Green Infrastructure

A Plan for Balancing Our Natural and Built Systems

An Element of the Livable Frederick Comprehensive Plan

Frederick County, Maryland 2026

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A FOUNDATIONAL ACKNOWLEDGMENT

A MESSAGE FROM THE COUNTY EXECUTIVE

FREQUENTLY USED TERMS

Champion Tree: The largest tree of its species within the United States, a state, county, or municipality, as appropriate.

Conservation: The management and protection of natural resources, such as wildlife and habitats, to maintain their ecological integrity and ensure their sustainability for future generations. In the context of the Green Infrastructure Plan, the National Park Service simply summarizes conservation as the "proper use of nature."[1]

Corridor: A component of a green infrastructure network often comprised of forested stream valleys, ridgelines, or other natural areas that connect hubs. Corridors can also provide wildlife habitat, facilitate wildlife migration, and perform many of the same important ecological functions performed by hubs.

Ecosystem Services: Benefits people gain from the natural environment, such as clean air, clean water, and healthy foods.

Evapotranspiration: The process through which water moves from vegetation, the soil surface, or the soil subsurface to the atmosphere. It combines evaporation from soils and transpiration from plants. Transpiration is the exhalation of water vapor by plants through stomata (small pores or in their leaves) as part of photosynthesis.

Forest: A subtype of tree canopy defined by the US Forest Service as, "[A]n area of trees with at least 10% tree canopy cover that is at least 1 acre in size, [and] is at least 120 feet wide when measured from stem to stem." The Natural Resources article of Maryland defines forest as, "[A] biological community dominated by trees and other woody plants covering a land area of 10,000 square feet or greater. This includes areas that have at least 100 trees per acre with at least 50% of those trees having a 2 inch or greater diameter at 4.5 feet above the ground and areas that have been cut but not cleared." In the State of Maryland, this definition does not include orchards.

Gap: Areas identified in green infrastructure networks often comprised of developed, agricultural, mined, or cleared lands that could be targeted for restoration. Gaps also refer to areas in a green infrastructure network that lack natural vegetation and can be naturally occurring. Some natural gaps are part of a healthy ecosystem and should not be targeted for forest restoration.

Gray Infrastructure: Systems engineered and constructed by humans like roads, drinking water systems, wastewater systems, and dry utilities (electric, gas, data, etc.).

Green Infrastructure: Often viewed as a corollary to gray infrastructure systems, green infrastructure can work in concert with them. Green infrastructure possesses a physical footprint like hard infrastructure, but it can augment soft infrastructure to build capacity, improve health, create job opportunities, and improve community cohesion.[2] Also defined to as, "[A] strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains ecological processes, sustains air and water resources, and contributes to the health and quality of life for America's communities and people." [3]

FIDS: Forest interior dwelling bird species (FIDS) that require large, contiguous blocks of forest to breed successfully and maintain viable populations. This designation includes many migratory bird species that spend their summers in Frederick County, including tanagers, warblers, and vireos.

GreenPrint: Another name for a green infrastructure plan. It illustrates the structure for a green infrastructure network in the same way a "blueprint" illustrates the structure of a building.

Hard Infrastructure: Infrastructure with a physical footprint.

Hub: A component of a green infrastructure network often comprised of large blocks of intact forest or wetland habitat that provide shelter for wildlife and perform a variety of important ecological functions

Intermittent Stream: A stream in which surface water is absent during a portion of the year as shown on the most recent 7.5-minute topographic quadrangle published by the United States Geological Survey as confirmed by field verification.

Landscape: A mosaic of ecosystems or land uses that possess common attributes that are repeated across a large area.[4]

Managed Retreat: Managed retreat is a tool for community adaptation to repeated environmental threats that involves the physical relocation of people, structures, and infrastructure away from areas exposed to repeat hazards.[5]

Nontidal Wetland: An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation. In the State of Maryland, the determination of whether an area is considered a nontidal wetland is made in accordance with the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands", published in 1987, and as may be amended and interpreted by the U.S. Army Corps of Engineers (USACOE). For Frederick County, the Regional Supplement to the USACOE Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0) provides supplemental technical guidance and procedures for delineating nontidal wetlands.

One-Hundred-Year Floodplain: An area along or adjacent to a stream or body of water, except tidal waters, that can store or convey floodwater during a 100-year frequency storm event. A 100-year flood is a flood which has a 1% chance of being equaled or exceeded in any given year. Except for Class III waters (natural trout streams), a body of water with a watershed less than 400 acres is excluded.

Perennial Stream: A stream containing surface water throughout an average rainfall year (October 1st – September 30th of any given year), as shown on the most recent 7.5-minute topographic quadrangle published by the United States Geological Survey, as confirmed by field verification.

Preservation: The protection of natural, cultural and historical sites, such as the unique features of landscapes or landmarks in order to maintain their authenticity or historical significance. In the context of the Green Infrastructure Plan, the National Park Service simply summarizes preservation as the "protection of nature from use."[6]

Priority Funding Area (PFA): A PFA is a developed or planned development area, within which certain State or Federal agencies will prioritize investments to support growth and economic development. Also identified under § 5-7B-02 of the State Finance and Procurement Article.

Riparian Buffer: An area adjacent to a stream, lake, or wetland that contains a combination of trees, shrubs, and/or other perennial plants and is managed differently from the surrounding landscape, primarily to provide conservation benefits.[7]

Soft Infrastructure: Systems of services provided to a community such as education, healthcare, and governance.

Specimen Tree: A tree having diameter measured at 4.5 feet above the ground of: (1) Thirty inches or greater; or (2) Seventy-five percent of the diameter of the current state, county, or municipal champion tree of that species as designated by the Department of Natural Resources, or the county, or the applicable municipality.

Watershed: "[T]hat area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of the community." - John Wesley Powell

Section Endnotes

1 <https://www.nps.gov/teachers/classrooms/conservation-preservation-and-the-national-park-service.htm>.

2 Rouse, D. C., & Bunster-Ossa, I. F. (2013). Green infrastructure: A Landscape Approach. Routledge.

3 Benedict, M. A., McMahon, E. T. (2006). Green Infrastructure: Linking Landscapes and Communities.

4 Forman, Richard T. T., 1995, Land Mosaics: The Ecology of Landscapes and Regions. Cambridge, UK: Cambridge University Press

5 American Meteorological Society. (n.d.). Managed Retreat: An Introduction and Exploration of Policy Options. <https://www.ametsoc.org/ams/policy/studies-analysis/managed-retreat-an-introduction-and-exploration-of-policy-options/>

6 <https://www.nps.gov/teachers/classrooms/conservation-preservation-and-the-national-park-service.htm>

7 Riparian forest buffers. (n.d.). <https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php>

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The Livable Frederick Vision Description

Our COMMUNITY enables young and old to lead fulfilling lives. We ensure that all people can be successful, enjoy a HIGH QUALITY OF LIFE and are free from poverty.

Residents are energized by our UNIQUE SENSE OF PLACE, our rich and deeply rooted history, small towns, natural resources, and cultural amenities.

Frederick County provides interesting and fulfilling JOBS and options for everyone to support their families.

We embrace businesses of all types and sizes to ensure a vibrant and STRONG ECONOMY.

We value our traditional industries while seizing the opportunities of THE FUTURE, healthcare, biotech, advanced technology, and more.

AGRICULTURE is vibrant and viable. People love fresh food and farm to fork.

GOOD HEALTH is fundamental to our quality of life. We value a HEALTHY ENVIRONMENT, clean air, water, and green energy, and are good stewards of our environmental and natural resources.

Frederick County planning enhances our towns and neighborhoods, while preserving what we love: FARMS, HISTORY, OUTDOOR ACTIVITIES, and THE ENVIRONMENT.

Our transportation system is MULTI-MODAL and diverse. It moves people, and goods both locally and regionally, in a timely and safe manner, and provides the ability to enjoy and function in life WITHOUT NEEDING A CAR.

Frederick County is a SAFE PLACE to live, work, and play due to our many committed emergency services providers and caring communities.

Frederick County offers excellence in public EDUCATION and lifelong LEARNING opportunities, which results in an educated and trained workforce to ensure our long term economic prosperity.

Frederick County PROVIDES GREAT PLACES TO LIVE, from our small towns and villages, to our urban downtown, quaint main streets, and rural countryside.

There is SOMETHING FOR EVERYONE!

Chapter 1

Introduction

LIVABLE FREDERICK MASTER PLAN

The Green Infrastructure Plan is a long-range planning document that exists within the context of a broader planning initiative known as Livable Frederick. With the adoption of the Livable Frederick Master Plan in September 2019, Frederick County created a new framework for making strategic decisions about the County's future. The Livable Frederick Comprehensive Plan serves as an umbrella under which a multitude of plans, policies, studies, and regulations are continuously emerging and evolving. This Green Infrastructure Plan is one such effort. This opening chapter is intended to familiarize you, the reader, with the Livable Frederick Comprehensive Plan, the relationship of the Green Infrastructure Plan to the Livable Frederick Comprehensive Plan, and to provide background and justification for green infrastructure planning in Frederick County.

The Livable Frederick Master Plan (or LFMP) is a vision-based strategic plan for the County's long term future well-being and, once it was adopted, it became the beating heart of the County's Comprehensive Plan. The LFMP features a Vision, a Development Framework, and an Action Framework detailing goals and initiatives organized by the four fundamental Livable Frederick Vision themes of Community, Health, Economy, and Environment.

The LFMP Vision

The LFMP Vision provides a description of the characteristics of life in Frederick County in the year 2040. It was generated through a collaborative process of citizen participation, and it is intended to create a vivid mental image. The LFMP Vision establishes the starting point for all policy content described in the Livable Frederick Master Plan. The LFMP Vision is also composed of three parts: a statement, a description, and the four vision themes.

The statement describes the desired future of the County in brief:

IT IS THE YEAR 2040. FREDERICK COUNTY IS A VIBRANT AND UNIQUE COMMUNITY WHERE PEOPLE LIVE, WORK, AND THRIVE WHILE ENJOYING A STRONG SENSE OF PLACE AND BELONGING.

The Vision description expands on the Vision statement. It acknowledges those aspects of living in Frederick County that make it vibrant and unique, and it indicates the things that Frederick County has done and can continue to do that will help us achieve the Vision.

The Vision themes group functionally-specific vision content into four categories: Our Community, Our Health, Our Economy, and Our Environment. The Vision Themes also serve to organize the goals and initiatives described later in the Action Framework of the LFMP and in Chapter 5 of the Green Infrastructure Plan. Much of the work associated with the Green Infrastructure falls under the vision theme of Our Environment, and the following statements directly influence the preparation of this Green Infrastructure Plan:

WE LIVE IN A COUNTY, A PLACE, of great physical richness and beauty. We are fulfilling our stewardship by making Frederick County an environmentally sustainable place with clean air, clean water, healthy soil, protected farmland and open space.

OUR COUNTY HAS MAINTAINED the commitment to respond to our ongoing climate change crisis in a manner that reflects the magnitude of the threat to our community and our share of the responsibility for the problem. We have been resolute and innovative in our efforts to reduce our contribution to greenhouse gas emissions, to sequester carbon, and to be adaptive and resilient in the face of the changes and challenges associated with our changing climate.

WE SUPPORT FLEXIBLE AND EFFICIENT ELECTRIC GRIDS by enabling the integration of growing deployments of distributed energy resources powered by renewable energy resources. These improve the reliability and resiliency of the County's electrical grid.

WE ARE SHEPHERDS OF OUR County and leave to successive generations healthy soil that sustains our agricultural bounty, clean air and water, lessons from our rich heritage, and the fruits of our planning together for an intentional future.

WE HAVE ENSURED THAT THE contributions of natural resources to human well-being are explicitly recognized and valued. We are committed to preserving and improving their health and being in harmony with nature, and our County is greenhouse gas negative.

WE CONTINUE TO PROTECT AND enhance Catoctin Mountain, the Monocacy River, and all of Frederick County's watersheds for residents and visitors alike. Our County supports efforts in Maryland and the region to foster clean air and water resources. We support reduced carbon, heavy metal, and other toxic emissions into air, soil, and water through a variety of energy, transportation, building, agricultural, and active living initiatives.

FREDERICK COUNTY HAS IT ALL: beauty, prosperity, convenience, sustainability, and safety. It continues to offer a small town feel with 21st century urban opportunity. We are a model for counties nationwide.

The Development Framework and Thematic Plan

The Development Framework of the LFMP provides a written narrative and an illustrative map to explain the important ideas and concepts regarding the preferred geographic distribution and intensity of future growth. It is composed of two parts: Scenario Planning and a Thematic Plan.

Scenario Planning under the LFMP was conducted using growth forecasting tools and with a particular focus on the importance of transportation and how growth patterns within communities can impact transportation networks and quality of life for residents.

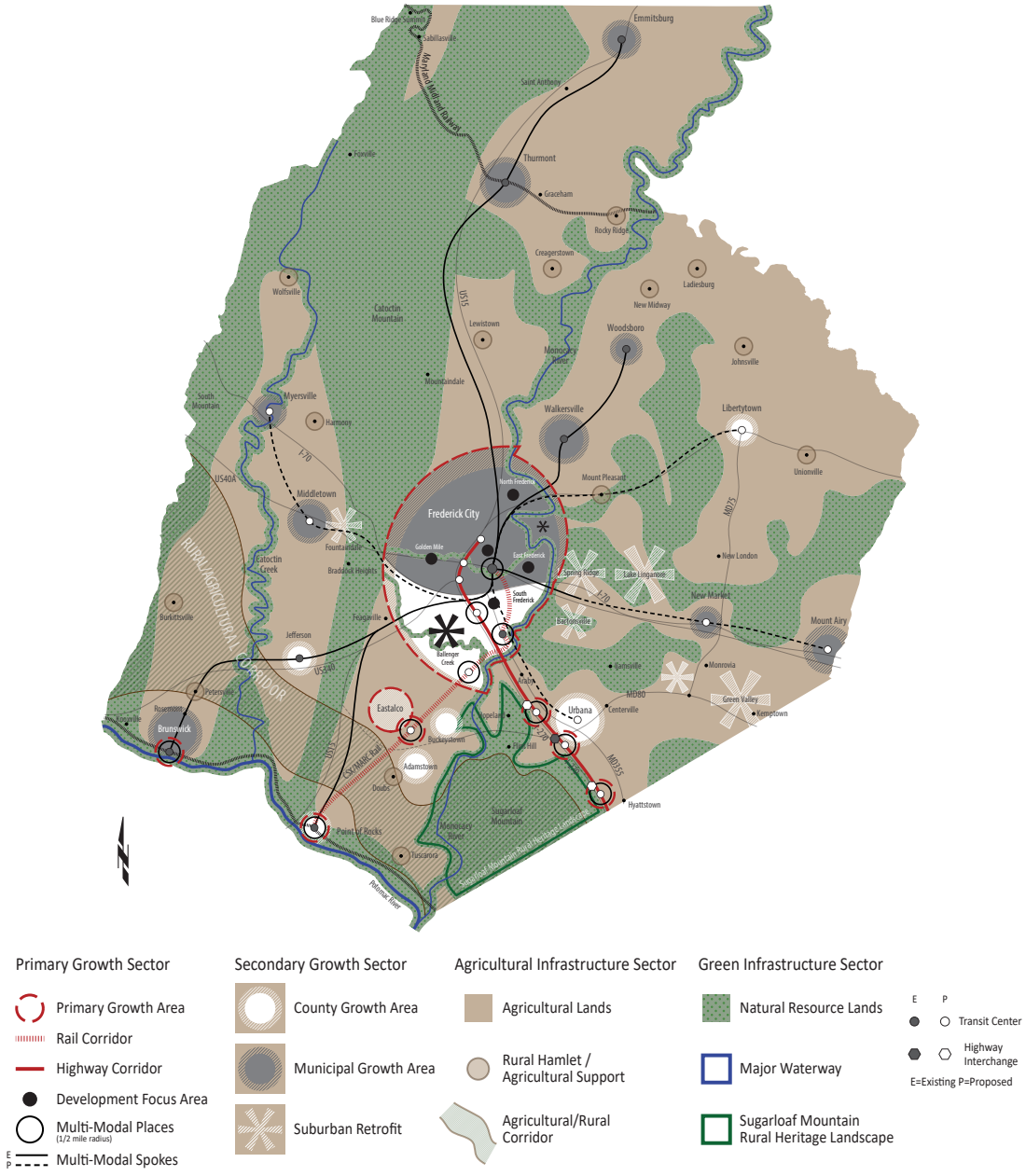
The Thematic Plan diagram broadly reflects the visions and strategies articulated in the LFMP. The Thematic Plan graphically depicts the preferred pattern and geographic distribution of new development in the County within the Primary and Secondary Growth Sectors, as well as the general pattern of conservation of our natural resources within the Green Infrastructure Sector and the Agricultural Infrastructure Sector.

The Primary and Secondary Growth Sectors

The Primary Growth Sector is composed of land in and around Frederick City, including the Frederick City Growth Area, the Ballenger Creek Community Growth Area, the South Frederick Community Growth Area,[8] and lands along major infrastructure corridors in the southern portion of the County that connect to regional employment centers. These areas include the Eastalco Growth Area, the Brunswick Community Growth Area, the Urbana Community Growth Area, and the I-270 corridor.

The Secondary Growth Sector is comprised of retrofit districts (areas in which further investment can make existing suburban communities stronger) and community districts (existing municipalities and growth areas that can be strengthened and improved through further investment).

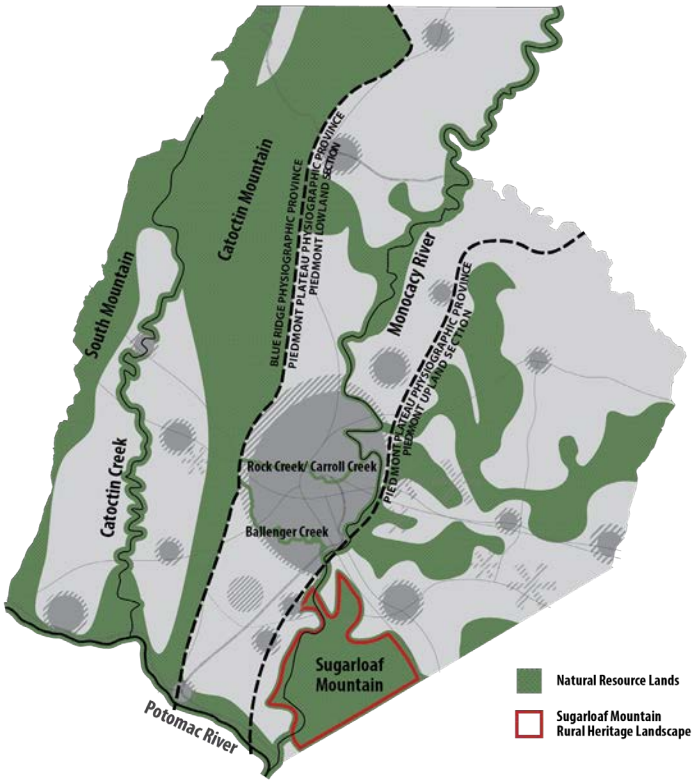
Figure 1: The Livable Frederick Thematic Plan.



The Green Infrastructure Sector

The Green Infrastructure Sector of the LFMP is identified as supporting the conservation of natural resources and environmentally-sensitive areas in the County, directing urban and suburban growth away from green infrastructure and sensitive areas, and ensuring the protection and integration of green infrastructure where it already exists within areas targeted for growth.

Figure 2: The Livable Frederick Green Infrastructure Sector.



The LFMP also states that the Green Infrastructure Sector in Frederick County is comprised of two components: the green infrastructure network (comprised of hubs and corridors) and Environmentally Sensitive Areas (ESAs). Hubs, corridors, and ESAs will be described in greater detail in the discussion of "what is green infrastructure" and of existing Sensitive Area regulations later in this chapter. Beyond these two elements, green infrastructure can also include other drivers and sustaining systems of communities, such as the generation, distribution, and consumption of clean energy. Within each component of green infrastructure identified in the LFMP, there is an inherent recognition of the benefits that it can provide to communities.

The Agricultural Infrastructure Sector

The Agricultural Infrastructure Sector is intended to support continued and innovative agricultural development in Frederick County, such as regenerative farming practices, and to direct urban/suburban growth away from high-value and high-functioning agricultural land. The Green Infrastructure Plan will address some aspects of the Agricultural Infrastructure Sector because agriculture can also be seen as a means of preserving and protecting open space and green space. Agricultural, or "working landscapes," also provide habitat for fish and wildlife, help protect water resources and promote aquifer recharge, and

can connect or buffer green infrastructure elements. The significant economic value of working landscapes in Frederick County, not only in terms of crop productivity, should also be acknowledged.

Functional Plans

Targeted planning initiatives under the LFMP include the creation of "Functional Plans," where the focus is on specific land uses, policies, or infrastructure throughout the County. The Green Infrastructure Plan is an example of a functional plan, intended to promote focused planning efforts that will serve to update the Comprehensive Plan as a whole. A functional plan is not intended to target a specific area of the County but to focus on specific types of land uses, resources, or infrastructure wherever they occur within the County.

THE GREEN INFRASTRUCTURE PLAN PROCESS

The Green Infrastructure Plan development process began in the Fall of 2024. The various stages of plan development are addressed in the following pages.

Green Infrastructure Advisory Group

Livable Frederick convened an Advisory Group to provide input and perspective during the planning process. This group included residents and representatives from businesses, institutions, and non-profit organizations across the County who have significant experience with topics covered in the Green Infrastructure Plan. The initial series of Advisory Group meetings were held between October 2024 and January 2025. Feedback was solicited from the advisory group through a series of activities and discussions. An additional Advisory Group meeting was held in July 2025 to review the input received at the Community Meetings as well as early work by Staff on network mapping and the plan document development. All Advisory Group meetings were open to the public, but the meetings focused on discussions between group members and Livable Frederick staff.

Image 1: Advisory Group members work on green infrastructure asset and risk mapping.

(Image Credit: Livable Frederick)

Community Outreach Meetings

A series of public outreach meetings were held to solicit input from landowners, residents, business owners, and institutional stakeholders. These meetings were conducted in an open house format in March 2025 and April 2025 at libraries in the Town of Thurmont, the Town of Middletown, and in Urbana. Meeting attendees were able to talk with staff about the Green Infrastructure Plan and to complete activities soliciting feedback on the Green Infrastructure Plan as well as the Housing Element of the County Comprehensive Plan and the County's update to the 2007 Historic Preservation Plan.

Image 2: The Frederick Futures open house at Urbana Regional Library in April 2025.

(Image Credit: Livable Frederick.)

Plan Drafting

The Green Infrastructure Plan was developed by the Livable Frederick Planning and Design Office between August 2024 and December 2025.

Planning Commission Workshops

A series of workshops were held with the Frederick County Planning Commission between August 2025 and December 2025 to develop the Commission's Recommended Green Infrastructure Plan. The workshops included opportunities for public comment on the initial draft of each chapter of the Plan.

60-Day Review

The Frederick County Planning Commission voted to release the Green Infrastructure Plan for 60-day Review on December 10, 2025. A draft of the plan was distributed to state agencies, to the incorporated municipalities in Frederick County, and to neighboring counties to request feedback on the draft plan.

Planning Commission Public Hearing

A Planning Commission public hearing was held on _____. Following the public hearing, the Planning Commission approved its Recommended Plan to be forwarded to the Frederick County Council.

County Council Workshops

A series of workshops were held with the Frederick County Council between _____ _____ to develop the final Green Infrastructure Plan. The workshops included opportunities for public comment on the Plan.

County Council Public Hearing and Adoption

Following the public hearing on _____,the Frederick County Council voted to adopt the Green Infrastructure Plan as a Functional Element of the Livable Frederick Comprehensive Plan on _____ _____.

