine particles, 2.5 micrometers in diameter or smaller, that includes nitrates, sulfates, organic chemicals, metals, soil, dust, ash and liquid droplets. Sources include fuel burning, industry, incinerators and motor vehicles. PM_{2.5} can penetrate into the lungs and blood stream, causing serious health problems.

ozone levels typically occur during the summer and can harm respiratory systems. Ground-level ozone is not directly emitted; instead, it is generated when heat and sunlight react with volatile organic compounds (VOCs) and nitrogen oxides (NO_x). VOCs are generated by motor vehicles, gas stations, solvents, oil-based paints, engine degreasers, aerosol products and many other cleaning products. NO_x are generated by industrial operations, motor vehicles, lawn equipment and power plants that burn fossil fuels.

Figure 14: Air Quality in the Washington Region

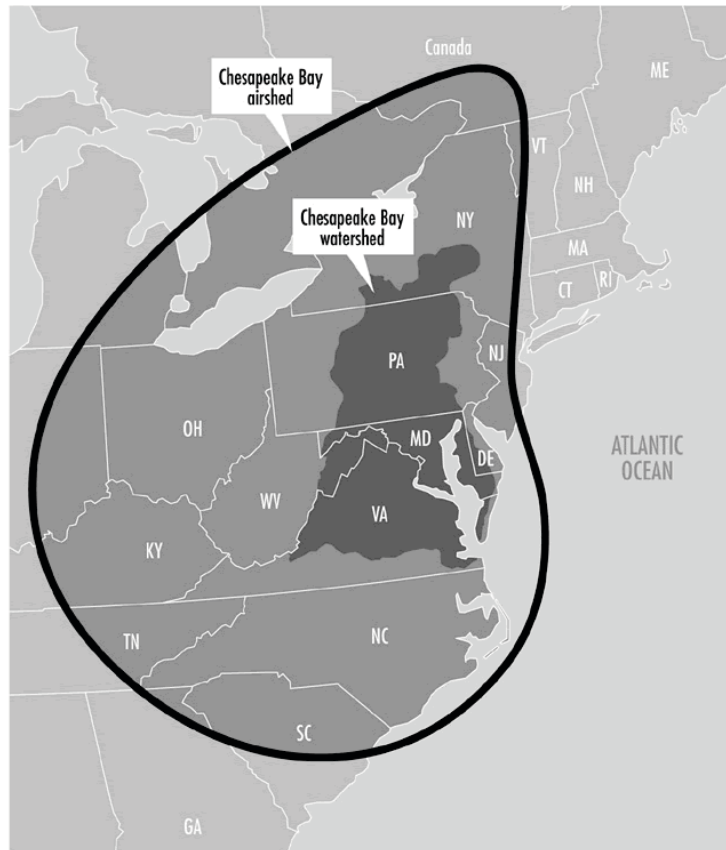


Ozone precursors and particulate matter pollutants are not only generated in the Washington region, but are also compounded by air pollution transported in the airshed by prevailing winds from western and southern states. Analogous to a watershed, an airshed is a geographical boundary that shares the same air supply and is influenced by topography, weather, and emissions from urban development and other human activities.

The Chesapeake Bay airshed extends well beyond the boundaries of its watershed, as illustrated in Figure 15. Significant pollution sources originate from the west (primarily power plants) and the south (motor vehicles and stationary sources). The Maryland Department of the Environment estimates that over half of Maryland's ozone pollution originates from these upwind States in the airshed.

For this reason, a combination of local, regional and national pollution controls is essential for improving air quality.

Figure 15: Chesapeake Bay Airshed



- Montgomery County's Air Quality Protection Strategy and Air Quality Control requirements (Chapter 3 of the Montgomery County Code)

While Montgomery County rather than Rockville directly regulates air quality, the City participates in several regional initiatives that support Federal, State and regional measures to reduce emissions and improve air quality:

- Transportation and Planning Policies
- Building and Energy Policies and Programs
- The Clean Air Partners Program administered by the Metropolitan Washington Council of Governments (MWCOC)
- Rockville's Single Stream Residential Recycling and Mandatory Commercial and Multifamily Recycling Programs
- Integrated Pest Management (IPM) Practices
- City Fleet Management
- City Urban Forestry and Green Building Practices

Regulatory Framework and Initiatives

Air quality is managed under a variety of Federal, State, regional and local government initiatives. Over one hundred different State and Federal control measures have been or will be adopted to achieve cleaner air in the Washington region.

There are several important air quality management programs applicable to Rockville:

- National Ambient Air Quality Standards (NAAQS)
- U.S. Environmental Protection Agency's Green Power Community Challenge
- The Interstate Air Quality Council (IAQC)
- The Maryland Department of the Environment (MDE) air quality regulations under Code of Maryland 26.11 and the Maryland Healthy Air Act
- The Metropolitan Washington Air Quality Committee (MWAQC) State Implementation Plan for PM2.5

Implications for the Master Plan

The following section discusses the implications of Rockville's current environmental conditions that can inform the City's Comprehensive Master Plan update and its broader safety and sustainability. In some cases, the City is already responding to these challenges with appropriate policies and actions; in others, more attention is needed. Many of the items listed here would require coordination among City departments and outside agencies, as well as support from the Rockville public.

Watersheds and Water Quality

As a largely urbanized environment, the City of Rockville's water quality is largely dependent on the ability of its built environment to manage stormwater as it flows over impervious surfaces and runs through its streams and waterways. Due to the development that has occurred over Rockville's history, the City's waterways are impaired to varying degrees due to the presence of pollution in its stormwater runoff. Consequently, stormwater facilities are now a critical element in Rockville's environment that helps support the natural streams and ponds that once served this function alone. Since open land no longer exists within the City of Rockville that would support a major expansion of large stormwater treatment ponds without significant financial investment or environmental impact, alternative stormwater treatments methods should be considered.

Throughout the Chesapeake Bay, stormwater treatment standards (e.g., MS4 permits) are moving toward holding municipalities to ever higher levels of watershed protection. The City's already-extensive efforts will need to expand to balance the effects of urban development with more effective watershed improvements. Also emphasized throughout multiple City planning documents are the goals to reduce impervious area, protect contiguous green space, provide high quality recreation opportunities, enhance tree canopy, and improve multi-modal transportation accessibility and connectivity. The City's watershed management program must balance these competing interests to achieve a net benefit for the community.

Future watershed and water quality challenges and opportunities include the following:

- Seek to balance competing City objectives to improve watershed protection, preserve tree canopy, provide recreation opportunities, and improve the safety and efficiency of transportation networks.
- Identify opportunities and strategies to expand the City's green/open space network to preserve, protect and enhance important ecological areas (wetlands, floodplains, streams, buffers, etc.).
- Identify untreated impervious areas in Rockville by mapping stormwater management facilities and their associated drainage areas.
- Study how redevelopment projects impact impervious surfaces to determine their impacts over time.
- Target commercial, industrial, municipal, and transportation pollution "hotspots" that may contribute pollutants such as nutrients, pesticides, road salt, trace metals, sediment, fuels, and toxic chemicals.
- Develop selection criteria for identifying City property appropriate for alternative stormwater treatment techniques (or ESD), such as 'green streets' candidates, stream restoration and stormwater management CIP projects, and sanitary sewer preventative maintenance.
- Engage with other public agencies, such as Maryland State Highway Administration and Montgomery County, on interconnected stormwater management and storm drain system maintenance and retrofit issues.
- Coordinate with Federal, State, MWCOG and regional partners to incorporate climate change projections and adaptation needs in plans for improved stream and watershed health.

Floodplains and Dams

Adequate floodplain protection and restoration in Rockville is critical to provide temporary storage for floodwaters, moderate peak flood flow, maintain water quality, recharge groundwater, prevent erosion, provide wildlife habitat, offer recreational opportunities, and foster aesthetic quality.

Future floodplain challenges and opportunities include the following:

- Consider amending the Rockville Floodplain Ordinance to incorporate updated FEMA flood zone mapping, updated State floodplain compliance provisions, and other flood protection best practices.
- Coordinate with federal, State, MWCOG and regional partners to incorporate climate change projections and adaptation needs in plans to protect from flooding and dam overflow hazards.

Soils and Steep Slopes

Soil erosion and sedimentation can be reduced when soil, vegetative, topographic, and climatic factors are considered during the planning stage of development. Continuing to limit development in sensitive areas, maintaining vegetative cover, and incorporating best-management practices for sediment and erosion control and stormwater management can minimize the effects of erosion and sediment loading.