WHY GREEN INFRASTRUCTURE

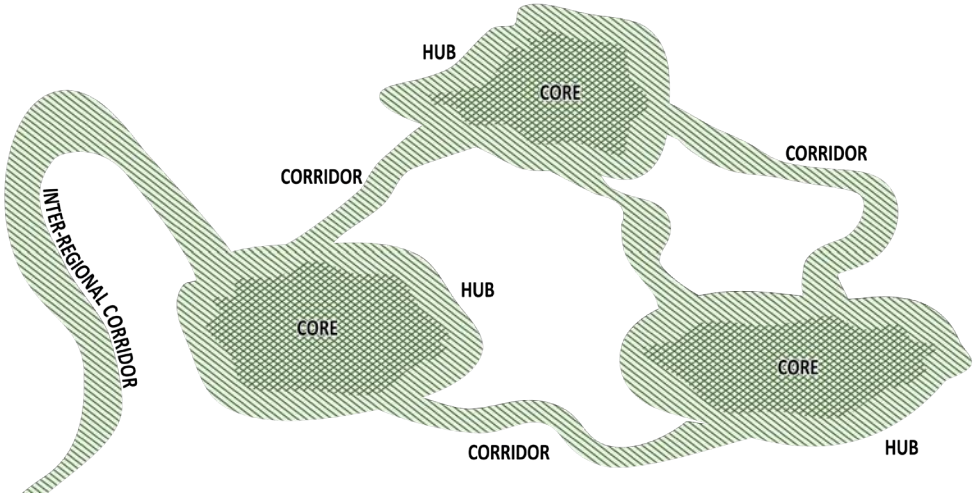
In the discussion of the Vision Theme 'Our Environment,' the Livable Frederick Master Plan highlights the role that the natural environment, wild habitats, and ecosystem services play in sustaining our quality of life. It also states that they should be a primary consideration in all land planning and government decision-making processes. The following section of the Green Infrastructure Plan is intended to provide more background to support the assumed value of the natural environment, wild habitats, and ecosystems in the LFMP.

Definition of Green Infrastructure

Green infrastructure can be defined in several ways. At a regional scale, it is typically defined as "[a] strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains ecological processes, sustains air and water resources, and contributes to the health and quality of life for America's communities and people."[9]

This strategically planned network is often comprised of two types of building blocks. The first are "hubs," which are defined as large blocks of intact forest or wetland habitat that provide shelter for wildlife and perform a variety of important ecological functions (improving air and water quality, facilitating evapotranspiration and groundwater recharge, etc.), and "corridors," which are often identified as the forested stream valleys, ridgelines, or other natural areas that connect hubs. Corridors can also provide wildlife habitat, facilitate wildlife migration, and perform many of the same important ecological functions performed by hubs.

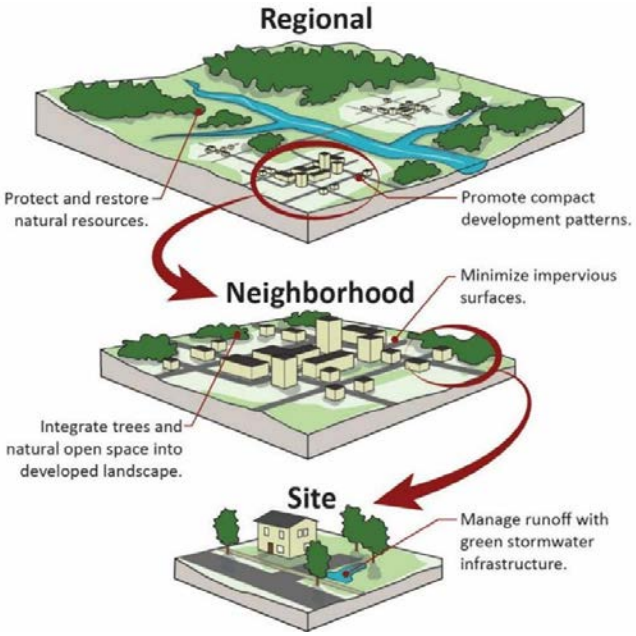
Figure 3: The Hub and Corridor Green Infrastructure Concept



Source: Modified from <https://archive.epa.gov/region03/green/web/html/infrastructure.html>.

Green infrastructure has also been used to refer to neighborhood or site specific practices that utilize natural processes to mitigate environmental impacts inherent to cities, towns, and the built environment. The United States Environmental Protection Agency (EPA) refers to green infrastructure as practices that use "filtration, infiltration, and evapotranspiration to treat and soak up rainwater where it falls. It [green infrastructure] can deliver multiple environmental, social, and economic benefits beyond stormwater management alone. Terms such as nature-based solutions, green stormwater infrastructure, and low-impact development are also used to describe green infrastructure installations, and there is overlap between these concepts."[10]

Figure 4: The Multiple Scales of Green Infrastructure



Source: <https://www.epa.gov/system/files/documents/202407/basics_of_green_infrastructure.pptx>

For the most part, this Green Infrastructure Plan is more focused on the regional-scale definition of green infrastructure, but it also addresses certain aspects of neighborhood and site-specific infrastructure.

Green infrastructure also represents one of several types of infrastructure that can be used to support communities or to enhance the efforts of federal, state, county, or municipal governments to improve quality of life for their constituents. These differing types of infrastructure include:

Types of Infrastructure[11]

- Hard Infrastructure: Infrastructure with a physical footprint.
- Soft Infrastructure: Systems of services provided to a state, county, or a community such as education, healthcare, or governance.
- Gray Infrastructure: Systems engineered and constructed by humans like roads, drinking water systems, wastewater systems, and dry utilities (electric, gas, data, etc.).
- Green Infrastructure: Often viewed as a corollary to gray infrastructure systems but can work in concert with them. Green infrastructure possesses a physical footprint like hard infrastructure that can augment soft infrastructure to build capacity, improve health, create job opportunities, and improve community cohesion.

It should be noted that, unlike hard or grey infrastructure systems that are typically funded or considered in federal, state, county, or municipal budgets, local green spaces are often viewed as inherently self-sustaining. While many natural processes can and often do continue to function without inputs in terms of capital or manpower, the misplaced assumption that these processes do not need to be monitored or carefully supported can lead to the establishment of environmental externalities, which result in situations in which costs generated by a limited number of producers are subsequently borne by a community as a whole.

What is an Environmental Externality?

Environmental externalities are the costs or benefits of a production or consumption activity that affect third parties not directly involved in a transaction. They manifest when the full environmental consequences of an action are not accounted for by the entity responsible for it, and they can have both positive and negative impacts for communities. Examples of negative externalities include deforestation and habitat loss and the resulting negative effects on rainwater infiltration, air quality, and biodiversity or the global impacts of a changing climate that are not reflected in the price of fossil fuels. Examples of positive externalities include the effects of carbon sequestration in trees and forests or improvements to air quality and the capture of rainwater by those same trees and forests. Externalities are revisited later in this chapter under the discussion of “ecosystem services.”

In the book, *Green Infrastructure: Linking Landscapes and Communities*, authors Mark A. Benedict and Edward McMahon note that the green infrastructure concept is a better framework for planning communities because it looks at land preservation and conservation in concert with development opportunities and in ways that can meet the needs of both people and nature. In their book title *Strategic*

In pursuit of a more balanced and measured way to manage land use and development across the State of Maryland, House Bill 286 was signed by Maryland's Governor Wes Moore on April 8, 2025, and it officially replaced the 12 State Planning Visions (adopted by the Maryland General Assembly in 2009) with 8 Planning Principles. The new Planning Principles are intended to emphasize a holistic approach to community development that focuses on sustainability, public participation and economic growth in a manner that also ensures environmental protection.

Maryland's 8 Planning Principles

(1) Land: Optimize land productivity of working landscapes, including farms and forests, and fisheries, and prioritize development within population centers and that are in proximity to existing infrastructure and facilities;

(2) Transportation: Prioritize transportation networks that create energy efficient, affordable, and reliable access to jobs, housing, and services;

(3) Housing: Enable a mix of quality housing types and affordability options to accommodate all who want to live in the state;

(4) Economy: Allow for adaptive reuse, mixed–use, and context appropriate new development that responds to changing markets and innovations;

(5) Equity: Engage all sectors of the community in plan development to ensure diverse voices are heard and the needs of underserved populations are prioritized;

(6) Resilience: Integrate resiliency measures that will minimize the impacts of rapid and unexpected natural– and human–caused threats on communities;

(7) Place: Provide for public spaces that encourage social interaction and value cultural, historical, and natural resources; and

(8) Ecology: Protect and restore sensitive ecological systems and conserve natural resources, including forests, agricultural areas, and waterways.

HB 286 also includes changes to both the Land Use Article and the State Finance and Procurement Article that incorporate the 8 Planning Principles with a goal of advancing sustainable growth in the State of Maryland. The 8 Planning Principles are intended to serve as a cleaner, simpler focus on policies that fairly and effectively address economic, social, and environmental issues affecting Maryland residents now and in the future.

Green Infrastructure Planning: A Multi-Scale Approach, Karen Firehock and R. Andrew Walker state that, "thinking about environmental resources as green infrastructure is a way to recognize that they have value to people," and that, "they provide life-sustaining function … with tangible social and economic benefits."[12] In other words, green infrastructure planning can be thought of as a means for achieving sustainable community growth.

The Triple Bottom Line of Sustainability

If there are terms used in this Plan that could have more potential meanings in more contexts than "green infrastructure" or "infrastructure," those terms would be "sustainable" or "sustainability." At the most basic level, "sustainability" is defined as anything capable of being continually utilized at a certain rate or level (i.e., it is "sustainable") without interruption or weakening.[13] The most often quoted definition for the concept of sustainability in the context of the impact of development on the environment comes from the United Nations World Commission on Environment and Development's Brundtland Report, which states that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[14]

A common way of describing sustainable systems is illustrating how they account for the "triple bottom line" of sustainability, or the three "E's" of "equity, economy, and environment." The three E's are intended to highlight the relationships between the availability of resources, the rate of their consumption (and by whom), and the ability of those resources to recover as a result of use. In *Green Infrastructure: A Landscape Approach*, Daniel Rouse and Ignacio Bunster-Ossa also described the triple bottom line as the three "P's" of sustainability, or "people, prosperity, and planet." Rouse and Bunster-Ossa also identify a number of ways in which green infrastructure can help support the triple bottom line of sustainability in our communities:[15]

Equity (or People)

- Green infrastructure can promote healthy lifestyles by providing outdoor recreation opportunities and enabling people to walk or bike as part of their daily routines.
- It can improve environmental conditions (e.g., air and water quality) and their effects on public health.
- It can promote environmental justice, equity, and access for underserved populations.
- It can provide places for people to gather, socialize, and build community spirit.
- It can improve the aesthetic quality of urban and suburban development.
- It can provide opportunities for public art and expression of cultural values.
- It can connect people to nature. Studies have shown that better health outcomes, improved educational performance, and reduced violence can be among the resulting benefits.
- It can yield locally produced resources (food, fiber, and water).

Economy (or Prosperity)

- Green infrastructure can create job and business opportunities in fields such as landscape management, recreation, and tourism.
- Studies have shown that it can stimulate retail sales and other economic activity in local business districts.
- It can increase property values.

- It can attract visitors, residents, and businesses to a community.
- It can reduce energy, healthcare, and gray infrastructure costs, making more funds available for other purposes.

Environment (or Planet)

- Green infrastructure can absorb stormwater, reducing runoff and associated impacts such as flooding and erosion.
- It can improve environmental quality by removing harmful pollutants from the air and water.
- It can moderate the local climate and lessen the urban heat island effect, contributing to energy conservation.
- It can preserve and restore natural ecosystems and provide habitats for native fauna and flora.
- It can mitigate climate change by reducing fossil fuel emissions from vehicles, lessening energy consumption by buildings, and sequestering and storing carbon.

Together with gray infrastructure systems, green infrastructure systems help make up the landscape of many communities. The relationship between the two systems can often be seen as competitive given the scarce availability of space, funding, or other resources, but opportunities do exist for cooperation in these systems. Communities that effectively harness, integrate, and maintain both green and grey infrastructure stand to benefit from a variety of perspectives. An excellent local example of leveraging both green and grey infrastructure to realize their respective strengths are Baker Park and Carroll Creek Linear Park in the City of Frederick. Together, these parks integrate engineered (grey) flood control structures and public parkland with ample urban tree canopy (green) to support the local population, enhance local prosperity, and improve the planet.

Image 3: The weir wall in Baker Park in the City of Frederick maintains water levels in Carroll Creek upstream of the flood control structures in Carroll Creek Linear Park.

(Image Credit: Livable Frederick)

Ecosystem Services and "Return on Environment"

Green infrastructure can provide a variety of benefits to states, counties, and towns that include but are not limited to the following, as described by the United States Environmental Protection Agency (US EPA):

Figure 5: The Potential Benefits of Green Infrastructure

Source: https://www.epa.gov/system/files/documents/2024-07/basics_of_green_infrastructure.pptx.

While the US EPA's categories reflect the "triple bottom line," in *Green Infrastructure: A Landscape Approach*, the authors categorize these benefits in a similar, yet slightly more comprehensive set of four categories. They include:[16]

- Regulating Services: Maintaining air quality, reducing the heat island effect, improving water quality, sequestering carbon, and reducing localized flooding.
- Supporting Services: Crop pollination, nutrient cycling, improving property values, reducing flood damage costs, green jobs, and habitat connectivity.
- Cultural Services: Outdoor recreation, community bonding, spiritual inspiration, and improved community health and engagement.
- Provisioning Services: Food production, water production, timber, and firewood production.

Taken together, these benefits are also often defined as "ecosystem services," or the direct and indirect contributions that healthy ecosystems provide to society.

The Maryland Department of Natural Resources' (DNR) Chesapeake and Coastal Service studied the impact of ecosystem services on the state's economy in a 2017 report titled *Accounting for Maryland's Ecosystems Service: Integrating the Value of Nature into Decision Making.* At the time the report was drafted, DNR identified Maryland as the 5th most densely populated state in the nation.[17] The report also notes that, while it's relatively easy to apply a dollar value to provisioning services, it's not as easy to apply value to environmental benefits of green infrastructure that are often referred to as regulating services.

DNR adds that an absence of commonly accepted economic values for these services can lead them being viewed as "free subsidies" for society or as "positive market externalities" that provide a benefit to parties that are not financially responsible for the management or protection of the benefits they receive from them. If such services, or the resources that provide them, are overtaxed or under supported, there

is potential for the resources and the associated services to be lost - opening the gates for an eventual impairment of the health of current or future generations. Examples of free subsidies received by society would be shade and clean air provided by a community's tree canopy. If each property owner in a community were to remove all the trees from their property because they did not wish to rake leaves each year, while counting on their neighbors not to do the same because they assume everyone appreciates shade and clean air, the few trees (if any) that remain would not be able to provide the full scope of services that were provided by the previous tree canopy.

Types of Economic Value

Market Value: The type of value we most often consider. It equates to the price of a good or service in a market. From the market price economists calculate consumer surplus, the difference between what someone paid for a good or service and the most they would have been willing to pay.

Social Value: For most ecosystem services, such a market does not exist. Many different non-market valuation methods have been proposed. They range from asking a sample of people what they would pay for an ecosystem service (contingent valuation) to using the price of proximal homes to estimate the value people place on being near natural areas (hedonic pricing), or evaluating what it costs to visit a natural area (travel cost analysis). Social Value measures the benefit of something not just at the level of the individual (i.e., someone's willingness to pay for a good or service), but the benefit to a group of people. This type of valuation is particularly appropriate for valuing ecosystem services, as they very often benefit the public as a whole and do not have traditional markets.

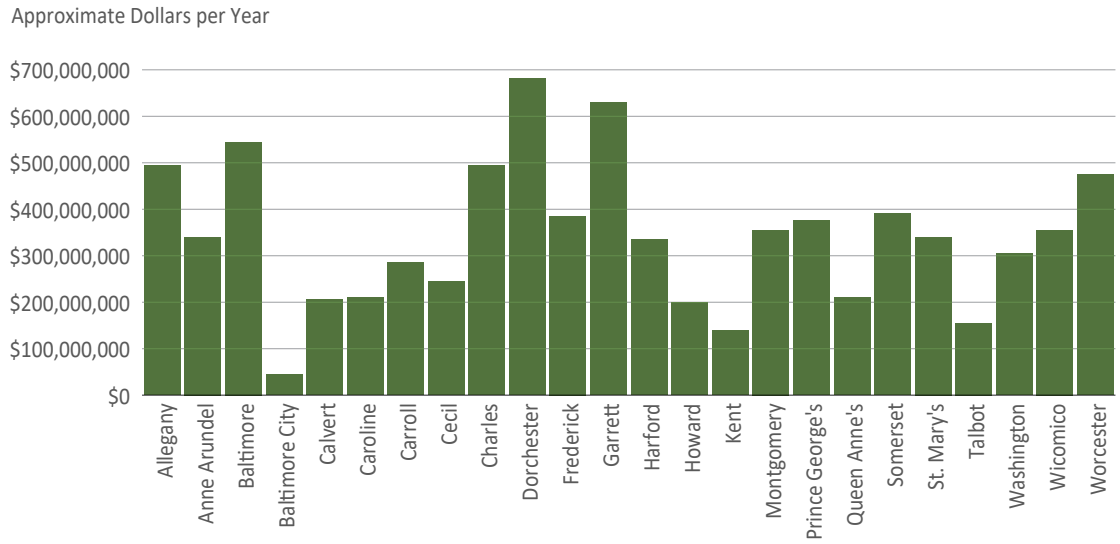
(from Accounting for Maryland's Ecosystem Services: Integrating the Value of Nature into Decision Making, 2017)

To arrive at a value for ecosystem services, DNR developed an "Eco-Price," or the ratio of the dollar amount that has been paid to preserve or restore ecosystem services, or the costs avoided by preventing their loss, to the change in ecological function, where dollar amounts are based on current trends in society's payment for and valuation of these services. As an example of establishing an Eco-Price, DNR considers a program like Maryland's Water Quality Trading Market.[18] In such a market, a private landowner can plant a riparian forest buffer on their land that will take up an estimated amount of nitrogen. This quantity of nitrogen could then be sold on a marketplace to other entities needing to meet a mandated water quality goal. DNR does note that the Eco-Price is not the same as an "open" market value[19] and, and it was not meant to imply that landowners would be entitled for the value of all services provided on a given property. Rather, DNR intended to highlight the value of services currently received by society and to identify the potential, resultant costs to society if those resources are not valued appropriately and are subsequently lost.

The result of the Eco-Price calculations for natural lands throughout the State of Maryland resulted in a total estimated value of $8.0 billion in 2017 dollars ($10.5 billion in 2025 dollars)[20] in benefits to the people of Maryland. Frederick County's benefits were estimated at approximately $400 million in 2017 dollars ($524 million in 2025 dollars)[21] annually. Services considered by DNR included the following:

- Carbon sequestration by trees and forests
- Habitat and biodiversity as an indicator of ecosystem function and as a way to support hunting and fishing opportunities
- Air pollutant removal
- Flood prevention and stormwater mitigation
- Groundwater recharge
- Surface water protection
- Nitrogen removal
- Outdoor recreation, including hiking, biking, hunting, and fishing

Figure 6: Total Value of Ecosystem Services (By County, Per Year, 2017 dollars)[21]



This type of ecosystem service valuation reveals the economic contributions of natural lands, which can be thought of as the "return on environment" that natural lands provide for residents of Maryland and Frederick County. It is important to note that the types of benefits valued in this study can also be identified at smaller scales of analysis, like neighborhoods or even individual properties, but they frequently are not considered because society often views environmental protection and the continued provision of ecosystem services as a social, rather than an individual, responsibility.

Natural lands can have additional, indirect benefits to property owners not specifically stated under the ecosystem services identified up to this point. They have also been shown to increase home values and generate jobs and economic activity through recreation and tourism. While no relevant local studies have been identified as of the development of this Green Infrastructure Plan, there are regional examples.

Montgomery County, PA: A Study in Return on Environment[22]

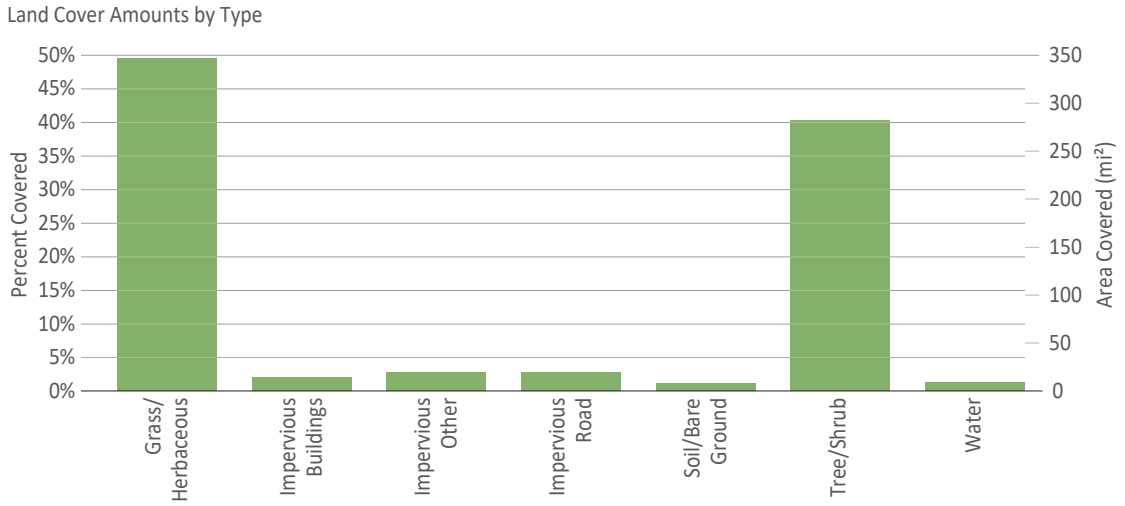
In 2011, the Economy League of Greater Philadelphia published a report for the GreenSpace Alliance and the Delaware Valley Regional Planning Commission about the economic benefits of protected open space in southeastern Pennsylvania. The report estimated that protected open space added approximately $16.3 billion dollars to housing property values and that protected lands generated as much as $240 million annually in local property tax revenues. Additionally, protected lands were identified as a factor in creating or maintaining 6,900 jobs and generating more than $299 million in annual earnings for the region.

In 2022, the Planning Commission of Montgomery County, Pennsylvania, requested an updated analysis focusing on the effects of protected open space specifically in Montgomery County. The report was prepared by Econsult Solutions, Inc., with assistance from the Delaware Valley Regional Planning Commission, the Stroud Water Research Center, and the Montgomery County Planning Commission. The report analyzed more than 46,022 acres of protected land along with 142,195 single family homes sales in Montgomery County between the years 2000 and 2020 to estimate the effect of protected land on local property values. The consultant used a "hedonic regression analysis," which attempts to isolate the explanatory power of a single variable of interest (such as proximity to protected open space) by holding constant other relevant housing characteristics (such as square footage, number of bedrooms, year built, etc.).[23]

The analysis revealed that protected open space added approximately $2.8 billion to the market value of housing stock in Montgomery County during the study period, with the value of the 250,000 homes within ½ mile of protected open increasing by more than $11,300. The report found that the County also receives approximately $48 million in annual property tax revenues as a result. The report also found that protected open space generated approximately $160 million in economic activity, supported 1,555 jobs in the County, and helped fund $49 million in annual salaries. Lastly, the report estimated that Montgomery County received $31.6 million in annual savings through the environmental services provided by protected open space and $180 million in annual stormwater pollutant removal costs when compared to a similar acreage of traditionally developed suburban land.