As the City continues to see urban infill and redevelopment in its commercial corridors, introduction of permeable land cover and integrated stormwater development techniques will help to improve the city's water quality and its impacts downstream.

Other future challenges and opportunities related to soils and steep slopes include the following:

- Update ordinances and guidelines for consistency in definitions and requirements, to incorporate current scientific data, and streamline development review processes.
- Identify sensitive areas in the city and prioritize for potential long-term protection, including areas with steep slopes and erodible soils, stream valley buffers, floodplain, and wildlife corridors.
- Identify potential priority areas for new stormwater best management practices (BMPs) to meet anticipated impervious area restoration requirements anticipated in future Phase II MS4 Permits that will seek to reduce sediment and nutrient pollution to meet TMDL reduction targets.
- Continue to implement sediment and erosion control and stormwater management programs to minimize

erosion and off-site sedimentation during development and construction.

Forests and Tree Canopy

Rockville currently has a strong set of policies for tree and forest stand preservation, both in stable areas of the City, as well as areas experiencing active redevelopment. Preservation of existing tree canopy and high quality forest stands will continue to be an important aspect of the City's environmental efforts far into the future.

Despite its strong tree canopy preservation policies, there are challenges and opportunities to the health of the city's forests, including the following:

- Explore, refine and implement urban tree planting systems that increase tree longevity.
- Develop a strategy for enhancing and expanding the private urban forest areas within Rockville, including non-residential, multifamily and common areas.
- Protect and enhance tracts of contiguous forest areas and areas identified as wildlife hubs and corridors.
- Preserve existing trees and forests through maintenance and regeneration.
- Develop a framework for balancing tree canopy goals and impervious area restoration requirements involving environmental site design (ESD) to the maximum extent practicable (MEP).
- Sustain existing tree canopy on private property through education on tree stewardship and incentives to plant and maintain trees.
- Evaluate the costs and feasibility of developing and implementing an exotic and invasive plant control policy or program.
- Explore whether tree canopy targets should be different in commercial corridors, as compared to areas of residential neighborhoods and environmental preservation.

Wildlife Habitat

Although Maryland harbors a rich variety of plants, fish and wildlife, populations of many species in the state have declined in recent years. Maryland's plant, fish and wildlife resources face a number of serious threats, including

human population growth, development, point and non-point source pollution, rising sea levels, habitat losses and fragmentation, and a proliferation of invasive species that may adversely affect native species. In order to strengthen the protection of important wildlife habitat in Rockville, land use and landscape protections should be considered by the City where they are not currently in place.

Future wildlife habitat challenges and opportunities include:

- Explore habitat preservation and enhancement strategies that prioritize, protect and enhance potential wildlife hubs, corridors and FIDS habitat, such as land acquisition, conservation easements, stream valley buffer protection, and forest retention.
- Continue to implement wildlife habitat protection and enhancement strategies in development review to maintain corridors for safe wildlife movement, prevent fragmentation of forested lands, and promote reforestation of environmentally sensitive areas.
- Continue to collaborate on regional efforts to study and develop strategies to minimize human-wildlife conflicts.
- Continue to provide community education program to foster wildlife appreciation and tolerance.
- Evaluate potential strategies, costs and benefits associated with monitoring and managing invasive species on City-owned lands.
- Identify opportunities to connect future parks, wherever possible, with existing local and regional park systems to provide continuous greenways for wildlife habitat, hiking, biking and other activities.
- Identify priority habitat and open space opportunities in existing large tracts of land with potential redevelopment opportunities (e.g., existing golf courses).

Environmental Hazards

While there are not significant hazardous waste spill sites in or around the City of Rockville, the presence of hazardous waste on sites that currently or historically stored or utilized hazardous waste should be considered during any land disturbing redevelopment activity. The proximity of vulnerable facilities and populations to hazardous waste transportation routes should also be of concern to emergency managers and when new locations of vulnerable facilities or populations are proposed as new development.

Other than weather-related natural hazards associated with short-term weather forecasts, natural environmental hazards are difficult to predict. However, there is scientific consensus that increased extreme future weather events will occur in the face of accelerating worldwide climate change. Judging from historical experience and its geographical location, Rockville can anticipate future natural hazards from hurricane-related weather and severe storms, and the flooding that often accompanies them, and winter storms. The ability to ‘weather’ impacts through responsive building codes, appropriate land use regulations and effective emergency response, can make the difference in how costly natural hazards are to the community.

Air Quality

Air quality affects human health, soil and water quality, vegetation and ecosystem health, scenic visibility, property values and agricultural productivity. Management of air quality is largely a regional challenge since atmospheric pollutants travel long distances across geographical boundaries. Continued, and in some cases enhanced, participation by Rockville with regional air quality initiatives is needed to protect and improve Rockville’s air quality, in addition to the following:

- Strategies to reduce transportation-related emissions include: transit oriented land use planning, improved transit and bicycling facilities and infrastructure, improved pedestrian accessibility and safety, improved fleet fuel efficiency, planning and promoting alternative clean-fuel vehicles (such as electric vehicle charging stations), ridesharing and telecommuting programs, enforcing existing idling regulations, and other possible actions.
- Strategies to reduce emission from electricity production include: improved energy efficiency of existing and future buildings and promoting the use of clean energy sources.
- The impacts of urban heat island effects can be accomplished through site planning and design as well as protection and enhancement of tree canopy and public shade/cooling facilities.

Additional Environmental Opportunities

The following sections describe additional opportunities for Rockville to enhance its standing as an environmentally sustainable community.

Climate Change and Adaptation

There is now widespread scientific consensus linking global climate change to greenhouse gas (GHG) emissions due to human activities.¹ In recognition of this consensus, communities across the world are conducting evaluations to inventory GHG emissions, identifying mitigation strategies to reduce GHG emissions generated by their community, assessing their local community and public infrastructure for potential climate change vulnerabilities, and developing adaptation plans to support community resilience.

Climate change models typically address global or regional projections that tend to be difficult to apply and respond to at a local level. However, jurisdictions in the Washington, D.C. region, in coordination with NASA scientists, have produced localized climate change projections for the national capital region for the 2020, 2050 and 2080 time periods. The findings from these projections is that climate change poses a serious threat to the system upon which the governments and economies of the National Capital region rely and that understanding shared vulnerabilities and coordinating adaptation strategies will help leverage limited resources for the most effective near- and long-term actions. Table 10 summarizes the temperature, precipitation and sea level projections for this region through 2080.

Rockville prepared its own inventory of community-based and local government-related greenhouse gas emissions inventory for a baseline year of 2006 to coincide with the baseline parameters of the Maryland Greenhouse Gas Reduction Act of 2009. This inventory not only provides a snapshot of the City’s energy consumption patterns, but is also the foundation of the City’s actions to address climate change. The City utilized Clean Air and Climate Protection (CACP) software and methodology from the International Council for Local Environmental Initiatives (ICLEI) to

1 Intergovernmental Panel on Climate Change (IPCC). Fifth Assessment Report, Released between September 2013 and November 2014.

conduct the inventory in coordination with Montgomery County, PEPCO, and the Metropolitan Washington Council of Governments for data collection, training and technical assistance.

Table 10: Projected Climate Change Impacts in the National Capital Region²

Climate Projections	2006 baseline	2020s	2050s	2080s
Change in Average Annual Temperature	57.5°F	+1.5 to +2.5	+3 to +5	+4 to +7.5
Change in Average Annual Precipitation	39.4 in.	0 to +10%	0 to +15%	0 to +15%
Sea Level Rise (in.)	-	+2 to +5	+7 to +11	+13 to +21
Sea Level Rise under Rapid Ice Melt Scenario (in.)	-	+5 to +9	+19 to +28	+41 to +57
Daily Temperature Extremes (Hot and Cold Days)				
at or above 100°F	1	2 to 4	4 to 9	7 to 24
at or above 95°F	10	14 to 20	22 to 36	29 to 58
at or above 90°F	38	44 to 53	55 to 75	65 to 96
at or below 32°F	65	44 to 51	34 to 43	26 to 38

According to the 2006 inventory, the primary contributors of greenhouse gas emissions in the Rockville are existing buildings (59 percent) and transportation (40 percent). To address these emission sources and to promote sustainability and resiliency, the City of Rockville is making progress towards implementing action items outlined in MWCOG’s 2013-2016 Climate and Energy Action Plan.