To complete this discussion of ecosystem services with both a timely and locally focused assessment of ecosystem services, Livable Frederick utilized the iTree Canopy Tool, produced by the U.S. Department of Agriculture Forest Service, to estimate the return on environment from the County's tree canopy. The iTree Canopy Tool is just one of a suite of a state-of-the-art, peer-reviewed software tools that can provide an assessment of tree canopy assets and to develop plans to further support urban and rural forestry.[24] All iTree tools involve a web-based application that can be accessed by anyone. The Canopy Tool estimates tree canopy cover and other land cover types within a defined area, using Google Maps imagery. It generates random points within the study area, which users then classify based on the land cover type (e.g., tree, non-tree, water). This data can be used to assess the benefits of tree canopy cover, such as carbon sequestration, air pollution reduction, and stormwater management. Livable Frederick staff entered over 2,000 data points to independently estimate canopy and land cover to generate the following results: [25]

Figure 7: Land Cover from iTree Canopy (2024)



- Approximately 49.3% of the County is in Grass/Herbaceous cover (including lawns, fields, and row crops)
- Approximately 40.5% of the County has Tree/Shrub cover (including fallow fields, forests, and residential landscapes)
- Approximately 2.0% of the County is covered by buildings (including homes, business, and institutional uses)
- Approximately 2.8% of the County is covered by paved roads and parking lots
- Approximately 2.7% of the County is covered by other impervious surfaces (including gravel lots and roads)
- Approximately 1.2% of the County is covered by bare soil (including actively disturbed land and quarries)
- Approximately 1.2% of the County is covered by water (including rivers, streams, and ponds)

Table 1: iTree Carbon Sequestration Benefits for Frederick County (2024-2025)

Description	**Carbon (kT)**	±SE	CO_2 Equiv. (kT)	±SE	Value (USD)	±SE
Sequestered annually in trees	262.58	±7.12	962.78	±26.10	$113,623,783	±3,080,059
Stored in trees (Note: this benefit is not an annual rate)	5,934.84	±160.88	21,761.09	589.89	$2,568,167,577	±69,616,660

Note: Currency is in USD and rounded. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Amount sequestered is based on 0.971 kT of Carbon, or 3.559 kT of CO_2, per mi²/yr and rounded. Amount stored is based on 21.940 kT of Carbon, or 80.446 kT of CO_2, per mi² and rounded. Value (USD) is based on $432,727.12/kT of Carbon, or $118,016.49/kT of CO_2 and rounded. (English units: kT = kilotons (1,000 tons), mi² = square miles)

The iTree Canopy Tool estimates that the value of carbon sequestration services provided by the trees in Frederick County at over $113 million annually, with a total of over $2.5 billion worth of carbon currently sequestered in Frederick County's forests, trees, and shrubs.

Table 2: iTree Air Pollution Benefits for Frederick County (2024-2025)

Abbr.	Description	Amount (T)	±SE	Value (USD)	±SE
CO	Carbon Monoxide removed annually	74.97	2.03	$13,797	374
NO2	Nitrogen Dioxide removed annually	200.63	5.44	$17,918	486
O3	Ozone removed annually	4,055.48	109.93	$1,098,840	29,787
SO2	Sulfur Dioxide removed annually	127.50	3.46	$1,866	51
PM2.5	Particulate Matter less than 2.5 microns removed annually	121.57	3.30	$1,581,708	42,876
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	1,152.48	31.24	$1,281,821	34,747
Total		5,732.62	155.40	$3,995,949	108,320

Note: Currency is in USD and rounded. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Air Pollution Estimates are based on these values in T/mi²/yr @ $/T/yr and rounded: CO 0.277 @ $184.03 | NO2 0.742 @ $89.31 | O3 14.992 @ $270.95 | SO2 0.471 @ $14.63 | PM2.5 0.449 @ $13,010.97 | PM10 4.260 @ $1,112.23. (English units: T = tons (2,000 pounds), mi² = square miles)*

iTree also estimates that Frederick County receives approximately $4 million annually in air quality improvement and $2 million in avoided stormwater runoff from its tree, shrub, and forest canopy. While these services are not actively accounted for in many (or perhaps any) annual budgets, they demonstrate the value that Frederick County's tree and forest canopy provide, regardless of their location. Perhaps the most important take away from these estimates is that future losses in tree or canopy cover could result in significant cost increases for communities looking to maintain air and water quality in Frederick County.

Table 3: iTree Hydrological Benefits for Frederick County (2024-2025)

Abbr.	Benefit	Amount (Mgal)	±SE	Value (USD)	±SE
AVRO	Avoided Runoff	249.03	6.75	$2,225,365	60,324
E	Evaporation	11,457.35	310.58	N/A	N/A
I	Interception	11,457.35	310.58	N/A	N/A
T	Transpiration	25,577.22	693.34	N/A	N/A
PE	Potential Evaporation	114,340.71	3,099.49	N/A	N/A
PET	Potential Evapotranspiration	86,112.57	2,334.30	N/A	N/A

Note: Currency is in USD and rounded. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Hydrological Estimates are based on these values in Mgal/mi²/yr @ $/Mgal/yr and rounded: AVRO 0.921 @ $8,936.00 | E 42.356 @ N/A | I 42.356 @ N/A | T 94.554 @ N/A | PE 422.695 @ N/A | PET 318.341 @ N/A. (English units: Mgal = millions of gallons, mi² = square miles)

Relationship to the Sensitive Areas Element of County Comprehensive Plans

The roots of green infrastructure in Maryland and Frederick County have been in place for decades. They reflect an early recognition of the role that the natural environment plays in providing clean air and clean water that was inherent in federal laws adopted in the 1960's, 1970's, and 1980's such as the Clean Air Act, the Air Quality Act, the Safe Drinking Water Act, and the Clean Water Act. While certain protections were set forth for navigable waters within the United States in the Section 404 of the amendments to the Federal Water Pollution Control Act of 1972,[26] in 1985 the U.S. Supreme Court affirmed in *United States v. Riverside Bayview Homes* that Clean Water Act's regulatory jurisdiction included wetlands adjacent to headwater streams. Additionally, in the 1985 Farm Bill and the 1990 reauthorization of that Bill, protections for natural resources, specifically wetlands, were further bolstered by federal law.

The importance of the natural environment to a sustained quality of life in Maryland was also evident in the establishment of the Maryland Greenways Commission in 1991. Envisioned in 1990, the Greenways Commission worked with State agencies, local governments, land trusts, and citizens to form a system of interconnecting recreational trails and wildlife corridors that link protective buffers along Maryland's waterways. These greenways – corridors of open space that follow streams, ridgetops, rivers, or other linear features – could be used for recreation and conservation. Greenways could be publicly owned for recreation and parks, or privately owned as wildlife habitat or to enhance water quality. Protections for existing forests and a framework for restoring lost forest habitat in Maryland were implemented with the passage of the Maryland Forest Conservation Act (Natural Resources Article Section 5-1601 through 5-1613), which was also passed in 1991.

In 1992, the Economic Growth, Resource Protection and Planning Act, or Planning Act, amended Article 66B of the Annotated Code of Maryland[27] to encourage economic growth, limit development sprawl, and protect the State's natural resources and environment. The Planning Act introduced the concept of Planning Visions, as well as the concept of "Environmentally Sensitive Areas" (or "Sensitive Areas") and the "Sensitive Areas Element" to comprehensive planning in Maryland. The following "sensitive areas" were identified under the act:

- a stream or wetland, and its buffers;
- a 100–year floodplain;
- a habitat of a threatened or endangered species;
- a steep slope;
- agricultural or forest land intended for resource protection or conservation;
- and any other area in need of special protection, as determined in a plan.

The Sensitive Areas Element was intended to develop a series of goals, objectives, and standards for protecting the sensitive areas, as listed above, from the adverse effects of development.

The Maryland Department of Natural Resources (DNR) began an initiative to identify the most ecologically important and ecologically sensitive areas in the state in the late 1990's. The Maryland GreenPrint program was established in 2001 to map ecologically valuable lands, and these features were identified at the time as "green infrastructure." These lands were also recognized for their importance for the long-term health of the State's environment. The GreenPrint program ended in 2006, but GreenPrint mapping has

been maintained by DNR and the mapping has received updates in subsequent years. DNR currently uses GreenPrint mapping in the Rural Legacy Grant Review System, and it was also carried forward into the Maryland Green Infrastructure Assessment in 2021 that identified gaps in the statewide green infrastructure network and in the updates to that network made during its reincarnation as the Maryland Habitat Connectivity Network (or HCN) in 2024.

Existing Sensitive Area Regulations in Frederick County

It should be noted that, because of federal, state, and local laws and ordinances enacted since early 1990's, protections for Environmentally Sensitive Areas have been implemented in Frederick County in the form of ordinances and land use or zoning designations. These ordinances and designations help to sustain and (in some cases) expand the footprint of protected lands in the County. A summary of the protections for Environmentally Sensitive Areas in Frederick County is provided on the next few pages as a way of describing those protections for natural lands that are currently in place and enforceable.

Streams, Wetlands, and Buffers

Protections for streams, rivers, lakes, and ponds and their associated buffers in Frederick County are set forth under Chapter 1-19, Article 9, Division 4 (Waterbody Buffer Requirements) of the Frederick County, Maryland, Code of Ordinances.[28] Originally adopted in 2007, the Waterbody Buffer Requirements state that waterbody buffers shall be provided on all properties on which subdivision or resubdivision activities (associated with development) are proposed in proximity to streams, rivers, lakes, and ponds.[29]

The minimum width of buffers is defined as 100 feet in the code, but specific site conditions can warrant wider buffers. Additionally, buffers must be "maintained in a natural vegetative state unless otherwise utilized for reforestation or afforestation to satisfy forest resource ordinance obligations or for environmental enhancement projects administered or approved by federal, state, or local government agencies." Certain uses, such as public infrastructure like roads and utilities may cross waterbody buffers, but only after it has been sufficiently demonstrated to the Frederick County Division of Planning and Permitting that no reasonable alternatives to such impacts exist and that all reasonable efforts will be made to minimize disturbance to waterbody buffers. In areas where subdivision or resubdivision are not proposed, a 50-foot stream buffer must be noted on land development plans.

Additionally, wetlands in the State of Maryland are regulated by the Maryland Department of the Environment (MDE) and, in specific cases, the United States Army Corps of Engineers (USACE) in accordance with the Environmental Article of the Code of Maryland (COMAR) and Section 404 of the Clean Water Act. MDE and the USACE regulate any land disturbance within 25 feet of a delineated wetland (100 feet for a wetland of special state concern) and require Nontidal Wetland and Waterway Permits or Tidal Wetland Permit applications to be submitted for review whenever proposed impacts to wetlands and adjacent waterways or tidal waters are proposed. In cases where impacts are proposed to isolated wetlands, MDE may grant a Letter of Authorization for impacts to small, isolated wetlands (not possessing significant nexus with Waters of the US), but only after a Jurisdictional Determination (JD) has confirmed the extent and specific environmental conditions associated with that isolated wetland.

Image 4: The Potomac River valley viewed from Weverton Cliffs near Knoxville, MD.

(Image credit: Livable Frederick)

100-Year Floodplain

Protection of 100-year floodplains in Frederick County is set forth in Chapter 1-19, Article 9, Division 1 (Floodplain District Regulations) of the Frederick County, Maryland, Code of Ordinances. [30] The Floodplain District was established to "protect human life and health, minimize property damage, encourage appropriate construction practices to minimize future damage, to protect water supply, sanitary sewage disposal, and natural drainage." It encompasses the most extensive limit of mapped Federal Emergency Management Agency (FEMA) 100-year floodplains, flooding soils, and/or wetlands adjacent to or overlapping the otherwise established limits of the Floodplain District.

The Floodplain District is treated as a zoning overlay, such that the provisions of the Floodplain District are considered in addition to those otherwise associated with the underlying zoning district. In cases where the provisions of the underlying district conflict with and/or are less restrictive than the regulations of the Floodplain District, the more restrictive regulations of the Floodplain District apply.

The Floodplain District also establishes minimum required setbacks for any proposed development activity from wetlands or waterways within the district and requires proposals for development in the district to seek approval from the Frederick County Board of Appeals. Certain proposals may require additional approvals from the Maryland Department of the Environment (MDE) or the United States Army Corps of Engineers (USACE). Review and oversight in the Floodplain District is intended to ensure that natural floodplain function is preserved and that risks to human health, safety, and welfare resulting from development in floodplains are minimized.

Habitats of Threatened or Endangered Species

Habitats of threatened or endangered species are protected in Frederick County under one mechanism in the Livable Frederick Comprehensive Plan, the Natural Resources Land Use Designation, and two separate mechanisms in the Ordinance, including the Resource Conservation Zoning District and the Forest Resources Ordinance (FRO).

Image 5: Edwards' Hairstreak (Satyrium edwardsii) is a native, North American butterfly species that has been identified as rare in Frederick County and endangered in the State of Maryland.

(Image Credit: Joshua Mayer via Flickr, https://www.flickr.com/photos/wackybadger/14405523779/, https://dnr.maryland.gov/wildlife/Documents/Frederick_County_RTEs.pdf

The Natural Resources Land Use Designation is assigned to properties on the County's Comprehensive Plan Map as part of updates to the Comprehensive Plan. It is intended to identify significant natural resources within Frederick County and to guide the assignment of the Resource Conservation Zoning District. The primary features that are designated Natural Resources include mountain areas, contiguous forest, major streams defined by the County's 20 subwatersheds, and the green infrastructure features as mapped by the Maryland Department of Natural Resources as of 2010. Additional lands will be considered for the Natural Resources Land Use Designation as part of this Green Infrastructure Plan process or in recommendations included in the plan.

Protections for habitats of threatened or endangered species are also included in the County's Resource Conservation Zoning District. The Resource Conservation Zoning District is assigned to properties to allow low-intensity uses and activities that are compatible with the goal of resource conservation to be located within mountain and rural wooded areas. Lands within this district include mountain areas, rural woodlands, and cultural, scenic, and recreation resource areas. Environmentally sensitive areas within the Resource Conservation zone, including FEMA floodplain, steep slopes, wetlands, and the habitats of

threatened and endangered species, are to be protected from development. Regulations for land-use that prohibit impacts to sensitive areas containing habitat for threatened or endangered species are identified in Chapter 1-19, Article 7, Division 2 of the Frederick County, Maryland, Code of Ordinances. [31] Protections for steep slopes and floodplains are also afforded under the Resource Conservation Zoning District.

Additionally, all subdivision or permitted activities within Frederick County that require compliance with the Frederick County Forest Resources Ordinance (FRO), are required to document the known presence of threatened or endangered species on a property prior to the clearing of forest communities. The FRO is set forth in Chapter 1-21 of the Frederick County, Maryland, Code of Ordinances. [32]

To comply with FRO, permittees are required to conduct a Forest Stand Delineation (FSD) and prepare a plan and report that summarize the condition and quality of existing forests on a property and identify priority areas for forest retention. The presence of threatened or endangered species automatically qualifies a portion of forest or an entire forest stand as a high priority for conservation. The likelihood of the presence or absence of threatened or endangered species on a given property is often considered in consultation with the Natural Heritage Program of the Maryland Department of Natural Resources.

Steep Slopes

Protections for naturally occurring steep slopes are incorporated into multiple aspects of the Frederick County, Maryland, Code of Ordinances.[33] Steep slopes receive specific protection from impacts of development in the Resource Conservation zoning district and they are identified as priorities for the planting of new forest required by the FRO. Additionally, steep slopes must be mapped as part of the subdivision and site development processes overseen by the Frederick County Division of Planning and Permitting. The presence of steep slopes can also contribute to wider waterbody buffers and/or in the incorporation of those slopes into the waterbody buffers to mitigate the potential for erosion of steep slopes near waterways.

WHEN TO USE THIS PLAN

This Green Infrastructure Plan is intended to fulfill several needs for the citizens, planners, and policymakers in Frederick County.

First, it is intended to provide an overview of the planning, policy, geographic, and regulatory contexts in which it was developed and in which land use decisions are currently being made. It is also intended as a resource for introducing readers to the principles of green infrastructure and the benefits that can be derived from effective planning for green infrastructure.

Second, the Plan is intended to set forth a framework for updating and expanding mapped green infrastructure in Frederick County. This plan will attempt to identify those areas that have high levels of inherent cultural, economic, or environmental value as it pertains to green infrastructure, as well as those areas that may be in need of additional investment in the future to help ensure more equitable outcomes for both current and future generations when it comes to the benefits that can be derived from green infrastructure and access to nature.

Third, the Plan will propose recommendations and policies for utilizing green infrastructure to achieve the 2040 Vision for Frederick County set forth in the Livable Frederick Master Plan. The Green Infrastructure

Plan also proposes a series of methods or metrics that could be employed to track progress on the policies and recommendations proposed in this Plan. While this plan has been drafted as a stand-alone document, it is also intended to function as a reference that can be revisited in future planning and regulatory efforts to ensure that the important benefits of green infrastructure afforded to the residents of Frederick County are supported by those efforts.

GREEN INFRASTRUCTURE GOALS

The County Executive's 2023 Transition Report identified the following goals for the development of the Green Infrastructure Plan.

To build on the framework of the Livable Frederick Master Plan, the County Executive should develop a comprehensive greenway corridors and infrastructure plan which should:

- Connect Green Infrastructure Hubs
- Reduce Fragmentation of Natural Areas
- Provide More Options for Wildlife Migration
- Adapt as Climate Changes
- Identify Forest Conservation and Afforestation Opportunities
- Reduce Vehicle Miles Traveled
- Increase Outdoor Recreation Opportunities for Low- to Moderate-Income Families.

The following Goals were identified within the Livable Frederick Master Plan and are directly associated with the focus of the Green Infrastructure Plan.

- Natural Resources and Green Infrastructure (LFMP Goal): The natural environment and its habitat provision and ecosystem services are critical to our quality of life, and so they should be the primary consideration in all land planning and governmental decision-making processes.
- Built Environment (LFMP Goal): Increase energy efficiency and environmental standards in existing and new built infrastructure.
- [Water] Quality (LFMP Goal): Improve and protect water quality for human and environmental health by eliminating impairing levels of pollution to local waterways and by adequately funding and implementing water quality restoration and protection efforts.
- Supply & Treatment Infrastructure (LFMP Goal): Ensure that wastewater and water supply infrastructure is adequate, sound, and efficient to provide for current and future populations.
- Air Quality (LFMP Goal): Continue to meet or exceed federal pollution standards in order to promote a healthy living environment and satisfy the most basic human health need.
- Climate Resilience (LFMP Goal): Plan and prepare for the impacts to public infrastructure, human health, private property, and the environment from increasing flooding, fires, droughts, crop and tree damage, temperature extremes, and intense storm events.

More information regarding green infrastructure goals can also be found in Chapter 5 of this Plan.

THE CLIMATE IMPERATIVE

Several large-scale regional changes, affecting the overall terrestrial landscape of the northeastern and midwestern United States, are anticipated to occur in the coming years because of a changing climate. These effects are also certain to be experienced in the Middle-Atlantic states. A study conducted by the University of Massachusetts Amherst, in partnership with the United States Geological Survey and the Northeast Climate Science Center, was completed in 2015 to identify the potential impacts climate change could have on habitat, vegetation, and wildlife throughout the region. These changes include:[34]

- Warming is occurring in every season, particularly in winter and particularly at higher latitudes, at higher elevations, and inland (i.e., away from the ocean and lake coasts).
- Heat waves may become more frequent, more intense, and last longer.
- Precipitation amounts are increasing, particularly in winter, with high-intensity events in summer.
- Snow is shifting to rain, leading to reduced snow cover extent and depth, as well as harder, crustier snowpacks.
- Stream flows are intensifying.
- Streams are warming.
- Thunderstorms may become more severe.
- Floods are intensifying, yet droughts are also on the rise as dry periods between events lengthen.
- Growing seasons are getting longer, with more growing degree days accumulating earlier in the season.

Summary points of the same study indicated that:

- Climate change will have cascading effects on ecological systems.
- These changes are expected in shifts of timing, distribution, abundance, and species interactions.
- Some wildlife groups, including montane (mountain slope dwelling) birds, salamanders, cold-adapted fish, and freshwater mussels, could be particularly affected by changes in temperature, precipitation, sea and lake levels, and ocean processes.
- Interactions between different species under the influence of man-made land use change could exacerbate the impacts of climate change.
- A focus on improving habitat connectivity and water quality and removing invasive species will increase resilience for wildlife populations in the face of climate change.

As the summary points note, habitat connectivity will be critical to mitigating the effects of a changing climate for plant and animal communities in Frederick County. It is anticipated that migration patterns for animal species will be altered because of climate change and that plant communities will shift over time from south to north, as species requiring cooler climates slowly migrate north in search of those climates. A green infrastructure network can ensure that corridors are preserved or created to facilitate the migration of plant and animal species in an uncertain climatic future.

Visualizing Changes to Habitat and Migration

The Nature Conservancy has developed a "Migrations in Motion" map that shows the average direction that mammals, birds, and amphibians need to move to track hospitable climates because of a changing climate. The map can be viewed online at: https://maps.tnc.org/migrations-in-motion/. Catoctin Mountain in Frederick County forms the easternmost edge of the Blue Ridge Province of the Appalachian Mountains, and forests of the Blue Ridge and the Appalachian Mountains provide an important sanctuary and travel corridor for many plant and animal species, including bird species utilizing the Atlantic Flyway.

Frederick County Government has also identified potential risks to County and community infrastructure that may result from a changing climate in reports like the 2023 Climate and Energy Action Plan for Local Government Operations and the 2022 Hazard Mitigation and Climate Adaption Plan. Green infrastructure is a potential tool to help the County improve the resiliency of the natural and the built environment in the face of climate change.

RELATED PLANS AND LEGISLATION – STATE OF MARYLAND

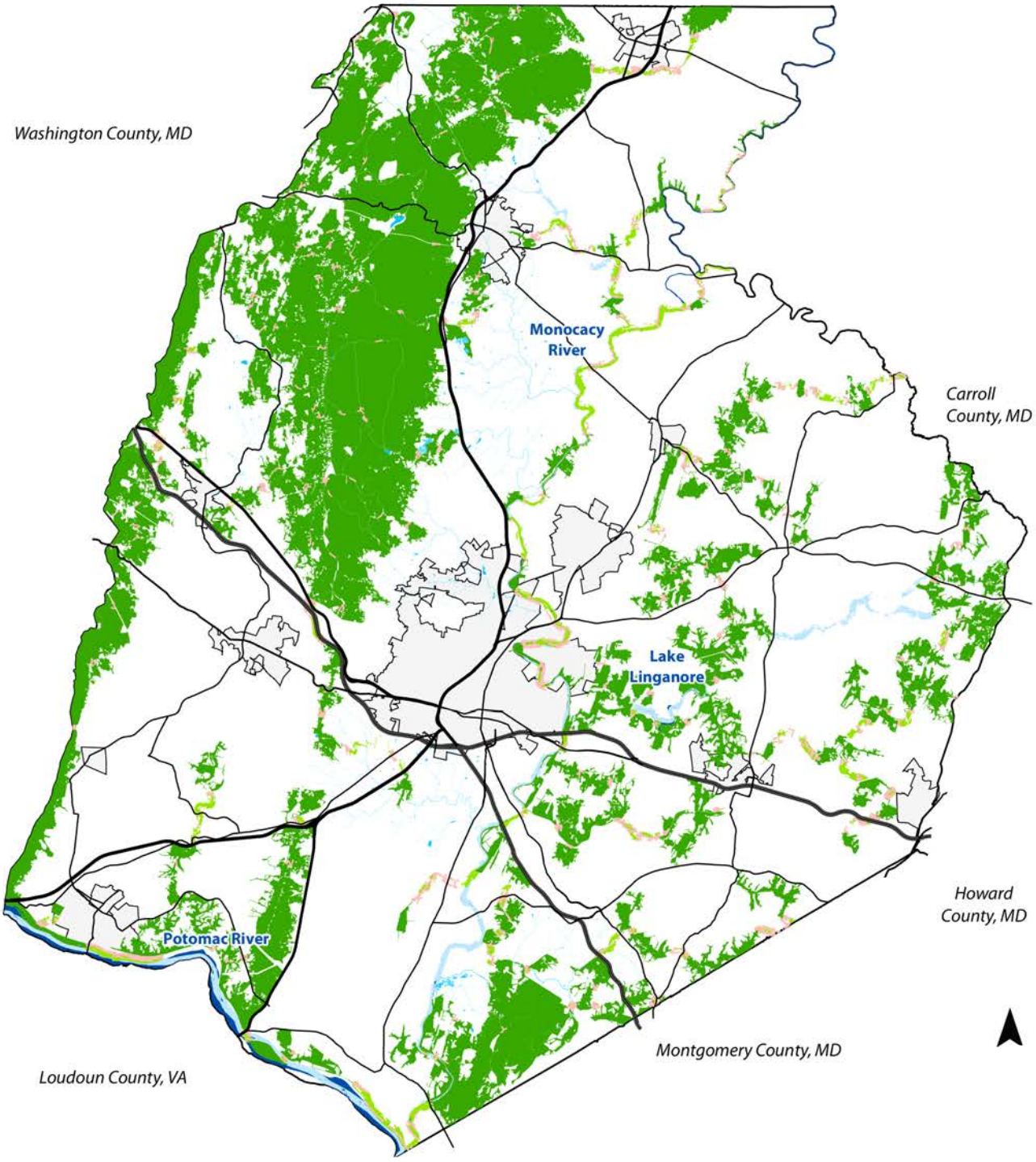
Maryland Green Infrastructure Assessment (GIA) and Habitat Connectivity Network (HCN)

Historically, Maryland was largely forested, but agricultural, industrial, and urban expansion have significantly reduced tree cover, fragmenting natural habitats to varying degrees over time. To counter this, the Maryland Department of Natural Resources (DNR) initiated a comprehensive mapping project in the late 1990s, identifying key ecological areas known as "hubs" and "corridors" to preserve connectivity. Alongside this effort, DNR developed databases highlighting rare species habitats, aquatic biodiversity hotspots, and watershed protection zones. Today, the State of Maryland integrates green infrastructure concepts into land conservation strategies, helping guide investments in high-priority areas. With nearly 39% of the state included in the State's mapped network, agencies use these tools to allocate conservation funding strategically, ensuring that Maryland's most ecologically valuable land remains protected. In August of 2024, the GIA was renamed the Habitat Connectivity Network to differentiate it from other mapping efforts related to stormwater practices and to more closely reflect the focus on wildlife habitat connectivity.

The Habitat Connectivity Network can also be viewed interactively online with the Maryland Department of Natural Resources GreenPrint Map: http://geodata.md.gov/greenprint/. The Habitat Connectivity Network is a significant tool that has also been incorporated in the Frederick County Green Infrastructure Network. This is discussed in more detail in Chapter 3.

The Maryland the Beautiful Act

The Maryland the Beautiful Act of 2023 established ambitious land conservation goals: conserve 30% of the state by 2030 (30 by 30) and conserve 40% of the state by 2040 (40 by 40). Through the combined efforts of state agencies, local governments, the federal government, and nonprofit land trusts, the first goal to conserve 30% of Maryland land (1,856,889 of 6,189,629 land acres) was achieved in 2024, well in advance of the 2030 goal year.



Map 1: The Maryland Habitat Connectivity Network (2024)

Hubs & Corridors

- Upland Hubs
- Wetland Hubs
- Aquatic Hubs
- Upland Corridor: Natural
- Aquatic Corridor: Natural
- Upland Corridor: Non-Restorable
- Aquatic Corridor: Non-Restorable
- Municipalities

The Maryland the Beautiful Act required the Sustainable Growth Subcabinet[35] to develop and publish a five-year plan by July 1, 2024, to outline how to meet the goals in the legislation, provide an annual report on the state's progress, and update the plan at least every five years through 2040. A copy of the 2024 Five Year Plan can be viewed online at: https://planning.maryland.gov/Documents/Our-Engagement/SGSC/2024-MD-the-Beautiful-SGSC-5-Year-Plan.pdf.

The Maryland State Forest Action Plan

The Maryland Forest Action Plan was developed as part of a national strategy, and it aims to improve forest sustainability by identifying threats, prioritizing conservation efforts, and enhancing resource management. Guided by the USDA Forest Service's State and Private Forestry program, the plan responds to federal directives from the Farm Bills of 2008, 2014, and 2018. It also aligns three key priorities: conserving working forests, protecting them from environmental threats, and maximizing public benefits. The 2020 plan consists of an assessment of forest conditions and a strategic framework for conservation and management. Additionally, it incorporates the Forest Legacy Program, which supports long-term land protection efforts through federal grants, ensuring Maryland's forests remain viable and ecologically valuable.

The Forest Action Plan consists of two parts, a Forest Assessment that can be viewed online here: https://dnr.maryland.gov/forests/Documents/Maryland-State-Assessment-2020FINALpages.pdf, and a Forest Strategy that can be viewed online here: https://dnr.maryland.gov/forests/Documents/Maryland-State-Strategy_wAON%202020FINALpages.pdf.

RELATED PLANS – FREDERICK COUNTY

The Land Preservation Parks and Recreation Plan

The Frederick County Land Preservation, Parks, and Recreation Plan (LPPRP) provides a framework for managing Maryland's outdoor spaces, ensuring coordinated efforts in park development, natural resource protection, and agricultural land preservation. The LPPRP, required under Maryland's Program Open Space (POS) and the Federal Land & Water Conservation Fund Act, must be updated every five years to remain eligible for POS funding. It contributes to the statewide Maryland Land Preservation and Recreation Plan, which was last updated in 2019. The plan prioritizes five goals: fostering collaboration between government agencies and stakeholders, promoting the benefits of outdoor recreation, improving access to open spaces and waterfronts, enhancing existing recreational infrastructure, and cultivating an informed stewardship culture through environmental education.

The Frederick County LPPRP can be found online here: https://www.frederickcountymd.gov/DocumentCenter/View/338747/2022-LPPRP-ADOPTED-PLAN.

The Bikeways and Trails Plan

The Frederick County Bikeways & Trails Plan, first adopted in 1999, outlined a framework for developing multi-use trails and bicycle facilities, proposing over 174 miles of trails and 334 miles of on-street bikeways. Since that time, the City of Frederick has implemented its own Shared Use Path Plan and expanded cycling infrastructure with strong support from local advocacy groups. The most recent version of the Bikeways

and Trails Plan, released in 2018, serves as a conceptual guide rather than a detailed engineering blueprint, requiring further feasibility studies before implementation. It aligns with broader regional and state initiatives to ensure connectivity across jurisdictions. Unlike the original plan, the current version also addresses pedestrian infrastructure, including sidewalk networks, crossings, and safe routes to schools, recognizing walking as a fundamental mode of transportation.

Frederick County Transportation Planning staff are beginning work on a new update to the Bikeways and Trails Plan at time of development of this Green Infrastructure Plan. The 2018 version of the Bikeways and Trails Plan can be viewed online here: https://www.frederickcountymd.gov/DocumentCenter/View/322377/Bikeways-and-Trail-Plans-2018_FINAL-PLAN_compressed.

The Water Resources Element

Frederick County's Water Resources Element (WRE) serves as a strategic framework for managing water systems, growth, and environmental sustainability. Divided into three components—Drinking Water, Wastewater, and Stormwater Assessments—it evaluates resource capacity, water quality, and stormwater impacts while outlining policies for sound land and water management. Mandated by the Maryland State Legislature in 2006, the WRE is regularly updated alongside the County's Comprehensive Plan to reflect evolving development conditions. Integrated into the Livable Frederick Master Plan in 2025, the WRE supports key state planning goals, including infrastructure development, environmental protection, and resource conservation, ensuring long-term sustainability for Frederick County's water systems.

A copy of the approved Frederick County Water Resources Element can be found online here: https://frederickcountymd.gov/DocumentCenter/View/353729

The Sugarloaf Treasured Landscape Management Plan

The Livable Frederick Master Plan highlights "Treasured Landscapes," with the Sugarloaf Area standing as a prime example due to its ecological, historical, and cultural significance. Recognizing the pressures of development and climate change, the plan emphasizes stewardship, conservation, and resilience through targeted policies and land use strategies. The Frederick County Council formally acknowledged the climate emergency in 2020 with Council Resolution 20-22, reinforcing the need for local action. The Sugarloaf Treasured Landscape Management Plan, developed with input from a stakeholders' advisory group, focuses on preserving forestlands, wildlife habitats, and water resources while addressing climate adaptation and greenhouse gas reduction. It provides a structured approach to long-term environmental protection of the Sugarloaf Treasured Landscape Area, guiding future planning and land conservation efforts in that part of Frederick County.

The Sugarloaf Treasured Landscape Management Plan can be found online here: https://frederickcountymd.gov/DocumentCenter/View/341431.

Chapter Endnotes

8 A name change for the South Frederick Community Growth Area has been proposed under the Housing Element of the Frederick County Comprehensive Plan, which is under development concurrently with this Green Infrastructure Plan. This growth area would become the South Frederick Corridors Growth Area following the name change.

9 Benedict, M. A., McMahon, E. T. (2006). Green infrastructure: Linking Landscapes and Communities.

10 <https://www.epa.gov/green-infrastructure/about-green-infrastructure>.

11 Rouse, D. C., & Bunster-Ossa, I. F. (2013). Green infrastructure: A Landscape Approach. Routledge.

12 Firehock, K., & Walker, R. A. (2015). Strategic Green Infrastructure Planning: A Multi-Scale Approach. Island Press.

13 <https://www.merriam-webster.com/dictionary/sustainable> and <https://www.merriam-webster.com/dictionary/sustained>.

14 <https://sustain.ucla.edu/what-is-sustainability/>

15 Rouse, D. C., & Bunster-Ossa, I. F. (2013). Green infrastructure: A Landscape Approach. Routledge.

16 Additional topics have been incorporated by Livable Frederick Staff to illustrate the full scope of services.

17 A position still held as of the development of this Plan in 2025 according to the U.S. Census Bureau's Population Clock. <https://www.census.gov/popclock/>

18 A voluntary market-based initiative developed in a collaborative effort between the Maryland Department of the Environment (MDE) and the Maryland Department of Agriculture (MDA). It allows for the trading of nitrogen, phosphorous and sediment credits between farmers, watermen, and other businesses.

19 The price at which an asset would trade in a competitive auction setting.

20 2025 Values derived from the Consumer Price Index (CPI) Calculator from the Minneapolis Federal Reserve in June 2025. < https://www.minneapolisfed.org/about-us/monetary-policy/inflation-calculator.>

21 Maryland Department of Natural Resources, Chesapeake & Coastal Service. (2017). Accounting for Maryland's Ecosystem Services: Integrating the value of nature into decision making (DNR 14-081518-92). Maryland Department of Natural Resources. Retrieved August 14, 2024, from <https://dnr.maryland.gov/ccs/Documents/AMESreportFinal_MDDNR.pdf>.

22 Econsult Solutions, Inc. (ESI). Return on Environment: The Economic Impact of Protected Open Space in Montgomery County, Pennsylvania. (2022).

23 As noted in the discussion of the Maryland Department of Natural Resources, hedonic regression analysis does not account for the direct value of ecosystems services, but this study was primarily concerned with impacts to real estate value.

24 <https://www.itreetools.org/>

25 The U.S. Department of Agriculture Forest Service recommends a minimum of 500 – 1,000 data points be entered to reduce standard error.

26 As amended in 1977 under the Clean Water Act.

27 Article 66B was later replaced with the Maryland Land Use Article in 2012.

28 https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-35842

29 Engineered stormwater management ponds are specifically excluded to allow for required maintenance.

30 https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-35723

31 https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-34531

32 https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-9121

33 In the Frederick County, Maryland, Code of Ordinances, a “moderate slope” means a slope with a gradient of 15% to less than 25%; and the term “steep slope” means a slope with a gradient of 25% or greater.

34 Staudinger, M. D., T. L. Morelli, and A. M. Bryan. 2015. Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans. DOI Northeast Climate Science Center Report, Amherst, Massachusetts.

35 <https://planning.maryland.gov/Pages/OurEngagement/SGSubcabinet/smart-growth-subcabinet.aspx>

Chapter 2

The County Setting

INTRODUCTION

Frederick County's rich landscapes are shaped by geology, hydrology, and communities of plants, animals, and people. The County spans two geologic provinces—the Piedmont Plateau and the Blue Ridge—resulting in a mix of rolling valleys, rugged mountains, and meandering waterways like the Monocacy River and Catoctin Creek. Its forests and fields support a rich variety of wildlife, while its groundwater and surface water systems play a vital role in sustaining both wild habitats and our communities. Historic settlements, rooted in agricultural and industrial traditions, further reflect the County's deep connections to the natural environment. This chapter provides a broad, yet concise, overview of the natural conditions and the cultural contexts in which this discussion of green infrastructure planning is being conducted.

Image 6: The rolling hills and valleys of Frederick County and the Blue Ridge Mountains in the distance.

Image by Appalachian Views. "View of rolling hills in rural Frederick County, Maryland." Canva.com, June 08, 2025, <https://www.canva.com/>

GEOLOGY, TOPOGRAPHY & SOILS

Geology, topography, and soil composition are some of the most fundamental determinants of Frederick County's natural and cultural character. As noted, the County spans two major geologic provinces, the Piedmont Plateau and the Blue Ridge, each with distinct landforms and hydrological features. These natural factors influence soil formation, stream flow, and land suitability for a variety of uses. Underlying geology impacts both ecological systems and the patterns of the communities that developed within them.

Geology

The Piedmont Plateau Province is divided into the Lowland Section, which covers the central part of the County with gently rolling terrain and slow-moving streams, and the Upland Section, which features rolling low-elevation land with streams in narrow valleys. Meanwhile, the Blue Ridge Province consists of rugged mountains with deep, incised valleys and fast-flowing streams. South Mountain Ridge also acts as a natural border between Frederick County to the east and Washington County, Maryland, to the west.

The Piedmont Plateau Province includes several distinct geological regions. The Frederick Valley is home to the City of Frederick and consists mostly of limestone, which erodes easily to form deep soils with gentle relief. The Mesozoic Lowland Region, located in the northern part of the County to the immediate east of the Towns of Thurmont and Emmitsburg, features red soils and limestone conglomerates. Sinkholes are a common occurrence here. The Piedmont Upland Region that is centered on the Town of New Market contains metamorphic, igneous, and sedimentary rock, shaped by volcanic activity from the Precambrian era (4.5 billion to 540+/- million years ago). This area includes the Harford Plateaus and Gorges, composed of quartzite and fine-grained schists, and the Wakefield Valley and Ridge Regions, which contain meta-basalt, rhyolite, and marble.

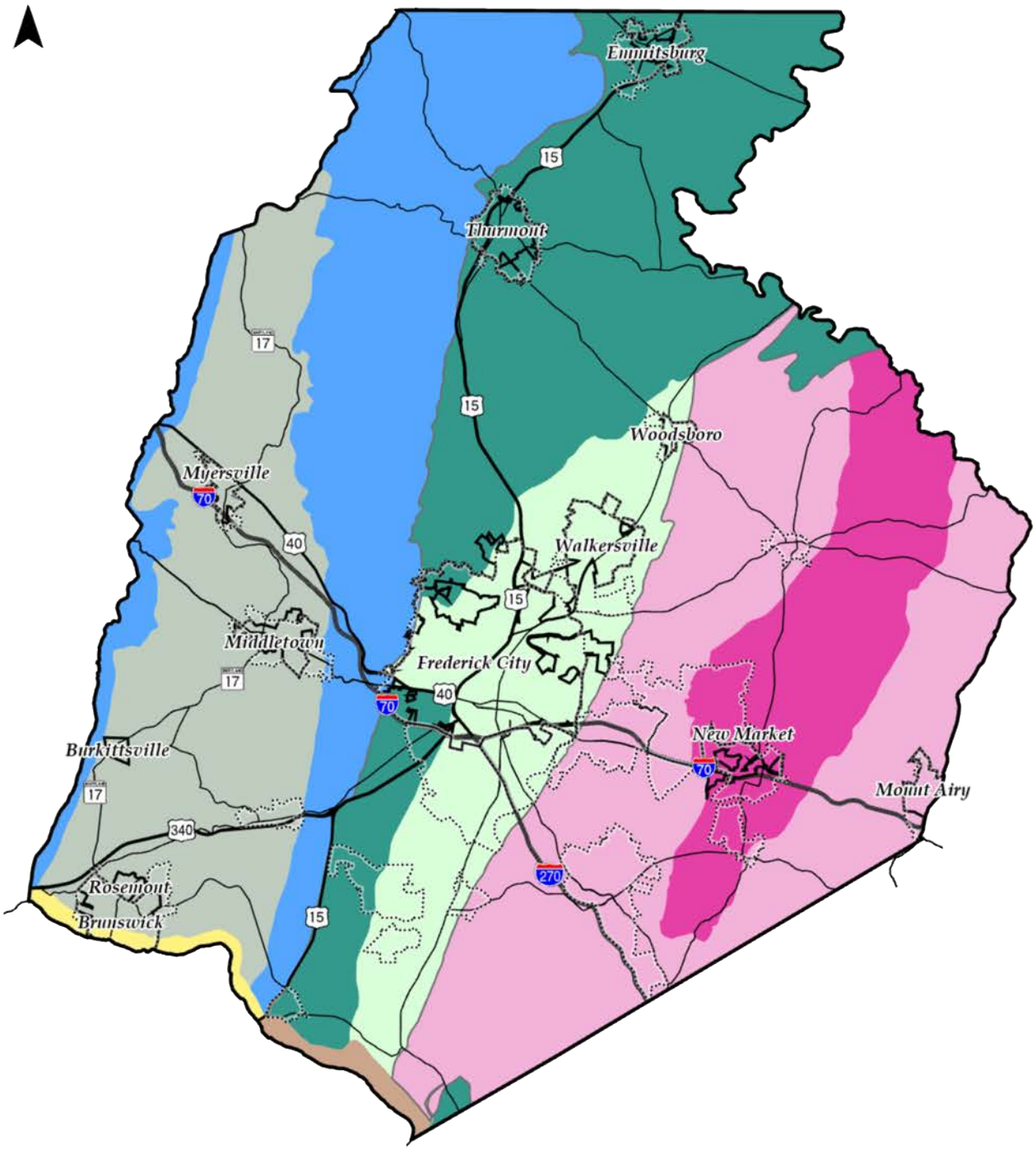
The Blue Ridge Province consists of the Northern Blue Ridge Section, which forms the Middletown Valley and is characterized by Cambrian Quartzite, a material resistant to erosion that shapes the mountain valley landscape. This province is divided into three regions: Catoctin-South Mountain, Middletown Valley, and Chesapeake Gorges. The Catoctin-South Mountain Region contains quartzite ridges that lend their names to the region, while the Middletown Valley includes meta-basalt and granite-gneiss, contributing to its varied geological features. The geologic materials found in this region share similarities with those of the Piedmont Upland Region, consisting mainly of metamorphosed rock of igneous origin.

A depiction of these provinces and regions can be found in Map 2.

Mineral Resources in Frederick County

According to the online mining records site, thediggings.com, approximately 48 mines have been identified in Frederick County through USGS records. The most produced commodities from those mines were iron, copper, and silver. Gold and lead complete the list of the top five commodities. Of the identified mines, 36 (75%) were in active production at the time they were entered into USGS records.[36]

The presence of nearby limestone quarries and iron mines also aided in the establishment of the City of Frederick in 1745 as a market hub.[37] Major producers in the lime industry included the Schley limestone quarries and the M.J. Grove Lime Company (now operated by Martin Marietta), which became one of the County's largest landowners and industrial operations. Manassas Jacob Grove expanded his company through acquisitions and diversified into stone crushing, road construction, and bridge building, helping shape the infrastructure of the region. By the early 20th century, the company was supplying stone for projects such as the White House grounds and Washington, D.C.'s McMillan Reservoir.



Map 2: Regions Within Physiographic Provinces for Frederick County

Resulting Landform

Due to differential rates of erosion in the various rock types underlaying Frederick County, its topography varies from the wide, flat Monocacy River valley to steep mountain slopes, with elevations ranging from below 400 feet above mean-sea-level (MSL) in the Frederick Valley to over 1,800 feet (MSL) in the northwest. The Monocacy River meanders slowly through the Frederick Valley, while streams in the Piedmont Upland Region carve deep channels as they descend westward. The Middletown Valley, bordered by the Catoctin and South Mountains, features rapid elevation changes, with streams like Catoctin Creek falling at a rate nearly five times that of the Frederick Valley. The northern part of the County has rugged terrain with peaks and valleys, while Sugarloaf Mountain, a distinct monadnock, rises 800 feet above the Piedmont Province to a height of 1,282 feet (MSL).

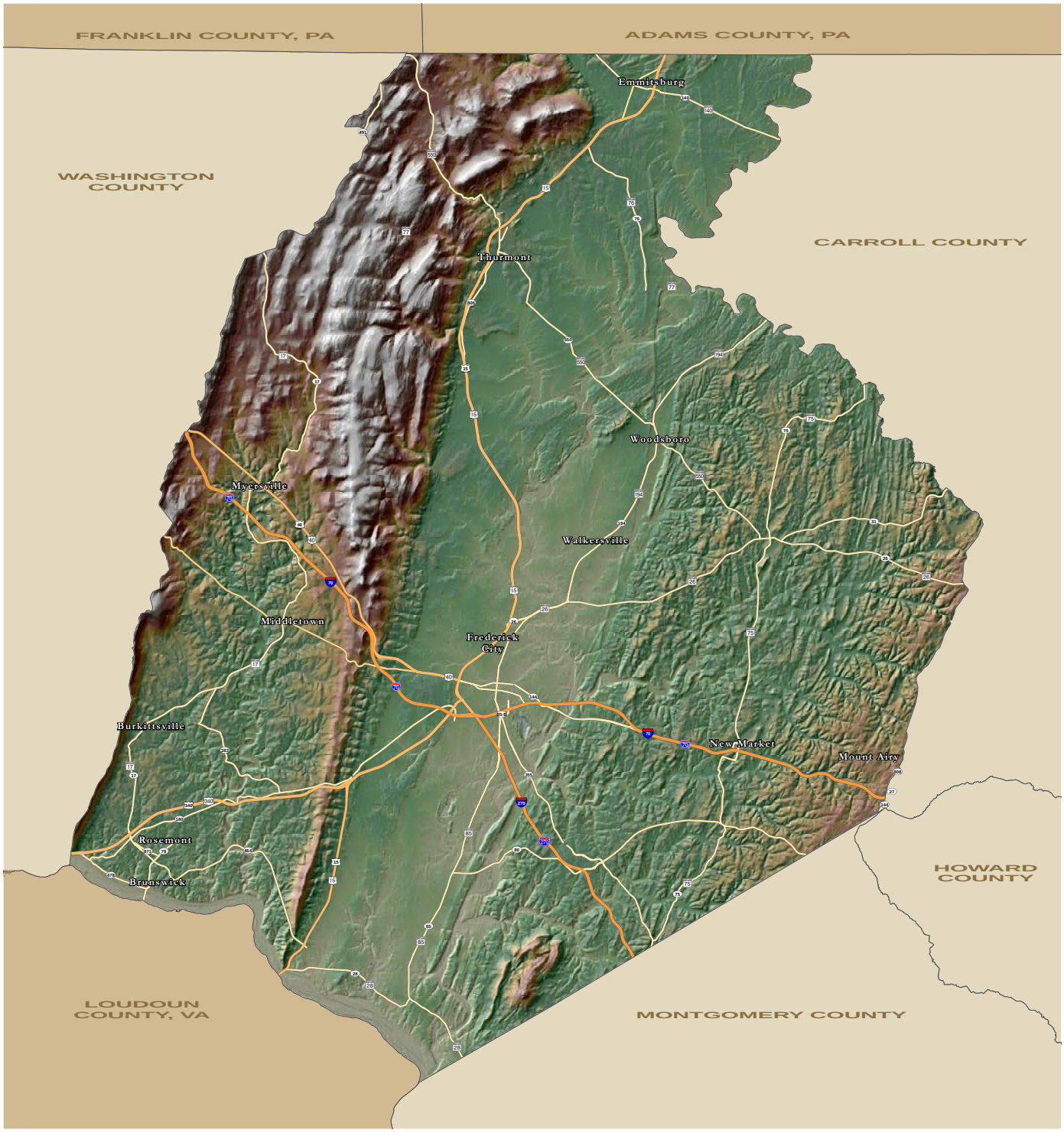
These variations in landform can be viewed on Map 3. When coupled with the underlying geology, landform has significant influence on the types and depths of soils that have developed in the County.