Greenhouse gas emissions from local government operations represent less than one (1) percent of the community’s overall emissions; however, they are important because the City has direct control over these sources. Out of the total municipal emissions, City buildings and facilities contributed the most emissions (40%), followed by water treatment and delivery systems (24%), street lights & traffic signals (16%), vehicle fleets (14%), and employee commutes (6%). Table 11 provides a summary of this emissions inventory for the City of Rockville.

2 NASA, Adapting to a Changing Climate, Federal Agencies in the Washington D.C. Metro Area www.mwcog.org/uploads/committee-documents/bF1YW19b20140721123701.pdf

Table 11: Rockville Greenhouse Gas Emissions Inventory (2006 estimates)

	Community Emissions	
	MMTCO2e (metric tons)	%
Total	2,886,760	100%
Commercial buildings	1,073,376	37%
Residential buildings	625,339	22%
Transportation	1,171,631	41%
Rockville Government	12,986	0.4%
Waste	3,428	0.1%

Due to its location and elevation, Rockville may not be directly impacted by rising sea levels like many of Maryland’s coastal communities and the District of Columbia; however, it is still vulnerable to impacts of climate change. The main impacts include rising temperatures, precipitation variability, isolated flooding, drought, and an increase in the frequency and severity of severe storms. Maryland and the National Capital Region have already experienced some effects of climate change and model projections indicate these trends will continue; including sea level rise of more than one foot in the last century, increasing water temperatures within the Chesapeake Bay, more rain and flooding in the winter and spring, and less in the summer.

Regulatory Framework and Initiatives

Climate and energy policies are generally made at the global, Federal and State level. At this time there are no Federal limits on GHG emissions. However, in 2014, the White House announced a 2025 target to cut U.S. climate pollution by 26 to 28 percent from 2005 levels. Proposed measures include a clean power plan to reduce emissions from the power sector, standards for heavy-duty engines and vehicles, energy efficiency standards, and other measures to cut emissions from industry, landfills, and agriculture.

The State of Maryland adopted a series of goals and policies to reduce GHG emissions as well as reduce energy consumption and increase renewable energy use. Maryland established a greenhouse gas emissions reduction target of 25 percent below 2006 levels by 2020 and has taken several actions to address both the drivers and consequences of climate change; while they do not place requirements on Rockville to reduce emissions, they establish policies and programs that facilitate reductions at the local level:

- The Clean Cars Act (2007)
- The Regional Greenhouse Gas Initiative (2007)
- The Maryland Commission on Climate Change (2007)
- The Maryland Climate Action Plan (2008)
- The Critical Area Act (2008)
- The Living Shorelines Protection Act (2008)
- The EmPower Maryland Energy Efficiency Act (2008)
- The Greenhouse Gas Emission Reduction Act (2009)
- Governor’s Executive Order on Climate Change (2012)
- The Maryland Offshore Wind Energy Act (2013)
- Maryland’s Greenhouse Gas Reduction Act Plan (2013)
- State Zero-Emission Vehicle Programs (2013)
- The Coast Smart Council and Bay Acidification Task Force Legislation (2014)

The Metropolitan Washington Council of Governments (MWCOC), of which Rockville is a member, and Montgomery County also have a reduction target of 20 percent below 2005 levels by 2020 and 80 percent below 2005 emissions by 2050. Progress towards achieving these goals will require coordination between Federal, State, regional agencies, local governments, as well as private businesses and households.

While Rockville does not currently have State or Federal regulatory requirements to reduce greenhouse gas emissions, the City has already committed to taking action, completed a greenhouse gas emission inventory, and is making progress on implementation actions outlined in the Metropolitan Washington Council of Governments’ (COG) 2013-2016 Climate and Energy Action Plan. In 2007, the Mayor and Council recognized the need for action and made several important climate commitments:

- Signed the U.S. Mayor’s Climate Protection Agreement
- Adopted a Resolution Authorizing the City to Join the International Council for Local Environmental Initiatives (ICLEI)
- Adopted the Strategy for a Sustainable Rockville

Continued progress towards meeting these climate and sustainability goals requires the ongoing collective efforts of Rockville’s elected officials, City staff and the community. Future challenges and opportunities include but are not limited to the following items:

- Coordinate with Federal, State, and regional partners

to improve and refine local climate change projection data, expand vulnerability assessments, and develop resiliency plans; particularly associated with risks to the region's transportation infrastructure, water and wastewater utilities, buildings, energy systems, and emergency response services.

- Evaluate and pursue energy efficiency policies and programs where practicable; including enhanced building codes, energy benchmarking, incentives for retrofitting existing buildings, demand response programs, energy savings performance contracting, green leasing, smart grid and advanced metering.
- Evaluate and pursue renewable energy policies and programs when practicable; including enhanced building codes, local government green power purchases, the use of solar power purchase agreements for the installation of renewable energy systems, and community renewable energy cooperative purchase programs.
- Coordinate with Federal, State and regional agencies to evaluate how potential climate change projections (temperature, severe weather, hydrology, etc.) should be factored into site and building design standards; including floodplain designation, land-use planning, stormwater management, stream restoration, landscape designs, transportation pavement standards, building HVAC system designs, and site and building design and construction standards and technologies to withstand increased heat, precipitation, and more intense weather events.
- Coordinate with Federal, State and regional agencies to develop, implement and promote transportation policies and programs that contribute to emission reductions; including complete streets policies, multimodal improvements, Bikeway Master Plan, Capital Bikeshare program, transit services, employer trip reduction programs, alternative fuel vehicles and infrastructure, and other programs to reduce vehicle miles traveled.
- Develop a framework to consider potential climate change impacts and effects in the planning, design and construction of future capital improvement projects; including facility construction and renovations; road, streetlights, bridge, sidewalk, and paving projects, and water, sewer, and stormwater infrastructure.
- Coordinate with Federal, State, and regional water utility partners to assess climate change risks on drinking water supply, treatment and distribution systems, identify mitigation strategies, and take actions to improve

resiliency and sustainability in utility facilities and overall utility management; including assessing energy efficiency opportunities, intake along the Potomac, water quality, drought hazard risk, energy reliability, extreme weather, community outreach, etc.

- Collaborate with utilities, regulators, and other government agencies on grid reliability and security improvement efforts; including microgrids, combined heat and power partnerships, demand response programs, line maintenance and enhancements, and infrastructure and technology upgrades.

Energy

Energy is fundamental to our daily lives, community and economy. Energy costs and reliability have significant daily impacts on the welfare of residents, operation and growth of businesses and institutions, and the cost and availability of government operations and services. Given that metropolitan areas are responsible for most of the world's energy consumption and there are growing concerns over energy price fluctuations, reliability, security, and the relationship of energy consumption to greenhouse gas emissions, jurisdictions across the national are assessing their community and municipal energy usage and vulnerabilities and identifying opportunities for innovative, lower-cost, less polluting, and more secure and reliable energy supplies and technologies.

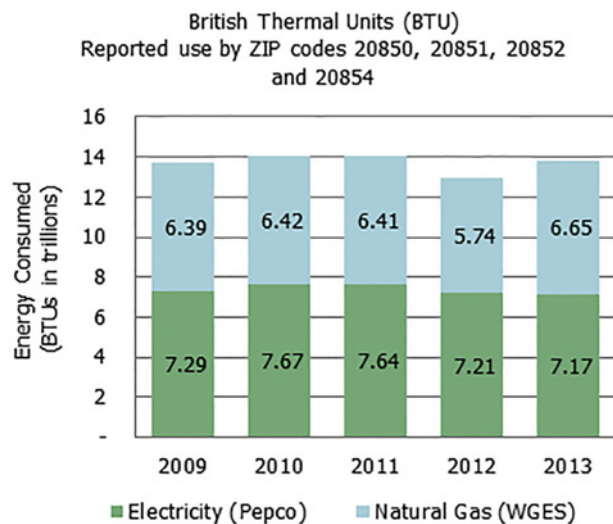
While Rockville does not own, operate or regulate electric or natural gas utilities or control the generation, transmission and distribution of other energy supplies, the City does influence how energy is used in the community and in municipal facilities and operations. Urban land use and design have significant bearing on three major energy end-use sectors: commercial buildings, residential buildings and transportation. Local government policies, programs and practices (e.g., land use planning, zoning, urban design, transportation planning, municipal services, building codes, fleet management, energy supply purchases, etc.) can influence energy infrastructure needs, markets and demand. Examining community and municipal government energy consumption patterns (electricity, natural gas, petroleum, renewable, etc.) helps develop an understanding of current conditions to plan for future sustainability.

Given that Rockville is an urban area without a significant

amount of industrial activity, public and private buildings and the transportation sector are the largest consumers of energy and, due to their energy sources, the largest generators of greenhouse gas emissions. Energy data is commonly not available or difficult to access because of confidentiality restrictions. However, the following provides an overview of the available community energy consumption (residential, businesses, institutions and governments), municipal energy consumption (Rockville facilities and operations), electricity energy sources, renewable energy usage, photovoltaic system installations, and alternative fueling stations.

Community Buildings Electricity comprises more than half of the energy consumed by commercial and residential buildings. Despite some growth and development in the city, electricity consumption exhibited a modest *decrease* from 2009 to 2013 to approximately 7.17 trillion British thermal units (BTUs). Reasons for the decline are not fully understood, but may include improved energy efficiency in building codes or greater application of available technology, the 2008 economic recession, and changes in behavior for how people inhabit buildings. Figure 16 graphs the annual building energy consumption for all residential and commercial electricity and natural gas accounts in Rockville zip codes between 2009 and 2013.

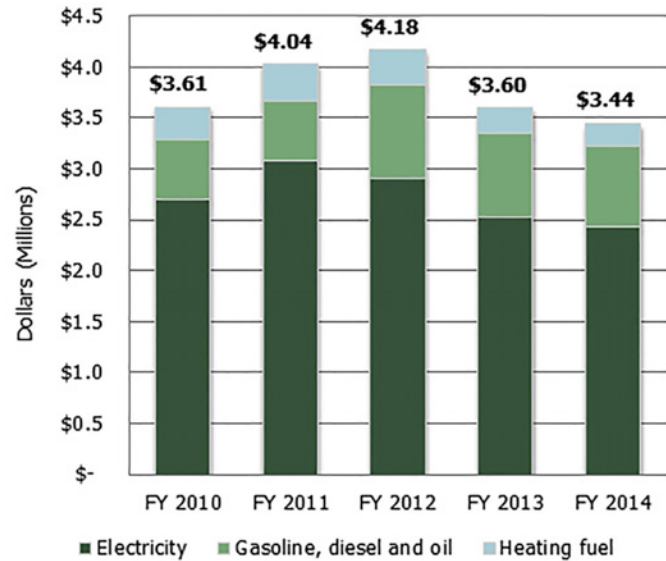
Figure 16: Community Building Energy Consumption



Municipal Facilities and Operations While municipal energy consumption comprises less than one (1) percent of the community’s overall energy consumption, energy, particularly electricity, plays a critical role in City services

and operations and is a significant annual cost. The operation of City facilities, water and sewer utilities, street and traffic lights, and fleet consume energy resources and between three to four percent of the City’s operating budget. Figure 17 presents five years of budgeted annual energy expenses for electricity, fleet gasoline/diesel/oil, and heating fuel (oil and natural gas). The City’s total annual energy costs ranged between \$3.44 and \$4.18 million, with the bulk being electricity costs.

Figure 17: City of Rockville Budgeted Energy Expenses



Environmental Impacts Electricity comprises a significant portion of the community and municipal energy consumption and there are significant economic and environmental impacts as a result. Maryland is part of the Mid-Atlantic regional electricity transmission grid operated by PJM Interconnection LLC. Since Marylanders consume more electricity than is generated from in-state sources, more than one-third of the power consumed in Maryland comes from resources outside the state through the PJM grid. These power plants generate electricity from a number of different fuel sources, resulting in different emissions.

The Maryland Public Service Commission requires the local energy company PEPSCO to report fuel sources and emissions data to customers. The general fuel mix is as follows: coal (43 percent), nuclear (34 percent), and natural gas (16 percent) provide the bulk of base load and peaking electricity generation with renewable generation (solar and wind) constituting seven (7) percent. This primary fossil fuel-

based electricity generation is a significant generator of air and climate pollution; such as CO₂ (a greenhouse gas), SO₂ and NO_x (reacts to form acid rain), and NO_x (reacts to form ground level ozone, an unhealthy component of smog). The amount of air pollution associated with the generation of electricity production for this standard offer service fuel mix is 2.2 pounds of sulfur dioxide (SO₂), 1.0 pounds of nitrogen oxides (NO_x), and 1,112 pounds of carbon dioxide (CO₂) per megawatt-hour of electricity generated.

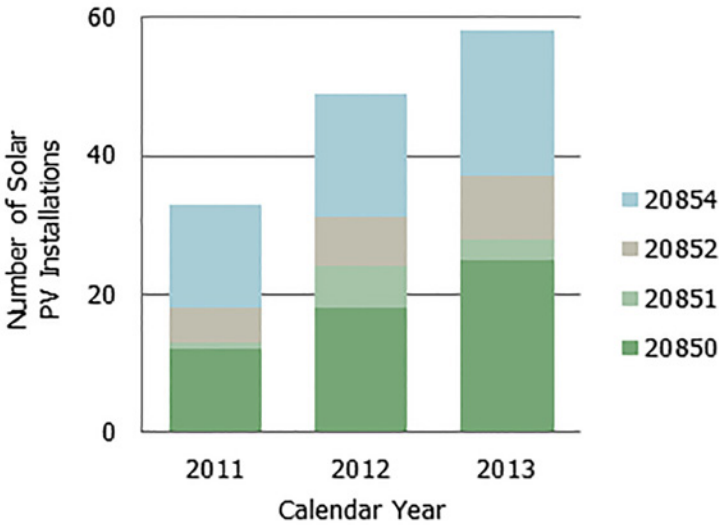
Alternative Energy Sources With the advent of electricity deregulation in the Rockville region, customers can choose to buy electricity from competing suppliers as well as to buy a percentage of their electricity from green energy sources, like wind or solar. Maryland is working toward achieving a more diverse mix of power generation and increasing renewable generation sources (such as solar and wind) to meet future energy demand, reduce air pollution, and keep carbon at reduced levels moving into the future. The State set an ambitious goal to increase Maryland’s in-state renewable energy generation to 20 percent by 2022. As of 2014, 8.2 percent of in-state energy was generated from renewable sources.

Rockville ranks high nationally for the collective amount of green power used by the community. The U.S. Environmental Protection Agency’s (EPA) Green Power Community Challenge is a national campaign that encourages communities across the nation to use green power. Rockville was named a Green Power Community in 2011, the second community in the State to join the program. Rockville tracks reported solar installations, purchased renewable energy certificates (RECs), and purchased green power from energy and reports the community’s annual collective green power use to EPA. The City of Rockville contributes to this program and has gradually increased its purchase of wind renewable energy certificates (RECs) from 5 percent of municipal electricity usage in fiscal year 2005 to 100 percent of municipal electricity usage in fiscal year 2015. Figure 19 illustrates many of the green power sources located in the Rockville vicinity.

In 2013, Maryland ranked eighth among national markets for solar installations. Rockville is experiencing a growth in net-metered renewable energy systems, as well. Declining system costs, mandatory renewable energy standards (RES), net metering, solar renewable energy certificates (SREC), state grants, as well as policies allowing innovative

financing tools have enabled these markets to grow. Figure 18 shows the upward trend in the number of photovoltaic energy systems installed every year. According to PEPCO, annual net metering photovoltaic solar unit installations for Rockville zip codes nearly doubled over the last three years; from 33 installations in 2009 to 58 installations in 2013.

Figure 18: Annual Net Meter Solar Unit Installations



Wind Energy A formal wind study has not been completed for the City; however, the U.S. Department of Energy’s Wind Program and the National Renewable Energy Laboratory (NREL) published the 80-meter height wind resource map for Maryland to assess the state’s wind resource potential. According to this map, Rockville is located in an area with wind speeds approximately 4.5 and 5.0 m/s which are below NREL’s recommended threshold of 6.5 m/s for wind development. Since wind speeds generally fall below the threshold considered suitable for wind development, wind technology is generally not utilized in the city.

Transportation Fuel Petroleum fuel consumption data specific to Rockville is not available. However, the U.S. Department of Energy maintains an alternative fuels data center with the locations of publicly and privately owned biodiesel (BD), compressed natural gas (CNG), ethanol 85 (E85), electric charging, and liquefied petroleum gas (LPG or propane) stations in and near Rockville. Rockville is home to 21 electric charging stations, many more than neighboring communities, and one LPG and E85 station each within its municipal borders.