Soils

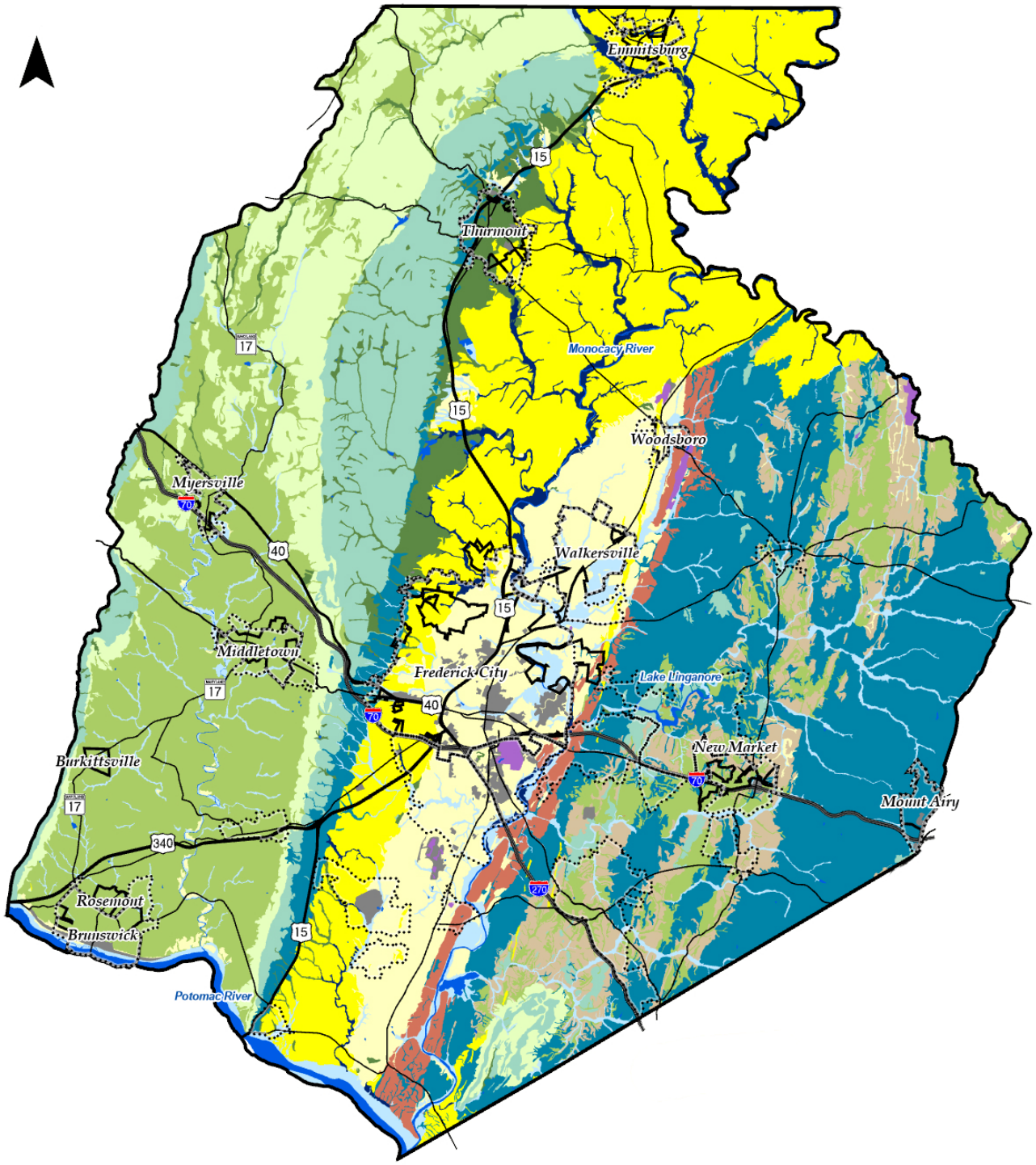
Frederick County features a wide variety of soils, grouped into eleven categories, as illustrated in Map 4, with distinct geological origins. Many of these soils form the backbone of the County's agricultural heritage. The most productive agricultural soils lie in lowland valleys and gently rolling terrain, where drainage, fertility, and moisture retention support high-yield crops. In the Monocacy River Valley, Sassafras and Duffield soils offer deep, well-drained conditions ideal for corn, soybeans, and wheat, while the river's natural irrigation enriches the floodplain. The Middletown Valley supports diverse farm operations with Glenelg and Myersville soils, known for strong fertility and good drainage.

Mountainous regions reveal slower-weathering soils formed from metabasalt and rock mixtures. In the Blue Ridge, soils like Highfield-Ravenrock and Myersville-Catoctin-Mt. Zion develop on steep slopes with poor surface permeability. Ridges on Catoctin and South Mountains contain Bagtown-Stumptown-Edgemont soils, limited by shallow bedrock and steep terrain. On Catoctin's lower eastern slopes, Trego-Foxville-Thurmont soils contend with flooding and permeability constraints. The eastern Piedmont Plateau presents Mt. Airy-Glenelg-Blocktown soils, derived from schist and phyllite, where slope and bedrock depth restrict land use. These steep and rugged landscapes often remain forested as they are unsuited for farming due to the underlying landform and their fertility.

Some lowland areas also have shallow bedrock but still support agricultural uses. The southern Frederick Valley contains Penn-Klinesville-Reaville soils (from Triassic red shale) and Duffield-Hagerstown-Ryder soils (from limestone), both facing permeability issues due to bedrock proximity. Between Urbana and Clemsonville, Linganore-Hyattstown-Conestoga soils show similar limitations. Along Araby Ridge and near perennial streams, Cardiff-Whiteford and Codorus-Hatboro-Combs soils contain high rock content and are prone to flooding. Lastly, Rowland-Bermudian-Bowmansville soils in the Triassic Basin frequently flood and sit above shallow water tables, making them better suited for habitat establishment and stream buffering than for intensive agriculture.



Map 3: Landform Map for Frederick County.



Map 4: Generalized Soil Types for Frederick County

- Highfield-Ravenrock
- Bagtown-Stumptown-Edgemont
- Myersville-Catoctin-Mt.Zion
- Trego-Foxville-Thurmont
- Mt.Airy-Glenelg-Blocktown
- Penn-Klinesville-Reaville-Goresville
- Duffield-Hagerstown-Ryder
- Linganore-Hyattstown-Conestoga
- Cardiff-Whiteford
- Codorus-Hatboro-Coms
- Rowland-Bermudian-Bowmansville
- Water
- Quarries
- Urban land
- Municipalities
- Community Growth Areas

Soil Resources for Frederick County

The U.S. Department of Agriculture's Web Soil Survey provides a wealth of information to anyone who would like to learn more about soils in Frederick County. Free, online tools allow visitors to the site to map and explore data related to soil characteristics and soil suitability for a variety of land uses, including farming, recreation, and forestry. The Web Soil Survey can be accessed online at: https://websoilsurvey.nrcs.usda.gov/app/.

HYDROLOGY

Frederick County, Maryland, possesses an interconnected network of surface and groundwater resources that play a crucial role in both the County's and the region's ecosystems, economy, and daily life. Surface waters, including rivers, streams, and lakes, support aquatic habitats, provide recreational opportunities, and serve as important sources of drinking water. Meanwhile, groundwater—stored beneath the earth's surface in aquifers—supplies public and private potable wells, sustains base flow to streams, and helps maintain water availability during dry periods.

Image 7: A cold water stream in the Catoctin Mountains of Frederick County.

Image by Mann, C. "Mountain stream in motion around rocks Frederick County, Maryland," Canva.com, June 08, 2025, <https://www.canva.com/>

Watersheds and Waterways

Frederick County's surface waters are part of the Potomac River Basin, and they primarily consist of three major waterways: the Potomac River, Catoctin Creek, and the Monocacy River. Several smaller tributaries, such as Bush Creek, Ballenger Creek, Little Catoctin Creek, and Tuscarora Creek, feed into these waterways,

contributing to the County's overall drainage system. While the Potomac River has a wide and shallow streambed that minimizes extreme flooding, Catoctin Creek and the Monocacy River exhibit distinct hydrologic characteristics, with typically steeper stream banks leading to rapid runoff and occasional severe flooding.

The Potomac River represents the southwestern limits of Frederick County, with bridges at Knoxville, Brunswick, and Point of Rocks facilitating travel between Frederick County and Loudon County, Virginia. With a watershed that is 14,800 square miles in size, the Potomac River flows approximately 405 miles from West Virginia to the Chesapeake Bay. Due to the size of the Potomac River basin and the volume of water conducted by the river, it has become the primary source of drinking water for Frederick County, supplying up to 26% of the County's drinking water needs.

Catoctin Creek drains most of the Middletown Valley. The valley's steep slopes contribute to fast water movement, causing about 38% of the precipitation that falls in the valley to run off rather than infiltrate, making flooding in the creek a significant risk. The creek has also seen extreme variations in flow, with its highest recorded discharge reaching 12,000 cubic feet per second and its lowest recorded flow dropping to zero in 1966. Below the Route 340 Bridge, near Knoxville, the creek is susceptible to flooding from its own runoff and backflow from the Potomac River, particularly when both waterways crest simultaneously.

The Monocacy River, Frederick County's largest tributary to the Potomac River, drains 543 square miles and is generally slow-moving, with an average drop of 2.8 feet per mile. Its tributaries to the west resemble the mountainous terrain of Middletown Valley, while those to the east flow through rolling landscapes with deeper soils. The Monocacy River carries away up to 46% of precipitation that falls within its watershed, supporting a relatively steady flow compared to Catoctin Creek. The highest recorded flow occurred in 1972 during Tropical Storm Agnes, with flow volumes reaching 81,600 cubic feet per second.

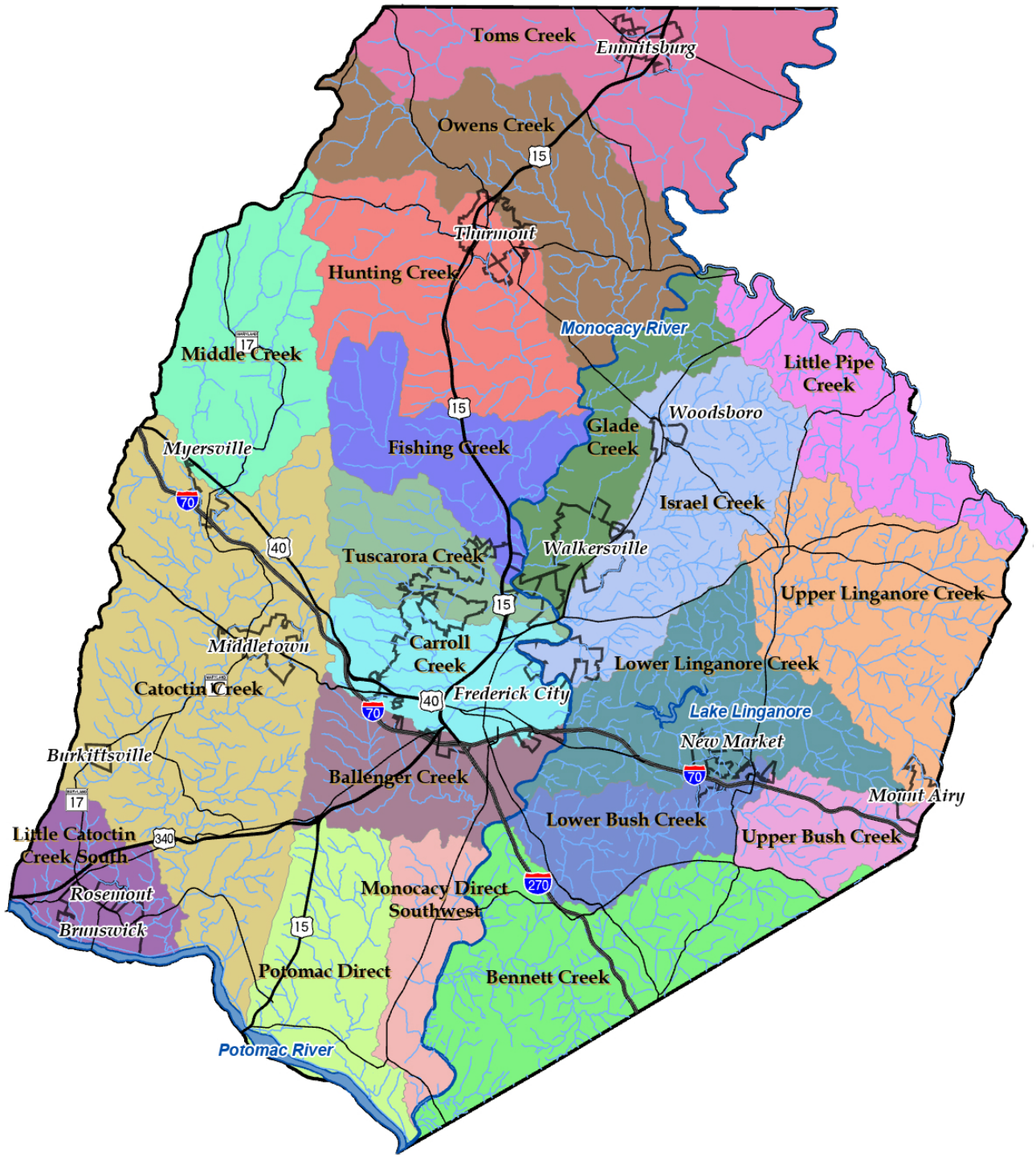
As noted earlier, each of these major waterways is made up of many smaller, contributing creeks and streams. Map 5 illustrates the location of Frederick County's named creeks and streams and the general pattern of surface water concentration in the County.

Water Resources in Frederick County

Understanding stream flow characteristics, such as the 7Q10 low-flow frequency, helps manage water resources and maintain ecological balance in Frederick County. To learn more about how water resources are utilized in Frederick County, please refer to the Water Resources Element of the Frederick County Comprehensive Plan. The Water Resources Element can be found online at: https://frederickcountymd.gov/8707/Water-Resources-Element.

Aquifers

Groundwater supplies in Frederick County originate from local precipitation that infiltrates the soil and reaches the "saturated zone" illustrated in Figure 8. Once underground, water typically travels only a few miles before discharging into nearby streams. Along the way, some of it evaporates or is absorbed by plants, rejoining the atmosphere to complete the hydrologic cycle.



Map 5: Watersheds for Frederick County

Watershed

- Ballenger Creek
- Bennett Creek
- Carroll Creek
- Catoctin Creek
- Fishing Creek
- Glade Creek
- Hunting Creek
- Israel Creek
- Little Catoctin Creek South
- Little Pipe Creek
- Lower Bush Creek
- Lower Linganore Creek
- Middle Creek
- Monocacy Direct Southwest
- Owens Creek
- Potomac Direct
- Toms Creek
- Tuscarora Creek
- Upper Bush Creek
- Upper Linganore Creek

Much of Frederick County lies within a "fractured rock aquifer," meaning deep geological fractures can complicate the task of identifying groundwater system boundaries, as these fractures can cut across formations and alter subsurface flow. In areas of the County with limestone geology and karst topography, groundwater flows can significantly diverge from surface drainage patterns, unlike in areas with confined aquifers or that lack limestone geology, where landforms better align with subsurface movement. In developed parts of the County without public water and sewer service, concentrations of private or public groundwater wells may also induce groundwater recharge by pulling water from nearby streams into aquifers.

Figure 8: The relationship between surface water and groundwater.

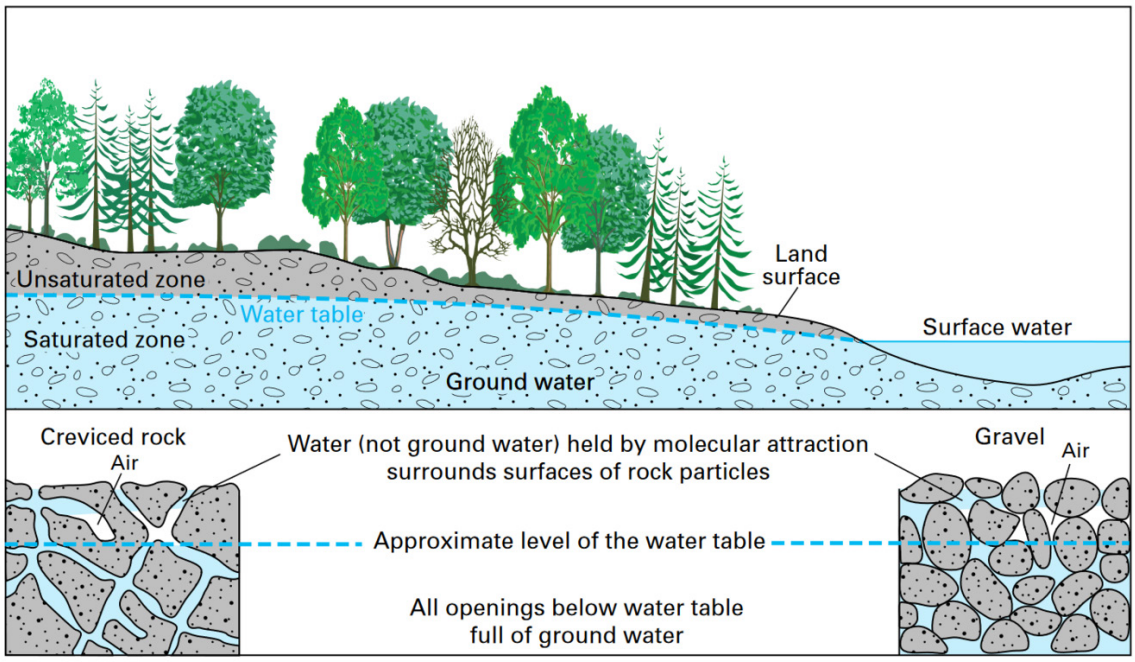


Image credit: The United States Geological Survey (n.d.). https://www.usgs.gov/media/images/groundwater-saturated-zone-soilrock-below-land-surface

Aquifer recharge happens throughout the County as rainfall seeps into the ground. Depending on local geology and soil types, typically 12 to 30 percent of precipitation contributes to groundwater supplies. Heavily flowing streams that overtop their banks into their floodplains can also contribute to groundwater recharge, as well as septic system discharges in some rural communities. As noted earlier in this section, groundwater discharges to the surface primarily through stream channels, and some streams—especially in the Frederick Valley—depend on limestone springs for sustained base flow. Most of this groundwater eventually drains into the Potomac River, though some springs, like Yourtee Springs near Brunswick, can also support public water systems.

In summary, multiple factors shape groundwater storage and availability in the County, including soil permeability, the presence of weathered or fractured rock zones, the presence of wells or septic systems, and the presence of limestone or karst topography. In locations with fine soils and a dense stream network groundwater storage and transmissibility in most formations. Sandstone formations in the Monocacy River Valley offers the highest storage capacity, followed by limestone in the lower Frederick Valley, though

What is Karst Topography?

"Karst" is a Slavic word meaning "barren, stony ground," and it describes terrain that is characterized by caves, underground streams, and other features that are formed by the slow dissolution of calcium and magnesium oxides in limestone, dolomite, or marble bedrock.

In populated areas, sudden subsidence features known as "sinkholes" can form under buildings, roads, and farmed land. Not only do sinkholes present a threat of injury to people and damage to property, but surface water runoff that enters a sinkhole can bypass the natural filtration processes otherwise provided by intact soils, subsoils, and geological features.

limestone's low flow rate slows recharge. In areas with low permeability, rural communities often require deeper wells to counteract rapid drawdown and slow water recovery. Map 6 shows the average well-specific capacity across regions, expressed in gallons per minute per foot of well depth.

Approximately 1/3 of Frederick County's population relies on the County's aquifers to meet their potable water needs. More information on groundwater supplies in Frederick County can be found in Chapter 2 of the County's Water and Sewerage Plan. The most recent update to the County's Water and Sewerage Plan, as approved by the Maryland Department of the Environment in April 2025 can be found on the County's website at: https://frederickcountymd.gov/8653/Water-and-Sewerage-Plan.

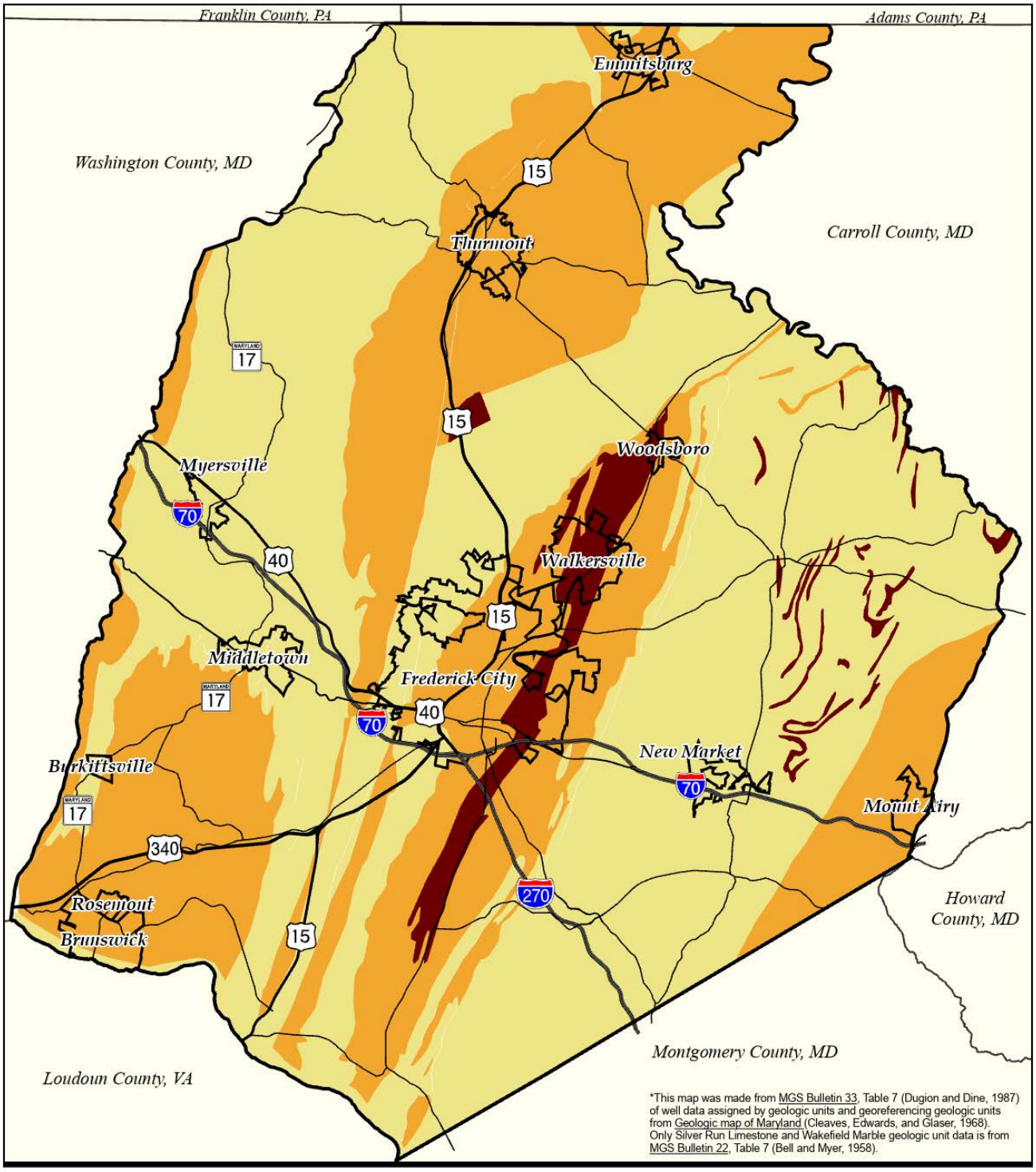
Tier II Streams

Tier II Waters are waterways in Maryland that exceed state water quality standards due to their exceptional environmental conditions, including thriving fish and insect populations. To protect these waters, the state has implemented an anti-degradation policy, requiring reviews for any proposed wastewater or stormwater discharges that could affect their quality. The Maryland Department of the Environment oversees this process to ensure that any changes are justified by necessary economic or social development while maintaining water usability. More information regarding regulation of Tier II waters by the Maryland Department of the Environment can be found on the MDE website at: https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/Antidegradation_Policy.aspx.