Regulatory Framework and Initiatives

The energy sector is complex, dynamic and highly regulated; with State, regional, and Federal agencies or authorities overseeing many aspects of its operations. The United States is the world's largest energy consumer and has a wide-ranging set of energy policies, subsidies, incentives, disincentives and restrictions that are administered by various Federal departments and agencies, including the Department of the Interior, the Energy Department, the Environmental Protection Agency, the Federal Energy Regulatory Commission, OSHA, and even the Internal Revenue Service.

Regional and State energy policies also play a significant role in shaping energy markets. In Maryland, distribution is regulated separately from generation and transmission. This structure allows consumers to purchase electricity and natural gas from a variety of suppliers (generators), but the delivery of those commodities is provided by regulated utilities. Given the complexity of the energy management framework, the following highlights a few of the agencies and authorities that impact energy markets in our community:

- The Maryland Energy Administration
- The Federal Energy Regulatory Commission (FERC)
- PJM Interconnection
- Regional Greenhouse Gas Initiative (RGGI)
- The Maryland Public Service Commission (PSC)
- Maryland Office of People's Counsel (OPC)
- The Maryland Department of Housing and Community Development (DHCD)
- Maryland Department of Human Resources (MDHR)
- Montgomery County Department of Health and Human Services
- Montgomery County Department of Housing and Community Affairs
- Montgomery County Department of Environmental Protection
- PEPCO, a subsidiary of Pepco Holdings, Inc. (PHI)
- Washington Gas & Light Company (WG&L)

At the State level, there are two important energy initiatives in Maryland that impact the energy market for residents, businesses and communities, the EmPOWER Maryland Energy Efficiency Act of 2008 and Maryland's Renewable Portfolio Standard (RPS). Maryland also established a voluntary framework to encourage municipalities and counties to support these energy goals. In 2013, the Maryland Energy

Administration (MEA) launched the voluntary Maryland Smart Energy Communities (MSEC) program to encourage municipalities and counties to voluntarily adopt energy goals that mirror state goals for energy efficiency, renewable energy, and/or transportation petroleum reduction. In exchange, MEA provides governments with technical assistance for energy policy adoption and funding for projects that support the following energy goals.

Rockville is leading by example through investing in greater efficiency in public buildings and infrastructure; promoting the development of energy efficient communities through land use and transportation incentives, policies, and mandates; promoting opportunities to increase renewable energy production; and supporting residents and businesses in making smart energy choices through information, services, and incentives. The City was recognized for these efforts by COG in 2014, when it became one of four recipients (and the first in the State of Maryland) of COG's first Climate and Energy Leadership Awards for outstanding efforts to reduce greenhouse gas emissions and increase energy efficiency. Examples of local policies, programs and practices that influence energy infrastructure needs, markets and demand include, but are not limited to the following.

Community Energy Initiatives

- Green Building and Energy Efficiency Regulations
- Citywide Land Use and Transportation Planning
- Incentives to Improve Efficiency in Existing Buildings such as Utility Rebates, Green Building Tax Credit, Rockville Emergency Assistance Program (REAP), and Rockville's Single Family Rehabilitation Program,
- Renewable Energy (Land Use, Zoning and Permitting, EPA Green Power Community Challenge, Coordination with MWCOG Rooftop Solar Challenge.
- Leveraging Partnerships and Incentives
- EPA Green Power Partnership

Municipal Energy Management

- The Strategy for a Sustainable Rockville
- Maryland Smart Energy Community
- Utility Bill Monitoring and Management
- Energy Efficiency Grants
- Energy Demand Management
- Renewable Systems
- Street, Parking and Traffic Lighting

With proper planning and management, Rockville can use energy in a smarter, more efficient way and invest in renewable resources to reduce environmental impacts, maximize reliability, reduce long-term costs and minimize emissions. The complex and changing energy landscape, however, requires coordinated efforts by Federal, State, regional regulatory agencies, utilities, local governments, businesses and residents to enable communities across the nation the ability to respond efficiently to changing energy challenges, policies and costs, in order to enhance economic competitiveness and long-term sustainability. Potential future energy challenges and opportunities include:

- Continue to evaluate appropriate model building codes/rating systems (e.g., International Green Construction Code (IgCC), LEED, LEED Dynamic Plaque, IECC, ASHRAE 189.1, ENERGY STAR, etc.) for updates to City building codes to improve the efficiency, health and performance of residential and non-residential buildings.
- Continue to work with utilities, residents and private partners to improve the energy efficiency of buildings (utility efficiency rebates, energy assessments and audits, building automation services, demand response programs, retro-commissioning, training, PACE, etc.).
- Work with local utilities and property owners to improve access to utility data for improved building energy management (e.g., smart meters, Green Button utility data access programs, etc.).
- Evaluate opportunities for commercial energy benchmarking and disclosure to improve market transparency (i.e., Montgomery County Building Energy Benchmarking)
- Follow the development and implementation of the Commercial Property Assessed Clean Energy (PACE) program in Montgomery County.
- Explore opportunities to increase local energy supply and distribution efficiency; including but not limited to renewable energy systems, microgrids, energy storage, district energy systems.
- Exploring opportunities to reduce electricity usage and costs for outdoor lighting and un-metered street lights; including but not limited to lighting retrofits when appropriate, modified utility rates for efficient lighting systems, energy standards, incentives, and CIP projects.
- Continue to promote transit-oriented development and long-term strategies to accommodate future growth and enhance mobility within activity centers to alleviate traffic congestion and reduce per capita VMT and emissions.
- Continue to identify and promote cost effective transportation technologies and opportunities that reduce number of vehicle miles traveled, congestion and fuel demand and support opportunities for alternative fuel vehicles, reduce transportation energy consumption and emissions, increase the use of high efficiency and alternative fuel vehicles when feasible.
- Continue to plan and implement CIP projects that improve energy efficiency, renewable energy, and back-up generation for critical City facilities and services.
- Continue residential and business education and outreach on energy supply, energy efficiency, renewable energy, alternative fuel and transportation opportunities.

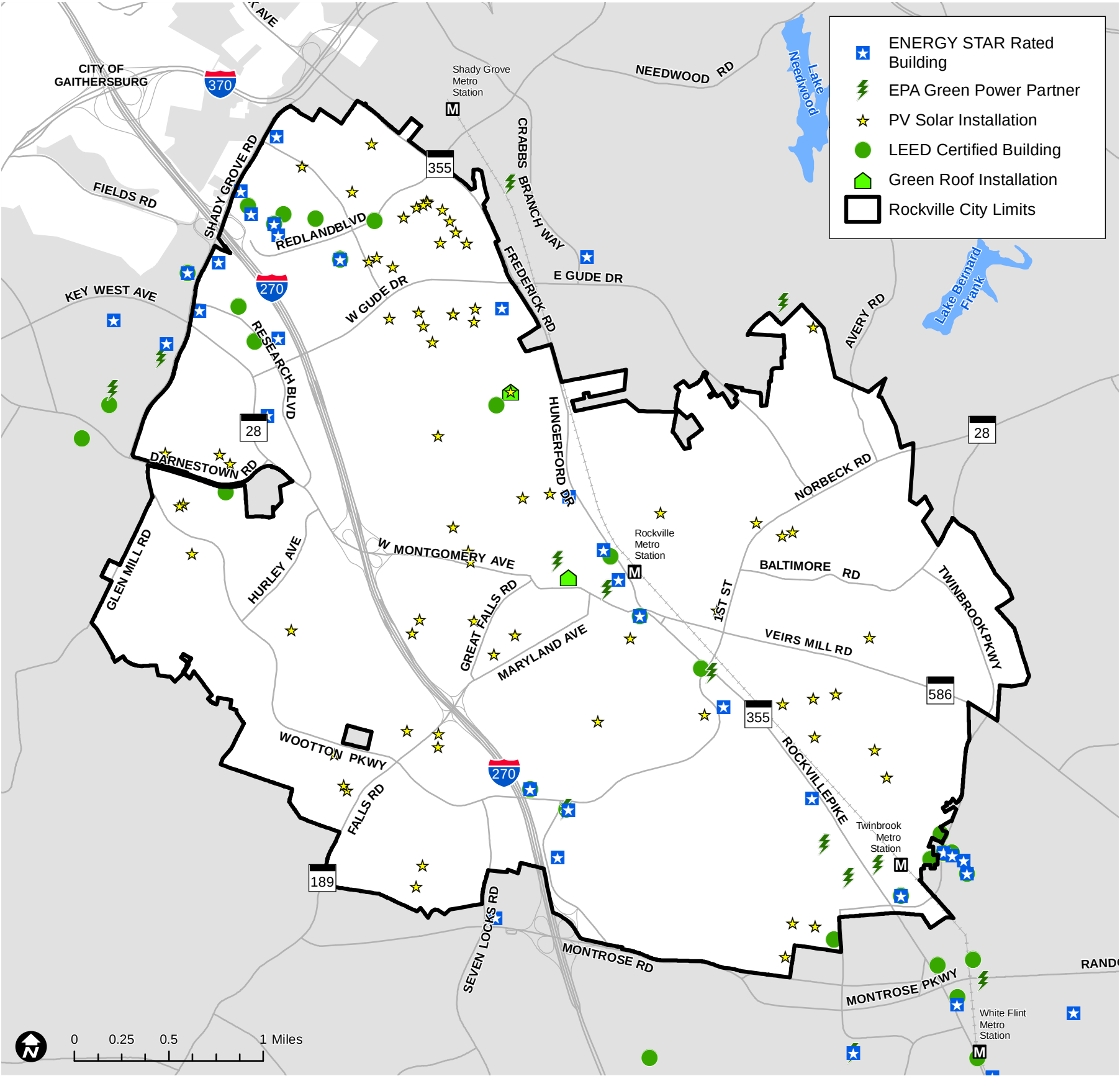
Green Buildings

The principle of ‘green building’ has gained momentum throughout the country in recent years to address the impacts that buildings have on our natural environment, economy, health, and productivity. Green building is the practice of reducing the overall impact of the built environment on human health and the natural environment while maximizing performance throughout a building’s life cycle – through site design, construction, operation, maintenance, renovation, and demolition. The principles apply to new construction, building renovations and additions, as well as retrofits to existing multi-family residential, commercial and government buildings.

The number of green and energy efficient buildings in Rockville and the National Capital Region has grown considerably over the last decade. A combination of green building policies and regulations, incentives, new technologies, and business demands continue to expand the green building market for both new construction as well as existing buildings.

A 2009 analysis conducted by the Metropolitan Washington Council of Governments (MWCOC) found that the majority of the region’s US Green Building Council’s Leadership in Energy and Environmental (LEED) certified green buildings are located in regional activity centers that have large employment concentrations. MWCOC also found that 64 percent of LEED-certified building space is located within one-half mile of a Metrorail station. Given that Rockville features regional activity centers and Metrorail stations, it

Figure 19: Renewable Energy and Green Buildings in Rockville



may not be surprising to find a growing presence of LEED-certified construction in the city.

The Green Building Information Gateway (GBIG), a global platform that provides access to various green building data, summarizes the following trends for buildings and professionals in Rockville. Over the last decade, the number of the U.S. Environmental Protection Agency's ENERGY STAR-labeled buildings and their average scores has increased in the City. According to the GBIG, as of 2013 there were 21 ENERGY STAR buildings in Rockville. The number of LEED-certified projects has grown over the last decade, as well. In 2013, there were 26 LEED certified projects in Rockville. This includes projects registered in all of LEED rating systems (new construction, core and shell, commercial interiors, schools, existing buildings operation and maintenance, etc.). The number of green building professionals has also grown significantly; there were at least 300 LEED professionals as of 2013 listed with a Rockville address, or the area covered by the four ZIP code areas that overlap the City of Rockville.

Figure 19 displays the location of 'green' buildings and a selection of renewable energy installations in the Rockville vicinity (LEED, ENERGY STAR, EPA's Green Power Partners, photovoltaics, etc.). Note that the EPA Green Power Partner's map locations are associated with the address of the organization partnering with EPA, and may not be geographically aligned with where a Partner is actually using its green power.

Regulatory Framework and Initiatives

The adoption of model energy codes, stretch codes (e.g., above-minimum codes), and green building policies and requirements present a significant opportunity to incorporate energy-efficiency, human health considerations, and environmentally-friendly practices into residential and commercial buildings. While the U.S. does not have a national energy code or green building standard, State and local governments and Federal facilities have taken the lead in adopting energy codes and green building requirements. Green building rating systems and stretch codes offer State and local jurisdictions the opportunity to improve energy efficiency, water conservation, and overall sustainability of their communities and buildings. Beyond-code programs incorporate all aspects of the life cycle of a building or home, from the initial design and construction phases to the operation of the building long after it has been occupied.

There are several building and energy requirements, codes and policies that affect the building industry and market in the national capital region.

- The Maryland Building Performance Standards (MBPS)
- 2007 MWCOG report with recommendations for local governments to improve the energy performance of buildings region wide, including a recommendation to establish the U.S. Green Building Council's LEED as the region's preferred green building rating system.
- Maryland High Performance Buildings Act (S.B. 208)
- International Green Construction Code (IgCC)
- Federal Energy and Green Buildings Requirements for Federal Buildings and Leased Property

While Rockville does not currently have State or Federal regulatory energy requirements, the City has various initiatives to improve energy efficiency of new and existing public and private buildings and promote municipal emissions reductions. Given that buildings are responsible for a majority of the Rockville's greenhouse gas emissions, the City worked with community stakeholders to create an innovative, demanding, yet flexible green building program.

As green building codes, rating systems and technologies continue to evolve, the City will need to continue to evaluate what is appropriate for Rockville. There are several future opportunities and challenges with green building:

- Continue to evaluate appropriate model building codes/ rating systems (e.g., International Green Construction Code (IgCC), LEED, LEED Dynamic Plaque, IECC, ASHRAE 189.1, ENERGY STAR, etc.) for updates to City building codes to improve the efficiency, health and performance of residential and non-residential buildings.
- Continue to work with utilities, residents and private partners to improve the energy efficiency of buildings (utility efficiency rebates, energy assessments and audits, building automation services, demand response programs, retro-commissioning, training, PACE, etc.).
- Work with local utilities and property owners to improve access to utility data for improved building energy management (e.g., smart meters, Green Button utility data access programs, etc.).
- Evaluate opportunities for commercial energy benchmarking and disclosure to improve market

transparency (i.e., Montgomery County Building Energy Benchmarking)

- Follow the development and implementation of the Commercial Property Assessed Clean Energy (PACE) program in Montgomery County.
- Following the evolution and implementation of product disclosure declarations.
- Promote green lease opportunities to remove the split incentive barrier to green building where the benefit of operational efficiency is realized by the tenants and not necessarily by the developers. This dilemma often prevents developers from exploring all the green building opportunities, as they might not be able to recoup the high initial costs.
- Continuing to coordinate with building officials, property owners, property managers and home owners on green building and energy education and outreach.

Conclusion

In summary, the City of Rockville has a strong suite of existing environmental policies and programs. Yet, as our understanding of environmental conditions and opportunities expands, our programs must evolve. The Rockville 2040 initiative provides an opportunity to update the City's policy statements in this regard as we look toward the future.

List of Resources

Watersheds and Water Quality

City of Rockville. 2010. Water Resources Element of the Comprehensive Plan.

www.rockvillemd.gov/documentcenter/view/900

City of Rockville, 2010. Parks, Recreation and Open Space Plan. www.rockvillemd.gov/DocumentCenter/View/4219

City of Rockville. 2012. Cabin John Creek Watershed Assessment and Management Recommendations.

www.rockvillemd.gov/documentcenter/view/1752

City of Rockville. 2013. Rock Creek Watershed Management Plan. www.rockvillemd.gov/DocumentCenter/View/1754

City of Rockville. 2014. Watts Branch Watershed Study and Management Plan.

www.rockvillemd.gov/DocumentCenter/View/1751

Maryland Department of the Environment. Appendix II. Maryland's Wetland Management Framework.

www.mde.state.md.us/programs/Water/WetlandsandWaterways/MDWetlandConservationPlan/Documents/www.mde.state.md.us/assets/document/wetlandswaterways/appendix_2fnl.pdf

Maryland Department of the Environment. Integrated Report Water Quality Assessment Maps.

www.mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/ImpairmentMaps.aspx

Maryland Department of the Environment. Soil Erosion and Sediment Control Program.

www.mde.state.md.us/programs/Water/StormwaterManagementProgram/SoilErosionandSedimentControl/Pages/programs/waterprograms/sedimentandstormwater/erosionsedimentcontrol/index.aspx

Floodplains and Dams

Federal Emergency Management Agency (FEMA). National Flood Insurance Program.

www.fema.gov/national-flood-insurance-program

Maryland Digital Flood Insurance Rate Maps.

www.mdfloodmaps.com/

Montgomery County Office of Emergency Management and Homeland Security. Montgomery County Hazard Mitigation Plan 2013.