Frederick County has four identified high-quality Tier II streams: Big Hunting Creek, High Run, Weldon Creek, and an unnamed tributary to Talbot Branch. The locations of these high-quality stream segments and the watersheds that supply them are highlighted in Map 7.

Stronghold Watersheds

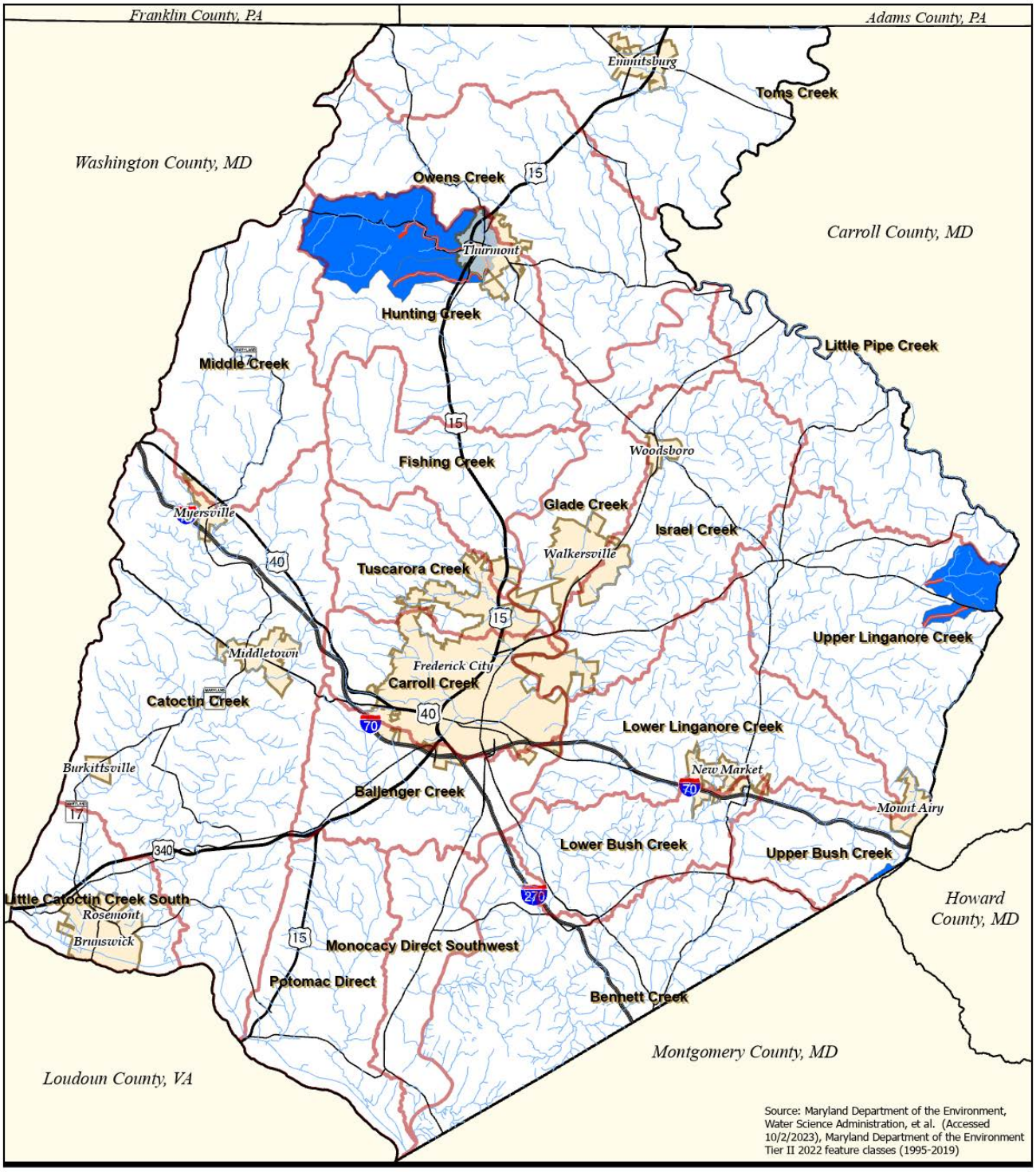
Maryland's Stronghold Watersheds are crucial for preserving the state's freshwater biodiversity. These areas support the highest abundance and diversity of species that are most in need of conservation, including stream-dwelling fish, amphibians, reptiles, and mussels. Once widespread, these species now survive in only a few locations, making them highly vulnerable to environmental degradation. Even minor changes in watershed health could lead to their permanent loss. Protecting these watersheds is essential for sustaining these species and the valuable ecosystem services they provide. There are just under one



Map 6: Aquifers (Delineated by Well Specific Capacity) for Frederick County

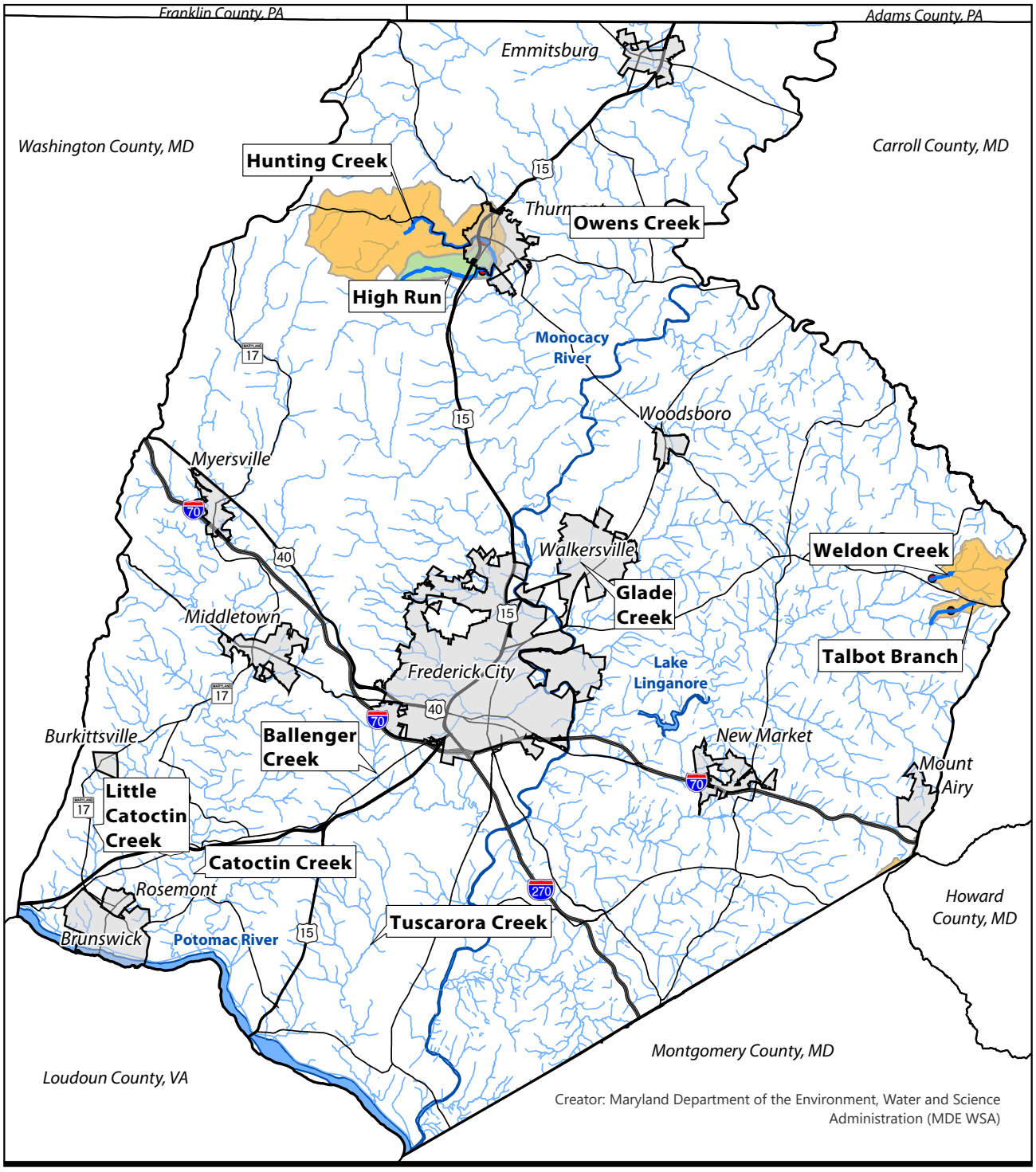
Specific Capacity (gpm/ft.)

- 0.000 - 0.700
- 0.701 - 2.011
- 2.012 - 8.2



Map 7: Tier II Streams Frederick County

Rivers & Streams
Tier II Stream Segments
Tier II Watersheds



Map 8: Stronghold Watersheds in Frederick County

Streams, Rivers, Lakes

Tier II Stream Segments

Tier II Baseline Stations 2024

Tier II Assimilative Capacity Catchments 2024

Assimilative Capacity Remaining

No Assimilative Capacity Remaining

dozen Stronghold Watersheds in Frederick County, highlighted in Map 8, including portions of the Upper and Lower Monocacy River, Carroll Creek, Ballenger Creek, and the lower limits of Catoctin Creek as it nears the Monocacy River.

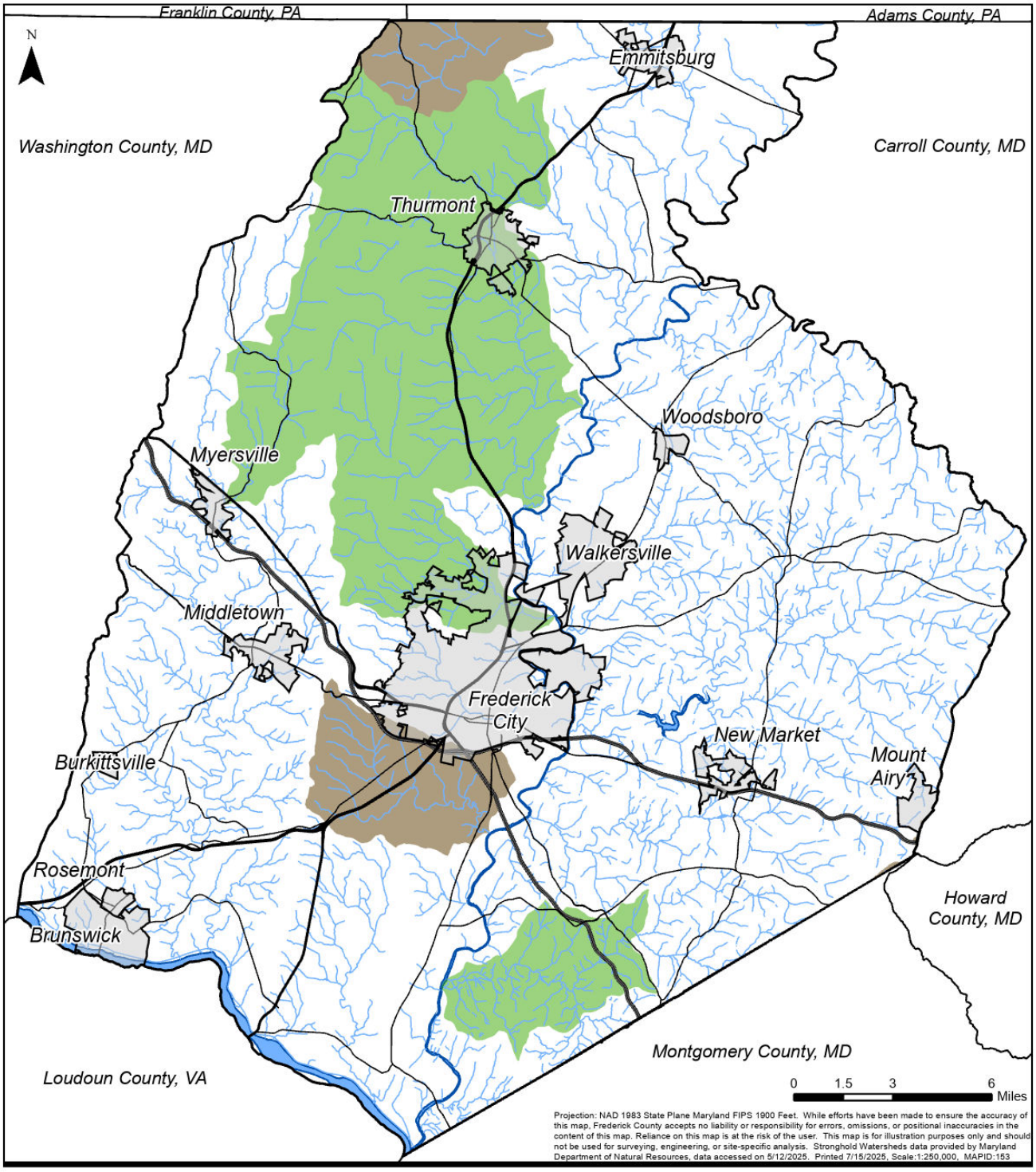
More information regarding Stronghold Watersheds can be found on the Maryland Department of Natural Resources website at: https://dnr.maryland.gov/streams/pages/streamhealth/maryland-stronghold-watersheds.aspx.

Coldwater Resources

Coldwater streams maintain cool temperatures year-round and support a specialized aquatic community that thrives within narrow thermal limits. In the State of Maryland, resource managers identify these sensitive ecosystems using three main indicators: summer water temperatures below 20°C, the presence of coldwater-dependent benthic macroinvertebrates, and evidence of naturally reproducing trout populations, especially brook and brown trout. Because land use changes, warmwater discharges, and climate change threaten these habitats, the State of Maryland uses data loggers and biological surveys to monitor and classify coldwater streams accurately.

To safeguard these resources, the Maryland Department of Natural Resources has built a centralized database and interactive mapping tool that displays statewide coldwater stream distribution. In August of 2023, the Maryland Department of the Environment also released new guidelines for the permitting of any new ponds, also referred to as "impoundments," in coldwater watershed. Ponds without adequate shading from intense sunlight or ponds that receive a significant portion of their water from heated impervious surfaces can contribute to thermal pollution of coldwater streams. As a result of the new guidance, the state now prohibits new detention ponds or ponds built in stream channels and limits the detention time of water to 12 hours. Groundwater outflows affected by pond construction must connect to streams underground, and existing ponds must be retrofitted to reduce surface area, capture no more than 50% of spring flow, and increase shading. During any construction activity in coldwater watersheds, sediment basins must release water gradually and avoid discharging warm water during hot weather.[38, 39]

There are 10 streams in Frederick County that have been identified as coldwater resources capable of supporting trout populations. They are illustrated in Map 9 and are also incorporated in the Frederick County Green Infrastructure Network mapping.



Map 9: Coldwater Streams Supporting Trout Populations in Frederick County

County Boundary
Municipalities
Major Roads
Route Type
Interstate
US Highway
US Alternate
Business Route

Trout Population by Watershed 2017
Brown or Rainbow Trout Present
Brook Trout Present
Streams, Rivers, Lakes

TREE & FOREST COVER

Trees and forests play a vital role in sustaining the environmental health and community well-being of Frederick County. They provide essential services to County residents, including improving air quality by absorbing pollutants, filtering stormwater runoff, and reducing the risk of flooding. Forests also help mitigate climate change by sequestering carbon and cooling local temperatures through shade and evapotranspiration. Additionally, they offer critical wildlife habitat, support biodiversity, and enhance recreational opportunities in Frederick County's federal, state, and County parks.

Frederick County has experienced notable changes in its tree cover over time. For much of its natural history, the County was densely forested. As agriculture and industry expanded following European settlement, substantial areas of forest were cleared for farming, timber, charcoal production, and the extraction of mineral resources like iron and limestone. The County's forest cover reached its lowest levels around the end of the 19th century and the early 20th century. Forest cover started to rebound prior to the mid- to late-20th century following the Great Depression, with the reforestation of many abandoned agricultural fields with pine and hardwoods, and the cessation of other types of industry impacting forest cover.[40]

Image 8: Forest canopy in Catoctin Mountain Park and the Blue Ridge Mountains near Thurmont.

Historic Forest Cover

It is believed that white pine and American chestnut were the dominant tree species in Frederick County throughout much of its early history. Oaks, maples, hickories, ash, and tulip poplar were also quite common. A typical forest was probably more sparsely populated with trees when compared with today's forests, but with a wider distribution of sizes and ages of trees. With much lower whitetail deer populations and less competition from aggressive, invasive plant species, a relatively diverse understory (tree and shrub) layer and a more abundant ground layer of herbaceous plants, including ferns and flowers, was probably present. [41]

From 1700 to 1820, settlers cleared much of the flat land in Frederick and Middletown valleys for farming, driving abundant fruit production. By 1870, they had expanded clearing across most flat areas in the County. Between 1870 and 1910, widespread logging and intentional fires on mountain slopes—meant to boost blueberry growth—nearly erased Frederick County's forests, leaving only small patches around farms and waterways. The Maryland Forest Service began monitoring forestry activities in 1906, but by the 1920s, a chestnut blight had decimated remaining populations of this former keystone species of Mid-Atlantic forests. This is when Frederick County reached a historic low in forest cover.

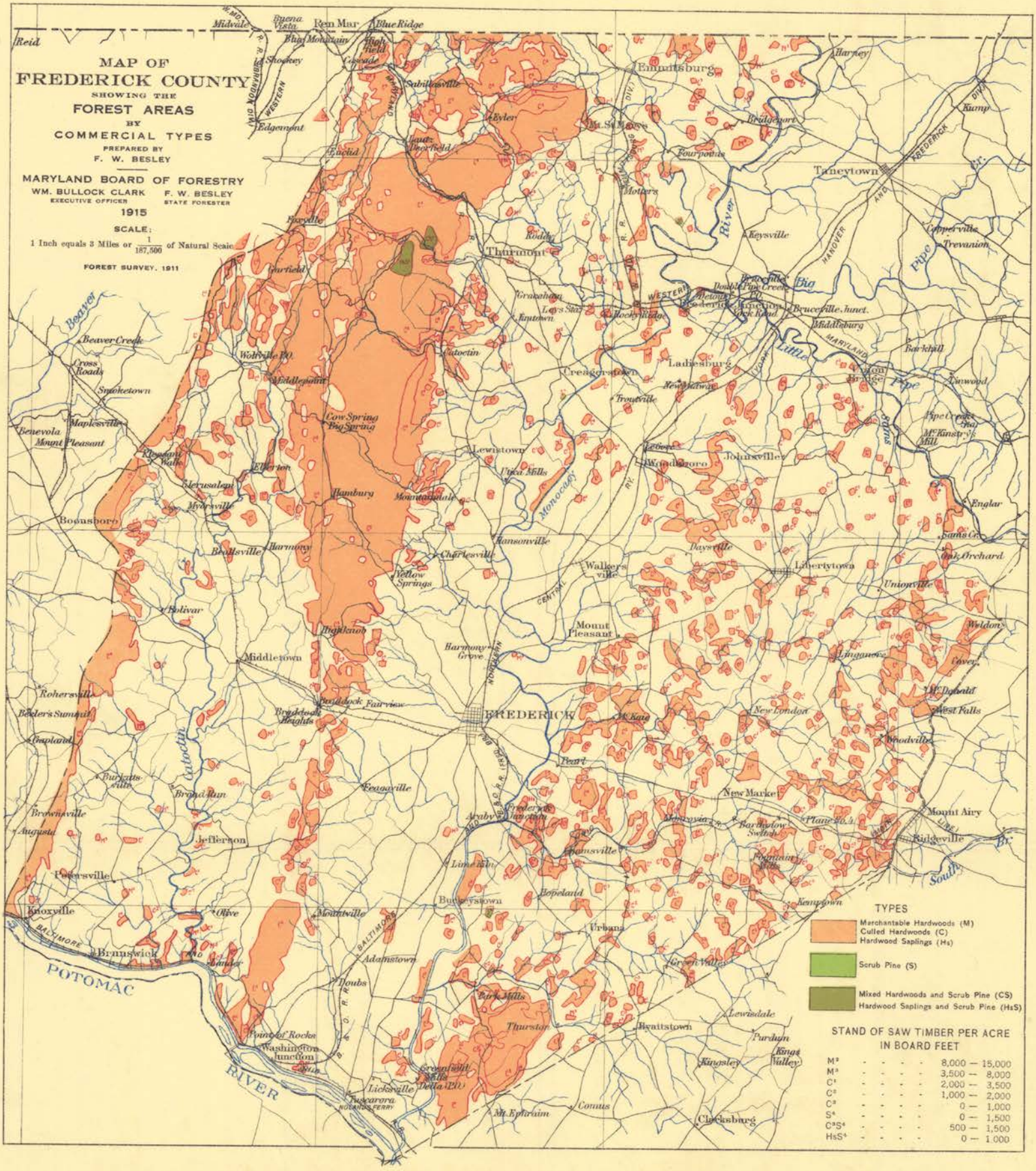
One of the best references for historical forest cover in Frederick County was produced in 1916 by the Maryland State Board of Forestry. The report describes the state of the forest products industry at that time and provides a detailed overview of each County. It states that, while most of the land in Frederick County is under cultivation, forested areas make up only 21% of the County. The forested areas that do exist consist primarily of hardwoods. The report references the significant role that the Catoctin Furnace played in iron production, leading to deforestation and regrowth of even-aged sprout forests. Despite rich forest soils, frequent fires and unsustainable harvesting were identified as causes of degraded forest conditions. At that time, Frederick County had a thriving timber industry, with sawmills and various manufacturers producing lumber, shingles, and other wood products, including structural supports for mining operations.

Long-term recovery in the amount of forested land has been hindered in the late 20th and early 21st century as pressure from land development has slowed, or even reversed, progress. As a result, Frederick County has undertaken additional efforts to increase forest mitigation requirements associated with development. Those efforts are described later in this section.

Current Tree and Forest Cover Trends

In September 2025, the Chesapeake Tree Canopy Network published fact sheets focused on changes in forest cover and tree canopy in the Chesapeake Bay Watershed between 2013/2014 and 2021/2022. The Frederick County Fact Sheet established the total amount of forest in the County in 2021/2022 at 150,402 acres (or approximately 36% of the County's area). The report also identified the total area of tree canopy outside of forest in the County at 29,671 acres or (or 7% of the County's area). Taken together, approximately 43% of Frederick County possessed some level of tree canopy coverage. [42]

It is important to note that, during this time period (and the years 2013/2014 to 2017/2018 in particular, it is estimated that Frederick County lost approximately 500 acres of forest (or 70 +/- acres of forest a year) as a result of a 2011 legislative change to the County's Forest Resources Ordinance (FRO) that eliminated a short-lived policy of "no-net-loss" of forest.[43] "No-net-loss" policies, as applied to the conservation of



Map 10: Frederick County Forest Areas by Commercial Type, c. 1915

Source: Maryland. State Board of Forestry., Besley, F. W. (Fred Wilson). (1916). The forests of Maryland. Baltimore, Md: Press of the Advertiser-Republican.

forests, are intended to ensure that any activity that removes existing forest provides for the replacement of an equal acreage of new forest on the same property or in a different location within the County.