www.montgomerycountymd.gov/COUNCIL/Resources/Files/SCANNED_DOCS/hazard_mitigation_plan.pdf

Soils and Steep Slopes

Maryland Department of the Environment. Soil Erosion and Sediment Control Program.

www.mde.state.md.us/programs/Water/StormwaterManagementProgram/SoilErosionandSedimentControl/Pages/programs/waterprograms/sedimentandstormwater/erosionsedimentcontrol/index.aspx

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. websoilsurvey.nrcs.usda.gov/

Forests and Trees

Maryland Department of Natural Resources. Forest Conservation Act.

dnr2.maryland.gov/forests/Pages/default.aspx

Maryland Department of Natural Resources. Maryland Forest Resource Assessment 2010. www.dnr.maryland.gov/forests/pdfs/sas/marylandstateforestresourceassessment.pdf

Maryland Department of Natural Resources. A Report on the City of Rockville's Existing and Possible Urban Tree Canopy (2009).

www.fs.fed.us/nrs/utc/reports/UTC_Report_Rockville.pdf

Rockville Forest and Tree Protection Ordinance.

www.municode.com/library/md/rockville/codes/code_of_ordinances?nodeId=CICO_CH10.5FOTRPR

Rockville Landscaping, Screening and Lighting Manual. [rockmail.rockvillemd.gov/clerk/egenda.nsf/d5c6a20307650f4a852572f9004d38b8/6cef50a51b08cc7f852575070069e6fe/\\$FI](http://rockmail.rockvillemd.gov/clerk/egenda.nsf/d5c6a20307650f4a852572f9004d38b8/6cef50a51b08cc7f852575070069e6fe/$FI)

LE/AttachmentB%20Landscaping%20Manual%20Final%20.pdf

Rockville Master Street Tree Plan.
www.rockvillemd.gov/documentcenter/view/10436

U.S. Department of Agriculture, 2012. Chesapeake Forest Restoration Strategy.
executiveorder.chesapeakebay.net/chesapeakeforestrestorationstrategy.pdf

Wildlife Species and Habitats

City of Rockville, 2010. Parks, Recreation and Open Space Plan. www.rockvillemd.gov/DocumentCenter/View/4219

Maryland Department of Natural Resources. 2005. Maryland Wildlife Diversity Conservation Plan.
www.dnr.state.md.us/wildlife/Plants_Wildlife/WLDP/divplan_final.asp

Maryland National Capital Park and Planning. Natural Resources Management Plan for Natural Areas in M-NCPPC Parkland in Montgomery County, Maryland. February 2013.
www.montgomeryparks.org/PPSD/Natural_Resources_Stewardship/documents/2013.02_naturall_resources_management_plan.pdf

Environmental Hazards

Maryland Department of the Environment, 2015. Land Restoration Program (LRP).
www.mde.state.md.us/programs/Land/MarylandBrownfieldVCP/Pages/programs/landprograms/errp_brownfields/default.aspx

Montgomery County Department of Environmental Protection. 2014. Gude Landfill Assessment of Corrective Measures, Montgomery County, Maryland.
www.montgomerycountymd.gov/SWS/Resources/Files/gude/ACM/ACM-final-draft.pdf

Montgomery County Office of Emergency Management and Homeland Security (MOEMHS), 2013. Montgomery County Multi-Jurisdictional Hazard Mitigation Plan 2013.
www.montgomerycountymd.gov/content/council/pdf/SCANNED_DOCS/hazard_mitigation_plan.pdf

Tornado History Project. <http://www.tornadohistoryproject.com/tornado/Maryland/Montgomery>. Accessed 10/16/16.

Air Quality

Maryland Department of the Environment (MDE): Air Quality. www.mde.state.md.us/programs/Air/Documents/Improving_MD_AQ_1990-2008.pdf

Metropolitan Washington Council of Governments. Metropolitan Washington Air Quality Committee (MWAQC): www.mwcog.org/environment/air

Metropolitan Washington Council of Governments. Air Quality Gold Book. State and Local Government Initiatives to Clean the Air:
www.mwcog.org/environment/air/downloads/GoldBook%20Measures.pdf

Metropolitan Washington Council of Governments (MWCOC). Improving Air Quality.
www.mwcog.org/uploads/pub-documents/zllyWw20061019075124.pdf

Metropolitan Washington Council of Governments (MWCOC). Air Quality State Implementation Plans for the Washington, DC- MD- Va Region.
www.mwcog.org/environment/air/SIP/default.asp

Montgomery County Department of Environmental Protection. Outdoor Air Quality program
www.montgomerycountymd.gov/DEP/air/current-air-quality.html

Climate Change

Boicourt K and ZP Johnson (eds.). 2010. Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II: Building societal, economic, and ecological resilience. Report of the Maryland Commission on Climate Change, Adaptation and Response and Scientific and Technical Working Groups. University of Maryland Center for Environmental Science, Cambridge, Maryland and Maryland Department of Natural Resources, Annapolis, Maryland.
www.dnr.state.md.us/climatechange/pdfs/climatechange_phase2_adaptation_strategy.pdf

City of Rockville, 2007. Strategy for a Sustainable Rockville.
www.rockvillemd.gov/DocumentCenter/View/550

City of Rockville, 2008. Zoning Ordinance (Chapter 25 of the Rockville City Code).
www.rockvillemd.gov/index.aspx?NID=614

Maryland Commission on Climate Change. Global Warming and the Free State. Comprehensive Assessment of Climate Change Impacts In Maryland.
www.umces.edu/sites/default/files/pdfs/global_warming_free_state_report.pdf

Metropolitan Washington Council of Governments (MWCOC) (2008). National Capital Region Climate Change Report.
www.mwcog.org/uploads/pub-documents/zldXXg20081203113034.pdf

Metropolitan Washington Council of Governments. 2013. Summary of Potential Climate Change Impacts, Vulnerabilities, and Adaptation Strategies in the Metropolitan Washington Region: A synopsis of lessons learned from the Metropolitan Washington Council of Governments' climate adaptation planning initiatives from 2010-2012.
www.mwcog.org/uploads/pub-documents/pl5cXls20130701111432.pdf

National Aeronautics and Space Administration. Adapting to a Changing Climate, Federal Agencies in the Washington, DC Metro Area.
www.mwcog.org/uploads/committee-documents/bF1YWl9b20140721123701.pdf

Energy

City of Rockville, 2013. City of Rockville Energy Action Plan. Available at Rockville City Hall

Environmental Protection Agency (EPA), 2015. EPA Green Power Partnership.
www.epa.gov/greenpower/partners/index.htm

Maryland Clean Energy Center. Energy 101: A Resource Guide to Building the Maryland Energy Economy.
mdcleanenergy.org/all-about-energy/energy-101

Maryland Energy Administration, 2013. Maryland Smart Energy Communities Guidance Document for the Energy Efficiency Policy.
energy.maryland.gov/Govt/smartenergycommunities/documents/Guidance-Policy1_EnergyEfficiency_2-4-13.pdf

Maryland Energy Administration, 2013. Maryland Smart Energy Communities Guidance Document for the Renewable Energy Policy.
energy.maryland.gov/Govt/smartenergycommunities/documents/Guidance-Policy2-RenewableEnergyGoals2-5-13.pdf

Northeast Energy Efficiency Partnerships, 2013. Mid-Atlantic Technical Reference Manual Version 3.0.
www.neep.org/sites/default/files/resources/TRM_March2013Version.pdf

Optony Inc. (contractor to the US. EPA Green Power Partnership), 2013. Solar Feasibility Study for the City of Rockville. Available at Rockville City Hall.

Pepco Environmental Information for Standard Offer Service for Maryland:
www.pepco.com/uploadedFiles/wwwpepcom/PEPCO-MD%20ENV%20FUEL%20MIX%20JUNE%202014.pdf

U.S. Department of Energy's Alternative Fuels Data Center via National Renewable Energy Laboratory (NREL), 2015. Alternative Fueling Stations Locator.
www.afdc.energy.gov/locator/stations/

U.S. Department of Energy's Wind Program and the National Renewable Energy Laboratory (NREL), 2010. Maryland 80-Meter Wind Map and Wind Resource Potential.
www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=md

U.S. Environmental Protection Agency, 2011. Methodology for Incorporating Source Energy Use.
portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

Weigand Associates, Inc., 2008. Energy Conservation Study for Mechanical, Plumbing, Electrical and Lighting Systems at the Rockville Municipal Swim Center. Rockville City Hall

Green Building

City of Rockville, 2012. Buildings and Building Regulations (Chapter 5 of the Rockville City Code).
www.rockvillemd.gov/index.aspx?nid=604

Metropolitan Washington Council of Governments (MWCOC) (2011). Green Building Trends – How Green Building Impacted the National Capital Region Between 2003 and 2009.
www.mwcog.org/uploads/pub-documents/p15eX1k20110414134918.pdf

Green Building Information Gateway. www.gbig.org/

Appendix A - Rockville's Environmental Milestones

Year	Milestone
1977	Adopted Floodplain Management Ordinance (Chapter 10)
1978	Adopted and amended Grading, Erosion and Sediment Control Ordinance (Sec. 17-1.00, precursor to Chapter 19)
1983	Amended Grading, Erosion and Sediment Control (Sec. 17-1.00)
1984	Amended Grading, Erosion and Sediment Control (Sec. 17-1.00)
1985	Adopted resolution to create the Commission on Science and Technology, a five member appointment commission to recommend new technologies or scientific developments that may improve productivity, reduce energy consumption or enhance environmental health and safety (precursor to the Environment Commission)
1986	Adopted Sediment Control and Stormwater Management Regulations to include water quality requirements (Chapter 19)
1988	Amended Floodplain Management Ordinance
1991	Amended Sediment Control and Stormwater Management Regulations (Chapter 19)
1992	- Adopted Forest and Tree Preservation Regulations (Chapter 10.5) - Amended Floodplain Management ordinance to comply with federally mandated changes to the National Flood Insurance Program
1994	Prepared Cabin John Watershed Management Study
1996	Prepared Cabin John Watershed Management Plan
1998	Adopted Bikeway Master Plan
1999	Adopted Environmental Guidelines to provide guidance during the development review process
2000	- Prepared Rock Creek Watershed Management Plan - Adopted Street Tree Master Plan to provide for the planting and maintenance of a uniform streetscape on the City's streets - Amended Forest and Tree Preservation Regulations (Chapter 10.5)
2001	- Adopted Watts Branch Watershed Study and Management Plan - Constructed the Croydon Creek Nature Center to provide educational materials and outdoor experiences for residents
2002	- Adopted resolution to create the Commission on the Environment (Environment Commission), a nine member appointment commission to recommend policies and programs relating to the environment; watershed stewardship and protection; and promoting a sustainable community through initiatives relating to natural resource management and development, energy efficiency, pollution prevention, and public education. - Amended Sediment and Erosion Control Ordinance (Chapter 19) and Regulations to include the 2000 Maryland Stormwater Design Manual and statewide requirements for water quantity, quality and recharge. - Adopted Chapter 5, "The Environment- Sensitive Areas and Critical Issues" as an element of the Comprehensive Plan
2003	- Covered under the National Pollutant Discharge Elimination System General Permit for Discharges from Small Municipal Separate Storm Sewer Systems - Entered into an Energy Performance Contract (EPC) with Johnson Controls, Inc. for retrofits to reduce energy costs, improve occupant comfort, operate facilities in an environmentally friendly manner, and develop and implement an effective energy strategy
2004	- Participated in the Montgomery County Clean Energy Buyers Group to purchase 5 percent wind power through renewable energy certificates (RECs) - Adopted Bikeway Master Plan
2005	As part of the Energy Performance Contract, completed energy efficiency upgrades at 13 facilities and retrofitted 42 traffic signals with LED technology

Year	Milestone
2006	• Amended Forest and Tree Preservation Regulations (Chapter 10.5) • Established the Environmental Management Division to undertake cross-departmental cooperation and foster collaboration on environment and sustainability issues and initiatives • Signatory to the Potomac Watershed Trash Treaty committing to making the Potomac River watershed trash-free
2007	• Adopted Water Quality Protection Ordinance (Chapter 23.5) • Amended Forest and Tree Preservation Ordinance (Chapter 10.5) • Adopted a resolution in support of the U.S. Mayors Climate Protection Agreement and committing to take action to minimize emissions of carbon dioxide and other greenhouse gases • Adopted a resolution authorizing the City to join the International Council for Local Environmental Initiatives (ICLEI) and committing to reduce greenhouse gases and air pollution throughout the community • Adopted the "Strategy for a Sustainable Rockville" to make sustainability a way of organizing and managing the City
2008	• Implemented residential single stream recycling program • Adopted ordinance allowing Montgomery Code to apply in the City with respect to multifamily and commercial recycling • Amended Sediment and Erosion Control Ordinance (Chapter 19) and Regulations to create the Stormwater Management Utility Fee to provide a dedicated source of funding to comply with State and federal clean water requirements and maintain the stormwater conveyance and treatment system • Increased wind power purchase through renewable energy certificates (RECs) to 60 percent of the City's electricity demand • Adopted comprehensive amendments to the Zoning Ordinance (Chapter 25) to promote smart growth and green building practices • Completed urban tree canopy assessment to identify existing and possible tree canopy coverage areas
2009	• Adopted the Parks, Recreation and Open Space (PROS) Plan • Amended Forest and Tree Preservation Ordinance (Chapter 10.5) • Completed construction of the Thomas Farm Community Center, the City's first sustainable building to feature a geothermal heating and cooling system and pervious pavement • Adopted Complete Streets Policy • Adopted Landscaping, Screening and Lighting Manual
2010	• Awarded \$683,000 Energy Efficiency and Conservation Block Grant (EECBG) to replace 185 standard streetlights with LED fixtures and improve the energy efficiency of the Pump House Community Center and the Rockville Senior Center • Adopted comprehensive amendments to the building codes (Chapter 5) referencing the 2009 International Energy Conservation Code to improve energy efficiency and establishing Green Building Regulations for new construction, major additions and renovations • Amended Sediment Control and Stormwater Management Ordinance (Chapter 19) and Regulations to comply with the Maryland Stormwater Management Act of 2007 • Adopted Water Resources Element of the Comprehensive Master Plan • Amended the Zoning Ordinance (Chapter 25) to revise the public use space requirements • Amended Forest and Tree Preservation Regulations (Chapter 10.5)
2011	• Amended Forest and Tree Preservation Ordinance (Chapter 10.5) • Approved Cabin John Watershed Study and Management Plan • Adopted a resolution to join the U.S. Environmental Protection Agency's (EPA) Green Power Partnership and become a Green Power Community. • The drinking water treatment plant enrolled in an electricity demand response program that pays the City for its ability to reduce loads on the electrical grid during peak demand times
2012	• Amended Sediment Control and Stormwater Management Ordinance (Chapter 19) and Regulations in accordance with the Code of Maryland Regulations (COMAR) 26.17.01, the 2011 Maryland Standards and Specifications • Adopted amendments to the building codes (Chapter 5) referencing the 2012 International Energy Conservation Code to improve energy efficiency of residential and commercial buildings • Adopted a high performance building tax credit for existing commercial buildings (Chapter 22) to encourage investment in energy efficiency and renewable energy, improve operations and performance, and to support and expand green jobs and businesses • Became the second Maryland municipality to achieve certification through the Sustainable Maryland Certified Program, a voluntary initiative of the University of Maryland's Environmental Finance Center and the Maryland Municipal League (MML) • Completed construction of the Rockville Police Headquarters, featuring energy efficient technology and the City's first green roof • Recognized as a Bicycle Friendly Community at the Bronze level by the League of American Bicyclists

Year	Milestone
2013	• Adopted a resolution to enroll as a Maryland Smart Energy Community and establish a 15 percent energy efficiency goal and a 20 percent renewable energy goal for municipal facilities and operations and developed an Energy Action Plan to identify potential projects to achieve the goals • Approved Rock Creek Watershed Management Plan • The Maryland Department of Housing and Community Development designated significant portions of Montgomery County, including the City of Rockville, as a Sustainable Community to be targeted as priority or enhanced consideration for various state programs and incentives promoting reinvestment and revitalization is established residential and commercial neighborhoods and transit-oriented development
2014	• Increased wind power purchase through renewable energy certificates (RECs) to 100 percent of the City's electricity demand • Adopted a resolution in support of the HEAL (Healthy Eating and Active Living) Cities and Towns Campaign
2015	• Approved Watts Branch Watershed Study and Management Plan (anticipated) • Approved updated Bikeway Master Plan (anticipated) • Reissued National Pollutant Discharge Elimination System General Permit for Discharges from Small Municipal Separate Storm Sewer Systems (anticipated)