During this period of forest loss, "no-net-loss" regulations were not required under the Maryland Forest Conservation Act (FCA), but they had been adopted by several counties within Maryland to reverse observed, yet slow, declines in forest cover under the FCA as originally implemented. With the adoption of Frederick County Bill No. 20-08 in late 2020, Frederick County restored the previously held policy requiring "no net loss" of forest associated with land development activities. More recently, the Maryland General Assembly took additional steps with the adoption of Senate Bill 526, the Forest Preservation and Retention Act, in 2022 to go beyond the concept of "no net loss" in the State and to focus on increasing the amount of forest statewide.

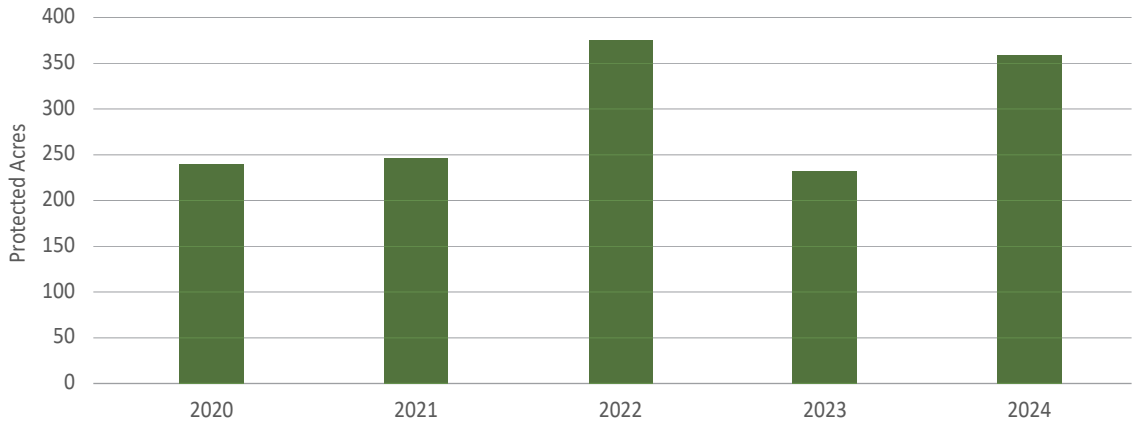
The Maryland Forest Conservation Act

The Maryland Forest Conservation Act (FCA), enacted in 1991, marked a pioneering step in statewide efforts to balance land development with forest preservation. The General Assembly passed the law in response to rapid growth and concern over forest loss. The FCA required developers to assess forest resources during the land planning process and to minimize clearing. Where clearing was unavoidable, the Act mandated reforestation or afforestation to offset the loss. State agencies and local governments adopted ordinances and regulations to implement the FCA, making it one of the first comprehensive laws of its kind in the country. In Frederick County, the FCA was implemented as the Forest Resources Ordinance, or FRO. More information on the Forest Resources Ordinance is provided later in this chapter in the discussion of current conservation and preservation programs.

Over the decades, Maryland strengthened the FCA through legislative amendments and regulatory updates. In 2013, lawmakers clarified afforestation thresholds and mitigation requirements to close loopholes that allowed excessive clearing with minimal replacement. In 2023, the General Assembly passed the Forest Preservation and Retention Act (SB 526), significantly reforming the FCA to move beyond the original no net loss goal and require a net gain in forest and tree canopy across the state. These changes increased replanting ratios, protected high-value "priority forests," and enhanced state oversight of local implementation. In 2024, the legislature passed HB 1511 which delayed some of these reforms until 2026, giving the Maryland Department of Natural Resources, various jurisdictions charged with enforcing the Act, and stakeholders time to prepare for full compliance. Throughout its history, the FCA has evolved to reflect Maryland's growing commitment to forest conservation and climate resilience.

As one of the early adopters of "no net loss," Frederick County has started to see an increase in the amount of forest preserved when compared to the area of forest impacted by development or clearing activities. This trend is expected to continue as more and more development projects are initiated after the enacting date of the legislation.[44] The number of forest acres permanently preserved in Frederick County between 2020 and 2024 is indicated in Figure 9.

Figure 9: Acres of Frederick County Forest Protected per year (2020 – 2024)



HABITAT

Maryland stands out as a unique ecological region, bridging northeastern and southeastern ecosystems due to its latitude and proximity to the Atlantic Coast. Its diverse landscape supports a variety of habitats, from Eastern Shore barrier islands and cypress swamps to Appalachian Plateau mountain bogs and limestone forests. As noted earlier in this Plan, Frederick County also occupies a particularly unique location, straddling the border between the Piedmont Plateau and the Blue Ridge Mountains of the Appalachian Range. The conditions in such transition zones create a variety of habitat conditions and enable a richness in biodiversity.

The Maryland Department of Natural Resources estimates that Maryland is currently home to 90 species of mammals, 93 species and subspecies of reptiles and amphibians, 400 species of birds, and several hundred species of marine and freshwater fish. The number of insects and other invertebrates may be too large to quantify. The Department of Natural Resources provides summaries of these various different categories of native species on the Department website at: https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/mdwllists.aspx. Of all the species and subspecies identified by DNR, over 300 are rare, and approximately 110 of these species are designated as threatened or endangered in Maryland. For this reason, they are afforded protection under the State Nongame and Endangered Species Conservation Act. [45]

The Maryland Department of Natural Resources also notes that due to historic patterns of land and development, many of which continue today, Maryland's natural heritage now exists in fragmented remnants of its original wilderness. Habitat protection and enhanced connectivity inherent in the implementation of a green infrastructure network is one method to help support the state's vulnerable fauna and flora.

2015-2025 Maryland State Wildlife Action Plan (SWAP)

As noted at the outset of this discussion of habitat in Frederick County, Maryland serves as an ecological crossroads, connecting northeastern and southeastern ecosystems while spanning from the Atlantic seaboard to the Appalachian Mountains. Its diverse landscapes include barrier islands, cypress swamps, tidal marshes, mountain ridges, caves, and forests, supporting an impressive variety of plant and animal communities.

Maryland's State Wildlife Action Plan (SWAP) drives conservation efforts by setting a clear strategy for protecting the state's fish, wildlife, and habitats. Mandated by the U.S. Department of the Interior, each state must develop and revise these plans to qualify for State Wildlife Grants, ensuring long-term funding for conservation. The Maryland Department of Natural Resources leads the initiative to develop the Maryland SWAP, ensuring agencies and organizations follow a unified plan development process. The SWAP also identifies threats to species and outlines necessary conservation actions to maintain thriving populations.

Chapter 4 of the 2015-2025 State Wildlife Action Plan describes approximately 26 different types of terrestrial, aquatic, and subterranean habitats that exist within Frederick County. These habitats range from cove forests to cliff and rock outcrops, to cold water streams, to managed grasslands. The full SWAP document can be found and read online at the following location: https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx. A summary and brief description of the various habitat types located in Frederick County can be found in the appendices of this Green Infrastructure Plan.

An abbreviated list of "Species of Greatest Conservation Need" (SGCNs) is also provided in the appendices, adapted from Chapter 3 of the SWAP. Species of Greatest Conservation Need (SGCN) are plant and animal species that are facing declining populations or limited abundance and are therefore considered to be at risk of extinction, extirpation, or being listed as endangered or threatened. This designation is used in SWAPs to help prioritize conservation efforts.

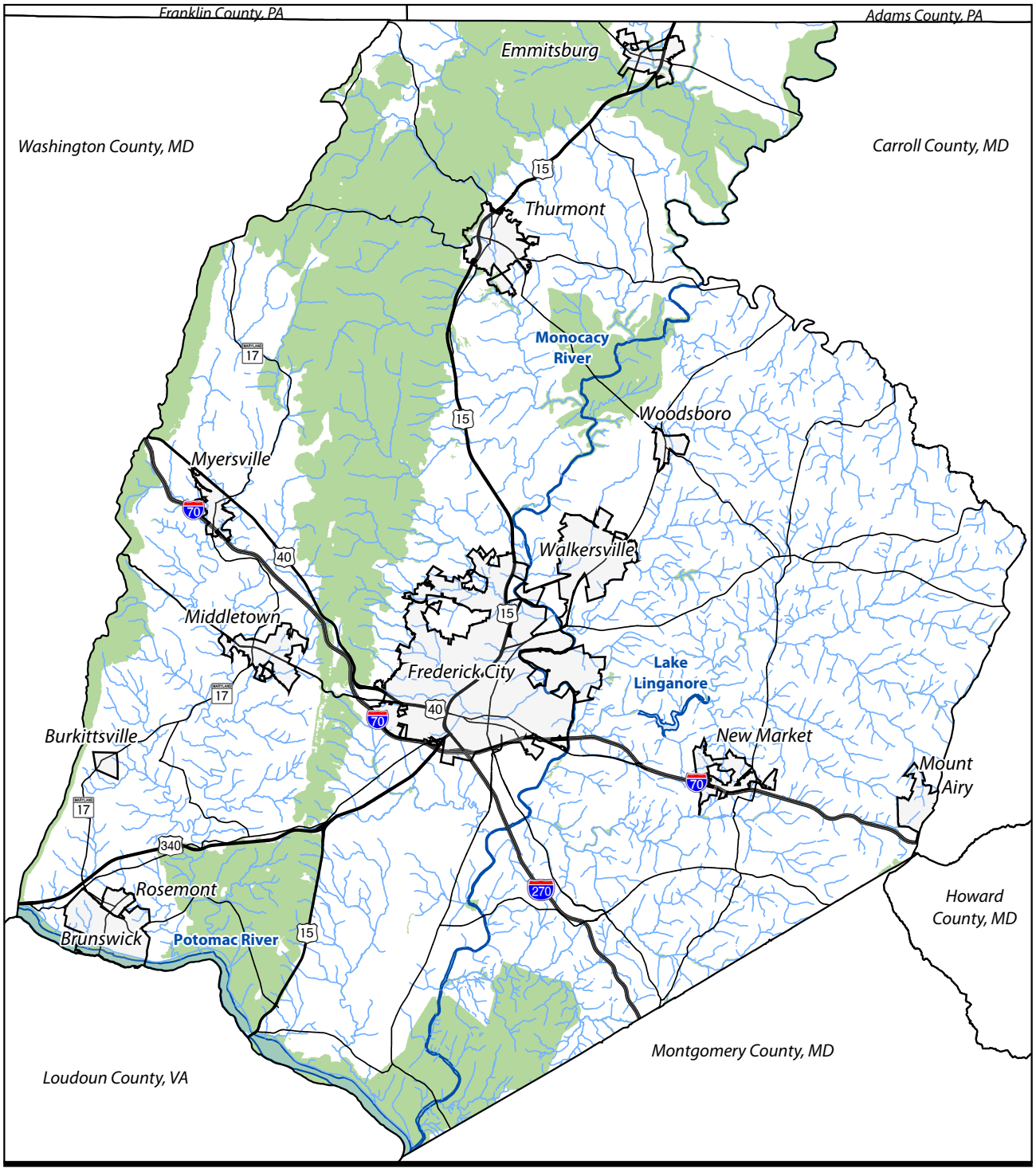
Targeted Ecological Areas

Maryland's Targeted Ecological Areas (TEAs) represent the most valuable lands and watersheds for conservation, identified by the Department of Natural Resources (DNR) as top priorities for protection. These areas include large, contiguous forests, wetlands, and critical wildlife habitats that support biodiversity, improve air and water quality, and safeguard against storm and flood damage. Also included are wildlife and rare species habitat, nontidal fisheries, tidal fisheries, and coastal wetlands that may be impacted by climate change. Based on their composition, TEAs also play a crucial role in maintaining corridors for plant and animal migration, reducing habitat fragmentation, and preserving rare species.

The Maryland GreenPrint Map[46] integrates TEAs into Maryland's conservation strategy, ensuring that land acquisition efforts align with ecological priorities. By leveraging data from the Green Infrastructure Assessment, rare species habitats, aquatic life hotspots, and coastal ecosystems, Maryland directs conservation funding to the most impactful areas. This approach strengthens environmental resilience, enhances climate adaptation efforts, and sustains the state's natural heritage for future generations.

Audubon Important Bird Areas

The National Audubon Society leads efforts to identify, monitor, and protect Important Bird Areas (IBAs) across the United States and beyond. As of the drafting of this document, Audubon has designated 2,758 IBAs, spanning 417 million acres of public and private land, including key locations like Jamaica Bay in New York City and coastal sanctuaries in Texas. IBAs are typically qualified under the following criteria:[47]



Map 11: MD DNR Targeted Ecological Areas in Frederick County

Municipalities
Streams, Rivers, Lakes
Targeted Ecological Areas

- Exceptional concentrations of regularly occurring birds
- Significant populations of species of conservation priority
- Assemblages of bird species characteristic of rare or representative habitats
- Sites where long-term research generates high quality data of value to conservation planning at a statewide scale.

There are 43 mapped IBAs in the State of Maryland and three mapped IBAs in Frederick County, including the Monocacy Grasslands IBA, the Maryland Blue Ridge IBA, and the Lower C & O Canal IBA.

Monocacy Grasslands IBA

Stretching across Frederick and Carroll Counties, the Monocacy Grasslands IBA consists of expansive open fields and meadows that sustain at-risk bird populations and a diverse range of grassland bird species like the Red-headed Woodpecker, Dickcissel, and Grasshopper Sparrow, all of which have significant populations within the region.

Maryland Blue Ridge IBA

The Blue Ridge Important Bird Area (IBA) provides critical habitat for over 250 bird species. Stretching across diverse elevations, this area supports both northern and southern bird populations, offering nesting grounds for species like the Canada Warbler, Black-throated Green Warbler, and Red-breasted Nuthatch.

Lower C & O Canal IBA

Spanning Washington, Frederick, and Montgomery Counties along the Potomac River, this area supports key populations of migratory and resident birds, including Bald Eagles, Wood Ducks, and various warblers. The riparian forests, wetlands, and open water create ideal conditions for nesting, feeding, and shelter.

Rare, Threatened, and Endangered Species in Frederick County

Frederick County, Maryland, is home to several rare, threatened, and endangered species that rely on conservation efforts to survive. The County's diverse habitats support species that face threats from habitat loss and environmental changes. A full listing of rare, threatened, and endangered species in Frederick County, as published by the Maryland Department of Natural Resources in November 2021, is also included in the appendices of the Green Infrastructure Plan.

As noted in Chapter 1, the County regulations contain provisions to ensure that habitats of these species, where they exist, are identified as part of planning or land development activities. Additionally multiple conservation organizations actively monitor these populations, implement habitat restoration projects, and make sure that regulations are enforced to ensure their survival.

Federally Endangered Species in Frederick County

Federally threatened or endangered species in Frederick County include the Northern and Indiana myotis (Long-eared and Indiana bats) and the "vulnerable" Tricolored bat (*Perimyotis subflavus*), the smallest bat species found in the eastern and midwestern United States. All have been impacted by "white-nose syndrome," a fungus (*Pseudogymnoascus destructans* or "Pd") that was introduced to North America, and was first noted in 2006. The fungus colonizes a bat's skin during the winter with a white "fuzz," particularly on or around the face. This coating causes the affected bat to awake from hibernation and use up the energy reserves that would normally sustain them through a winter hibernation, leading to death. The Indiana myotis was first listed as endangered in 1966, and the Long-eared myotis was listed as endangered in 2023. [48] The Tricolored bat was identified for addition by the U.S. Fish and Wildlife Service in in September of 2022.[49]

Image 9: The endangered Northern Long-eared bat (Myotis septentrionalis)

(Image Credit: J. Scott Altenbach via Bat Conservation International. https://www.batcon.org/bat/myotis-septentrionalis/)

THE CULTURAL LANDSCAPE

Much like the natural landscape, abundant resources, regional transportation infrastructure, and agricultural innovations have shaped Frederick County's development throughout its history. Key built infrastructure projects, such as the Baltimore-Fredericktown Turnpike, the C & O Canal, and several railroad lines, have boosted connectivity and the transportation of goods over time. The County's role in the Civil War, the effects of the Industrial Revolution, and suburban expansion further defined its modern identity. Today, the balance between growth and the preservation of both natural and cultural resources remains a central challenge for Frederick County.

Historic Patterns of Development

Pre-European Settlement

Archaeological investigations in Frederick County's Monocacy River Valley reveal a rich prehistoric history, tracing human occupation back to the Paleo-Indian Period (10,000–7,500 B.C.). Early inhabitants, though sparse, relied on the region's rivers for sustenance, with fluted projectile points found near the Monocacy and Potomac Rivers indicating hunting and camping activity. Over time, settlement patterns evolved, with populations expanding into tributaries and foothills during the Middle and Late Archaic Periods (6,000–2,000 B.C.). The use of rhyolite for tools and weapons became widespread, reflecting specialized trips to extract the material from Catoctin Mountain. These periods saw increasing habitation away from the rivers, signaling a more stable presence in the valley.

The introduction of ceramics in the Early Woodland Period (2,000–500 B.C.) marked a cultural shift, with large settlements appearing along the Potomac River. Seasonal hunting and gathering shaped habitation patterns in the Monocacy Valley, and archaeological evidence indicates a growing population dispersing across the region. By the Late Woodland Period (A.D. 900–1600), permanent villages emerged, fueled by agriculture and increased ceramic use. Sites like Noland's Ferry, Biggs Ford, and at Rosenstock on the Monocacy River site provide insights into community structure, trade, and daily life, showcasing the valley's significance in Maryland's early development.

European Settlement

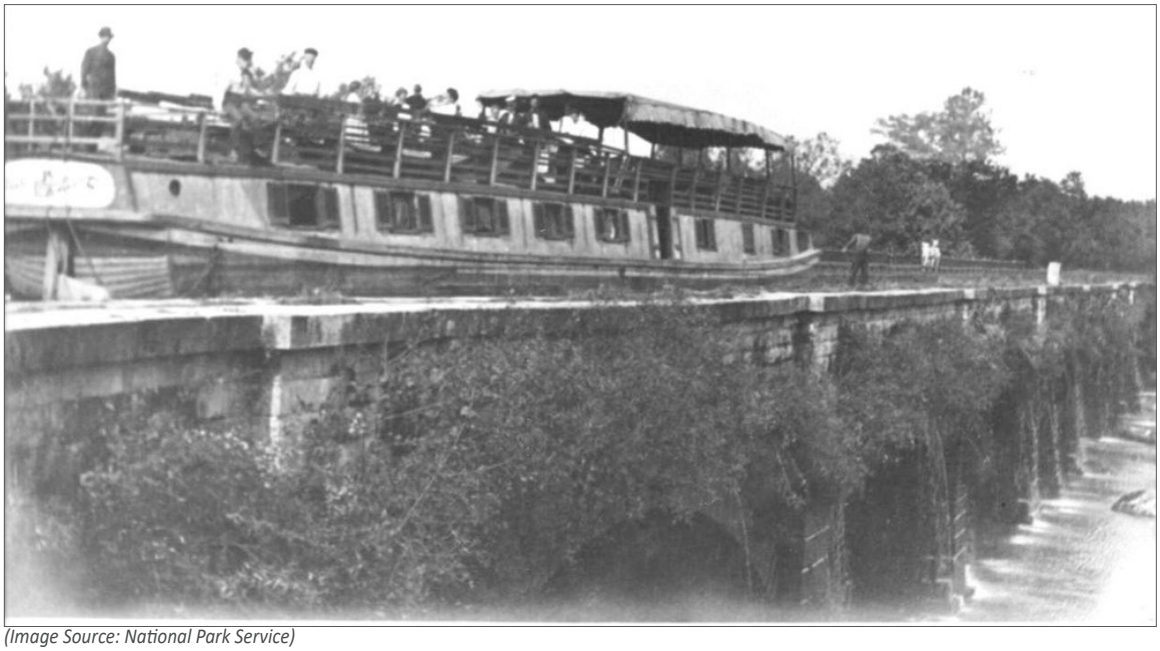
European settlement in Maryland began in 1634 with the establishment of St. Mary's City. Initially governed by the Lords Baltimore under a proprietorship, Maryland later became a royal colony after England's 1688 Revolution, before returning to proprietary rule in 1715. Frederick County remained largely unsettled during this early period, with sporadic visits by explorers and traders. In the early 18th century, the region was still primarily wilderness, though surveys and land acquisitions began increasing. Large tracts, such as Carrollton and Monocacy Manor, were purchased by investors, laying the groundwork for future development.

Settlement intensified between 1730 and 1805, with German immigrants moving from Pennsylvania into the fertile Monocacy and Middletown Valleys. These settlers, skilled in various trades, cultivated land, built homes, and introduced religious diversity. Meanwhile, English landowners in the southern County established plantations, initially relying on tenant farmers and enslaved labor to grow tobacco. However, by the late 18th century, agricultural diversification, including crop rotation, proved more viable. The blending of German and English influences shaped Frederick County's economy, buildings, and cultural traditions, marking a transformative era in its history.

Early Transportation

In 1805, Maryland authorized the Baltimore-Fredericktown Turnpike Company to construct a vital roadway connecting Baltimore to Boonsboro as part of the National Pike. The turnpike, later traced by the current MD 144 and US (Alternate) 40, spurred the development of infrastructure, including taverns, inns, and tollhouses, particularly at key crossings. It followed Bush Creek through the Piedmont Uplands before crossing Catoctin Mountain and South Mountain. Other turnpikes soon emerged, improving travel routes between Frederick and neighboring areas. These transportation improvements helped fuel economic growth, coinciding with agricultural and technological advances such as threshing machines, reapers, and crop rotation techniques.

Image 10: A canal boat traveling on the Monocacy Aqueduct.



(Image Source: National Park Service)

By the late 1820s, Frederick County expanded its transportation network further with the construction of the Baltimore and Ohio (B&O) Railroad and the Chesapeake and Ohio (C&O) Canal. The B&O Railroad, despite initial disputes over land access, became the County's most influential transport system, linking mills, quarries, and emerging settlements like Adamstown and Doubs. The Western Maryland Railroad and the Pennsylvania Railroad later extended connectivity throughout the region. These infrastructure developments, alongside growing industries and agricultural innovation, contributed to Frederick County's rapid growth, increasing its population by 50% between 1790 and 1840. Despite advances, slavery remained a labor source, but its role diminished as the employment of free blacks became more common.

The Civil War

Frederick County played a critical role during the Civil War, witnessing two major battles - South Mountain in 1862 and the Battle of Monocacy in 1864. Due to its location between Virginia and Pennsylvania and its extensive transportation network, the County became a strategic hub for both Union and Confederate forces.

Nearby battles at Antietam and Gettysburg also affected the County significantly. The war's aftermath left Frederick County in a state of recovery, with widespread destruction of crops, livestock, and property. Confederate raids targeted southern areas, while divided loyalties among residents reflected the broader tensions of border states. The post-war years saw significant rebuilding, with new institutions like the Maryland School for the Deaf and Montevue Hospital—demonstrating a commitment to progress. These developments marked the County's transition into a new era of historical growth.

Image 11: The Monocacy Junction station building in 1872—built to replace the former building burned in 1864.

(Source: National Park Service via WikiMedia Commons. https://commons.wikimedia.org/wiki/File:Monocacy_Junction,_ca._1872_(457e4e32-b02c-d54e-b187-8343ef57ff65).JPG)

Industrialization

By the 1870s, the Industrial Revolution reached its peak, driving advancements in science, transportation, and agriculture. Frederick County farmers, returning from war service, adopted improved cultivation techniques, including lime fertilization and guano imports, facilitated by railroad connections. The rise of steam-powered farm equipment led to shared-use arrangements and the growth of local repair shops. Ensilage (fermented, preserved forage) storage improved livestock feeding, reducing financial strain on farmers, while canning technology boosted agricultural production. Entrepreneurs like Louis McMurray expanded the canning industry in the City of Frederick by focusing on corn, peas, and other vegetables while establishing canneries and farms in the County. Such innovations transformed Frederick County's economy, laying the foundation for modernization in agriculture and beyond.

In the early late 19th and early 20th century, an ample supply of materials to produce cement and portable concreate block presses largely replaced traditional stone foundations by the 1920s and allowed for quicker and easier construction of buildings, but Frederick County's development slowed with the Great Depression in 1929, only regaining momentum when the U.S. entered World War II in 1941. Agricultural advancements, particularly electric power, revolutionized dairy farming by the late 1920s and 1930s, with the Hagerstown & Frederick Railway initially providing electricity as a subsidiary service. As trolley use declined due to

automobiles and trucks, electricity became a crucial service, transforming farm operations with automatic milking equipment and improved milk distribution via gasoline-fueled trucks. During the 1930s, Frederick County farmers increasingly adopted power machines, though traditional horse and mule teams remained in use on small farms until the late 1940s and early 1950s. The Great Depression forced the closure or merger of small banks and savings societies, leading to the sale of many family farms and a rise in dairy-owned farms.

The Federal government's highway construction program relocated a section of the Old National Pike, replacing old bridges with new concrete and ashlar stone structures, while the Civilian Conservation Corps created Gambrill State Park and promoted natural conservation. Fishing and hunting clubs established modern cabins along rivers, and a fish hatchery near Lewistown contributed to a growing cottage industry. President Franklin Delano Roosevelt frequently visited Frederick County, and his retreat near Thurmont, Shangri-La, later became Camp David.

World War II and Suburban Expansion

Following World War II, transportation networks in Frederick County evolved in response to economic and population shifts. The opening of the Frederick Shopping Center in 1957 marked a shift in economic activity, while the construction of U.S. 15 adjacent to the center diverted customers away from Frederick's historic shopping district. As automobiles became more accessible, rural general stores declined, and by the 1970s, the Interstate Highway system replaced older routes. Interstate 70, completed by 1969, followed the path of U.S. 40, while Interstate 270, originally designated as I-70S, was mostly finished by 1958. Widening projects and complex interchanges have been added or are planned, particularly along the I-270 corridor, where ongoing discussions among state and County officials address the challenges of suburban expansion and transportation demands.

Frederick County experienced significant suburban growth as the postwar population moved outward from Washington, D.C., drawn by government job stability and high salaries. While Montgomery County saw early housing development in the 1960s and 1970s, Frederick County quickly followed due to I-270's extension. However, job growth in Frederick did not match the rising population, leading to a daily commute pattern where a substantial portion of residents left the County for work that persists to some degree today. Efforts by economic development agencies have attracted high profile and high-tech employers like Leidos Biomedical Research, AstraZeneca, Thermo Fisher Scientific, and Kite Pharma, but Fort Detrick remains the largest local employer, housing both military and civilian operations. Despite economic expansion, commuter statistics from the American Community Survey 2016 - 2020 indicate that about 41 percent of Frederick County's labor force worked outside the County, and steady population growth continued through the early 21st century, albeit at a slightly slower rate than in the 1990s.

Image 12: A scene at the edge of a suburban housing development and farmland in Frederick County, Maryland.

(Source: Roger Auch via USGS. https://www.usgs.gov/media/images/expanding-suburbs)

Conservation and Preservation of Cultural Landscapes Today

Frederick County's agricultural, natural, scenic, and historic landscapes continue to face development pressure. To counteract this pressure, programs such as the Old National Pike Scenic Byway and the Catoctin Mountain Scenic Byway have promoted awareness and protection of significant historical routes. Additionally, the Heart of the Civil War Heritage Area (HCWHA), certified in 2006, focuses on preserving and interpreting sites linked to the Civil War, including Monocacy, Antietam, and South Mountain battlefields. Local organizations and museums work alongside governmental agencies to support research, tourism, and economic development, ensuring that Frederick County's historic and cultural identity remains intact amid ongoing growth.

Frederick County Government and Historic Preservation staff with the Livable Frederick Planning and Design Office have also undertaken many measures to help preserve culturally significant sites and landscapes in Frederick County. Between 2019 and 2024, Frederick County more than quadrupled the number of historic properties listed on the County Register of Historic Places. In 2023, the County established the first Rural Historic Preservation District in the State of Maryland with the creation of the "Peace and Plenty Rural Historic District" north of the Town of New Market that focuses not only on historic farm structures, but the 1,200-acre landscape that connects them. More information regarding historic preservation in Frederick County is provided later in this chapter.

Frederick County's incorporated municipalities have also played a central role in establishing current patterns of development and land conservation and preservation. To provide for a broad understanding of the past and present role of the incorporated municipalities in determining patterns of land use in the County, an overview of their establishment and ties to local transportation and industry follows.

Municipalities

There are twelve incorporated cities and towns within Frederick County. They include the cities of Brunswick and Frederick and the Towns of Burkittsville, Emmitsburg, Middletown, Myersville, New Market, Thurmont, Walkersville, and Woodsboro. The Town of Mount Airy straddles the jurisdictional border between Frederick County and Carroll County, Maryland. Frederick County is also home to the Village of Rosemont. The establishment and growth of the incorporated municipalities in Frederick County is reflective of both geographic and cultural factors.

Growth in the Cities

The City of Frederick became the first incorporated locality in 1745 with its establishment as a market town by Daniel Dulaney. Frederick incorporated as a city in 1816, followed by the City of Brunswick in 1890 on land formerly settled as early as 1787 and initially laid out as "Berlin." The growth of both cities was very much influenced by geography and their locations at crucial crossroads within the County. For the City of Frederick, it was the intersection of the Great Wagon Road (now known as the Historic National Road or Route 40) and the High Road (now known as the Journey Through Hallowed Ground National Scenic Byway or US-15).

For the City of Brunswick, it was proximity to the Chesapeake and Ohio Canal and, in time, the Baltimore and Ohio Railroad. The village of Rosemont in Frederick County, Maryland, began as a small settlement along the B&O Railroad in the 19th century near the City of Brunswick. Residents built homes and farms near the tracks, relying on the rail line for transportation and trade. As the community grew, locals pushed for incorporation to manage development and preserve their rural way of life. In 1953, Rosemont officially incorporated, giving residents a voice in local governance and control over zoning and infrastructure. Since then, the village has maintained its quiet charm.

The Blue Ridge Foothill Towns

Nestled in the northern foothills of Frederick County, Maryland, the towns of Thurmont and Emmitsburg grew from humble settlements into distinct communities with proud identities. Early German and Swiss settlers established both towns in the mid-1700s, drawn by fertile farmland and access to key travel routes.

Emmitsburg was the first to incorporate in the north County, officially becoming a town in 1825. Its early growth centered around agriculture, education, and religion. Home to Mount St. Mary's University, which was established in 1808, and the former Saint Joseph College, established in 1809 by Elizabeth Ann Seton as a parochial school for girls, Emmitsburg became a destination for students. Following the closure of Saint Joseph College in 1973 and the merging of the faculty and student body with Mount St. Mary's, the U.S. Government selected the former Saint Joseph College site to become the National Fire Academy in 1979 (now the National Emergency Training Center, or NETC, that serves as an interagency emergency management training body). A shrine was also established south of the town following the canonization of Elizabeth Ann Seton in 1975 as the first American Saint. While Mount St. Mary's and the NETC are not located within the limits of the town, it has maintained close ties with both facilities while still maintaining its unique, small-town character.

Thurmont, originally known as "Mechanicstown," followed a different path. Incorporated in 1831 under its original name, the town later adopted the name Thurmont (meaning "Gateway to the Mountains") in 1894 to distinguish itself from another similarly named place on the Eastern Shore of Maryland. The arrival of the

Western Maryland Railroad several decades earlier, in 1871, brought energy to the town, linking it to larger markets and accelerating its economic growth. Industries emerged alongside the railroad, and Thurmont began to thrive as a hub for trade and tourism, especially with its proximity to Catoctin Mountain and the future site of Camp David.

The "Valley" Towns

In the scenic Middletown Valley of Frederick County, Maryland, the towns of Middletown, Myersville, and Burkittsville emerged as close-knit farming communities shaped by their geography, shared culture, and deep historical roots. Settlers first arrived in the 18th century, primarily of German descent, drawn by the valley's fertile soil and sheltered location between South Mountain and Catoctin Mountain. As these communities grew, they built churches, mills, schools, and small businesses that formed the backbone of rural life.

Middletown, founded in 1767, thrived as a hub for surrounding farms that flourished upon the fertile land found nestled between the Catoctin and South Mountains and sustained by Catoctin Creek. The valley's gentle slopes made it ideal for agriculture, sustaining wheat, rye, corn, and fruit orchards, while Catoctin Creek powered local grist mills. Lacking major railroad connections, the community relied on self-sufficient industries, including tanneries, blacksmith shops, and distilleries.

Just to the west, the Town of Burkittsville received its name in the mid-to-late 1820's from one of the original founders, Henry Burkitt. Smaller in size but rich in history, the town originally served as a center of exchange for the surrounding agricultural community. Burkittsville played a notable role during the Civil War, particularly during the Battle of South Mountain and the engagement at Crampton's Gap in 1862, which caused many of the residents to temporarily flee the town. Following the Civil War, the town experienced some prosperity from the operation of two seminaries and two rye whiskey distilleries, with the distillery operations ending because of prohibition in the early 20th century.

Myersville came later. First settled in 1750, it was incorporated under an Act of the Maryland State Legislature in 1904 after years of steady growth fueled by agriculture and the arrival of the Hagerstown and Frederick Railway in 1898. Myersville also served as a hub for the surrounding agricultural community, with taverns, stores, and boarding houses established and operated by town residents in the late eighteenth century.

Together, these three towns reflect the influences of agriculture on patterns of life in the valley. Each was established as a hub for the rural community. While Middletown and Myersville experienced moderate growth in the latter half of the 20th and the early 21st century, all three towns have managed to maintain a distinct character and a sense of place.

The National Historic Road

Perched along the historic National Road, the towns of New Market and Mount Airy developed as key stops for travelers moving westward through Frederick County, Maryland. Both towns grew out of necessity and opportunity—small communities that took root because of commerce, transportation, and the pioneering spirit of their residents. As the flow of people and goods increased, so did the need for structure and leadership, prompting each town to incorporate and take charge of its future.

New Market, originally laid out in 1792 and established in 1793, but not officially incorporated until 1878, is integrally associated with the National Road, which brought steady traffic through the town even before the road's authorization by the U.S. Congress in 1806. Inns, taverns, and shops lined Main Street, serving stagecoach travelers and local farmers alike.

Mount Airy, which straddles Frederick and Carroll Counties, emerged in the 1830s when the Baltimore & Ohio Railroad carved its way through the hills. Incorporated in 1894, the town rapidly grew into a bustling rail stop that connected rural Maryland to Baltimore and beyond by road and rail. Railroad workers, merchants, and farmers built a thriving economy around the tracks. Even as rail traffic declined, Mount Airy adapted, taking advantage of its location at the intersection of two significant travel routes in Interstate 70 and Maryland Route 27, to become a vibrant community with easy access to the City of Frederick as well as Howard County and Montgomery County.

Together, New Market and Mount Airy represent the evolution of towns shaped by movement—of goods, people, and ideas along the Historic National Road. Their histories reflect a shared determination to thrive along one of America's most important early transportation corridors.

The Pennsylvania Central and Maryland Midland Railroad

Walkersville and Woodsboro are nestled in the heart of Frederick County's rich farmland and grew from small agricultural settlements into thriving towns shaped by hard working industry and a strong sense of local identity. Early settlers in both communities cleared fields, built churches, and established tight-knit neighborhoods that revolved around farming and milling. Over time, as the region's population increased and transportation improved, both towns were also integral in leveraging Frederick County's mineral resources by contributing to both quarry stone and agricultural lime production.

Walkersville incorporated in 1892 with the combination of the two communities of Walkersville and Georgetown. It is believed that the town was named Walkersville because a post office already existed there, and there was no post office in Georgetown. The arrival of the railroad may have also contributed, as the train station in Georgetown was also named Walkersville Station to avoid confusion with the Georgetown Station that already existed near Washington, D.C. In any case, the arrival of the railroad nearly two decades prior to incorporation brought new opportunities, and the town quickly grew into a hub of agricultural commerce, with agricultural products processing and milling being central industries. The Fountain Rock Lime Kilns also operated near Walkersville from 1872 to 1955, producing burnt lime for agricultural use and crushed stone for road surfacing.

Woodsboro, Maryland, was founded in 1786 by Joseph Wood along a trail used by indigenous people and travelers from Pennsylvania. With the establishment of the Woodsboro Pike (MD 194), the town benefited from turnpike development and increased commerce. Throughout the 19th and 20th centuries, Woodsboro remained agriculturally driven, but supported industries like grist milling, copper mining, and perfume production. The Frederick-Pennsylvania Railroad facilitated trade and transportation, contributing to Woodsboro's steady growth as a regional service center. The LeGore Lime Company, established near the town in 1861, operated one of the largest quarries, producing lime for agricultural use and crushed stone for construction. In 1874, Samuel W. Barrick founded the Barrick Quarry, which supplied local farmers with lime and later expanded to produce crushed stone. The Barrick Quarry and other mineral extraction and

processing facilities near the town contributed to Woodsboro's economy and shaped its landscape, leaving behind remnants of their operations that remain part of the town's historical identity.

Community Growth Areas & Rural Communities

Community Growth Areas in Frederick County are based on the "community concept," that was first introduced in Frederick County's 1972 Comprehensive Plan and refined in later years. The community concept aimed to create well-defined, vibrant communities that maintain strong identities while efficiently supporting growth. Historically, uncoordinated industrialization and suburban sprawl have weakened the connection between individuals and their communities, resulting in a loss of social cohesion and identifiable community character. To counter this, the "community concept" prioritized clustered growth, where essential facilities—such as schools, parks, stores, and transportation networks—are strategically integrated within distinct town and village centers. This approach supported harmonious living environments with diverse housing options, pedestrian-friendly streets, and mixed-use developments that respect both natural and cultural resources. The Livable Frederick Master Plan carried the community concept forward in its scenario planning and in the establishment of the Primary and Secondary Growth Sectors and the Thematic Plan discussed in Chapter 1 of this Green Infrastructure Plan.

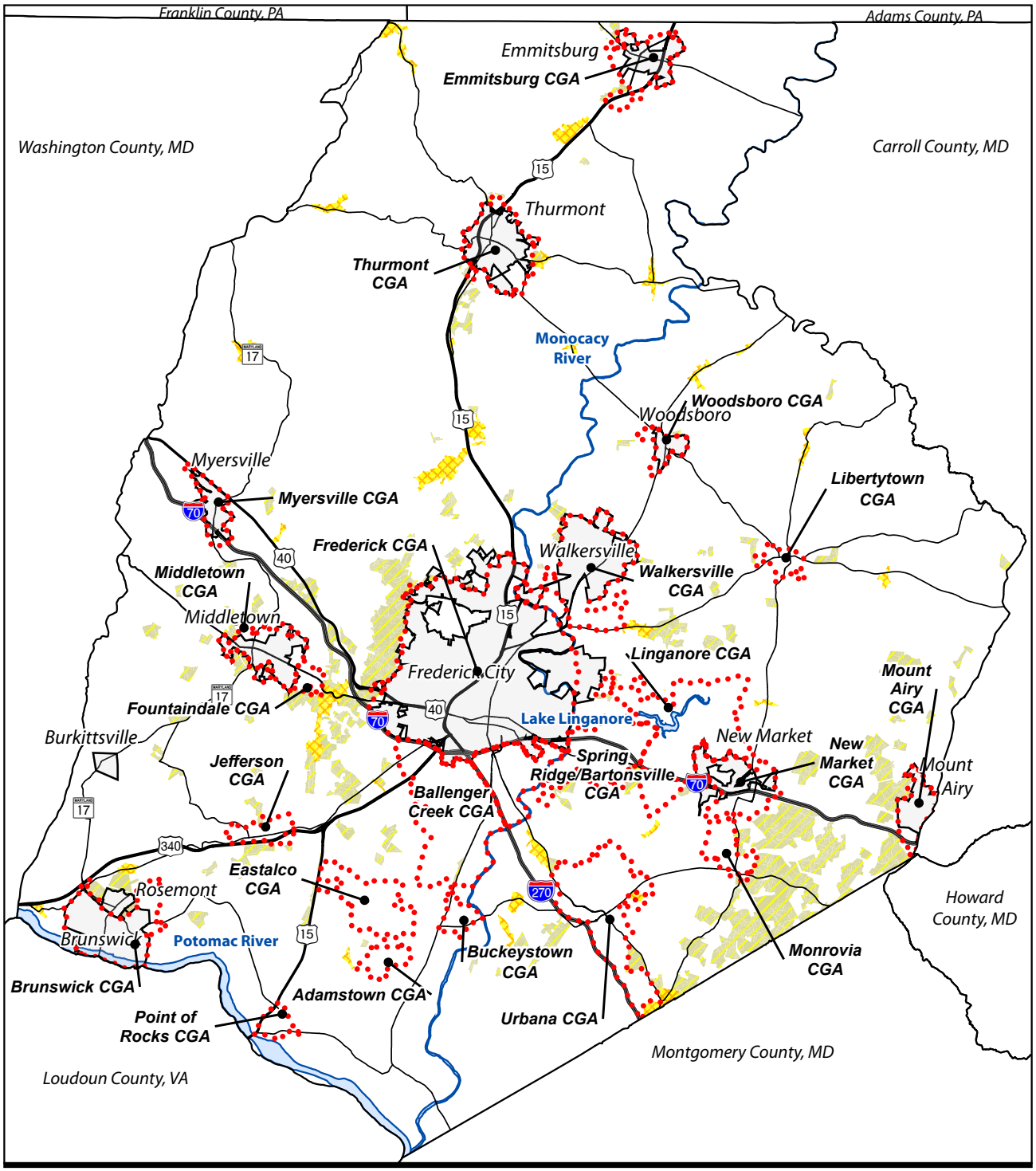
The Livable Frederick Master Plan also recognizes and addresses those small, compact villages located throughout the County's agricultural areas generally comprised of homes, a church or other community organization, and on occasion, some small businesses. These communities are often located at the intersection of rural highways, and they developed prior to the twentieth century as centralized locations or crossroads communities for area farmers to meet and trade. Their designation in the Livable Frederick Master Plan, as a Rural Community, serves to maintain the rural and historical character and permits some limited infill development. Rural communities are not identified as community growth areas and are generally not eligible for some types of community infrastructure like public water and sewer service.

A second type of rural development, designated as Rural Residential, has been accounted for in the County Comprehensive Plan to recognize areas of existing major residential subdivisions that occurred in the mid- to late-twentieth century or early twenty-first century, thar are zoned Agricultural or R-1 (1 dwelling/acre) and are located outside of municipal or unincorporated growth areas. Rural Residential areas are not intended to be served by public water/sewer, should only allow for continued build-out and infill of existing lots/subdivisions, and should not be expanded into surrounding agricultural properties per the Livable Frederick Master Plan.

Map 12 illustrates the locations of the various community growth areas and rural communities within Frederick County.

Municipal Community Growth Areas

Except for the Towns of Burkittsville and Walkersville, and the Village of Rosemont, each of the incorporated municipalities in Frederick County possesses a corresponding, mapped Community Growth Area identified in the County's Comprehensive Plan. Frederick County's towns and municipalities have thrived throughout their history by embracing traditional and, although it may not have been recognized at the time, sustainable development. Each community naturally fosters walkability, allowing residents to easily access stores, churches, and schools while engaging in local activities that strengthen neighborhood bonds. Historically, all of Frederick County's cities and towns have supported surrounding agricultural areas



Map 12: Generalized Population Distribution in Frederick County

- Municipalities
- Community Growth Area
- Rural Community
- Rural Residential

by providing essential goods and services while helping preserve the County's farming heritage by directing development away from rural regions. In other words, the function of community growth areas is to define an outer limit to the expansion of development into rural land, though this limit may be expanded through the municipal annexation process that will be described later in the Green Infrastructure Plan.

To sustain this dynamic, designated Municipal Community Growth Areas promote development that respects each town's unique characteristics and density. Regular reconciliations are conducted to ensure alignment between the County Comprehensive Plan and municipal comprehensive plans. Municipal input and public engagement play a crucial role in the reconciliation process to ensure that municipalities have adequate space available for future expansion and that land uses expectations are aligned between the municipalities and the County. Strengthening interjurisdictional coordination enhances growth management, infrastructure planning, economic development, and the preservation of green infrastructure where it exists. This process also ensures the continued functionality of essential services within Frederick County while reinforcing the County's commitment to sustainable and cohesive development.

Unincorporated Community Growth Areas

There are fourteen designated Unincorporated Community Growth Areas (CGAs) in Frederick County. These community growth areas are not associated with an incorporated municipality. Unincorporated Community Growth Areas are outlined in the Comprehensive Land Use Plan, and they represent land within the County where infrastructure expansion, zoning regulations supporting more intense and/or compact development, and appropriate environmental considerations supporting sustainable growth are focused. As is the case with Municipal Community Growth Areas, the function of Unincorporated Community Growth Areas is to shape policy decisions and scenario planning, which analyze potential future developments and their impacts on accessibility, land use, and economic trends.

These growth areas include several unincorporated yet distinct communities, such as Adamstown, Buckeystown, Fountaindale, Holly Hills, Jefferson, Libertytown, (Lake) Linganore, Monrovia, Point of Rocks, Spring Ridge/Bartonsville, and Urbana. Other growth areas are associated with the City of Frederick or neighborhoods close to the city, like the Frederick Southeast Community Growth Area and the Ballenger Creek Community Growth Area. The Eastalco Community Growth Area is associated with the former Alcoa Eastalco Works aluminum facility, which was in operation until 2005 and is now being redeveloped as a campus for the Critical Digital Infrastructure (CDI) industry.

CURRENT LAND CONSERVATION AND PRESERVATION

Overview

As of the publishing of Frederick County's most recent Land Preservation, Parks, and Recreation Plan, Frederick County boasted approximately 24,267 acres of parklands, excluding certain natural resource lands that permit limited outdoor activities. The County's federal, state, and local parks encompass a diverse range of natural and historic sites, including the C&O Canal National Historic Park, Monocacy National Battlefield, and Cunningham Falls State Park. County parks like Rose Hill Manor, Catoctin Creek Park, and Fountain Rock Park provide educational and recreational opportunities. Additionally, homeowners' associations, the Frederick County Public School System, and independent athletic associations contribute to local recreational spaces through additional County-owned and privately-owned parks and sports facilities.

Federal Parks

Frederick County is home to two federal parks that are maintained and operated by the U.S. National Park Service, Catoctin Mountain Park and the C&O Canal National Historic Park.

Catoctin Mountain Park spans approximately 5,760 acres in northern Maryland, offering visitors a range of outdoor experiences in a rugged and scenic environment. Hikers can explore over 25 miles of trails that wind through forests, past rock formations, and up to stunning overlooks like those found at "Chimney Rock" or "Hog Rock." Campers can be accommodated at Owens Creek Campground or the Adirondack-style shelters, while anglers can cast their lines in Big Hunting Creek, known for its excellent trout fishing. Visitors can also enjoy wildlife watching, as the park is home to deer, black bears, and a diverse range of forest interior dwelling bird species (also known as FIDS).

The C&O Canal National Historical Park stretches across almost 20,000 acres in Washington D.C., Montgomery County, Frederick County, Washington County, and Allegheny County and follows the Potomac River for 184.5 miles. Approximately 15 miles of the linear park are in Frederick County. Hikers and cyclists can traverse the historic towpaths and adjoining trails and visit any of the seven National Park Service visitors' centers within the Park. Boaters and paddlers can also take to the water for a leisurely trip or cast their lines in search of fish. Camping is also available at designated sites, as well as picnicking near visitor centers or boat ramps. In winter, adventurers enjoy ice fishing and cross-country skiing along the towpath.

State Parks

Frederick County is home to four Maryland State Parks. Portions of Greenbrier State Park and South Mountain State Park are situated on Frederick County's western limits. Gambrill State Park is located to the west of the City of Frederick, and Cunningham Falls State Park is in the north County adjacent to the Town of Thurmont and Catoctin Mountain Park. The Monocacy National Resources Management Area is also located in southern Frederick County. While it is not a state park, it offers land and water recreation opportunities to residents.

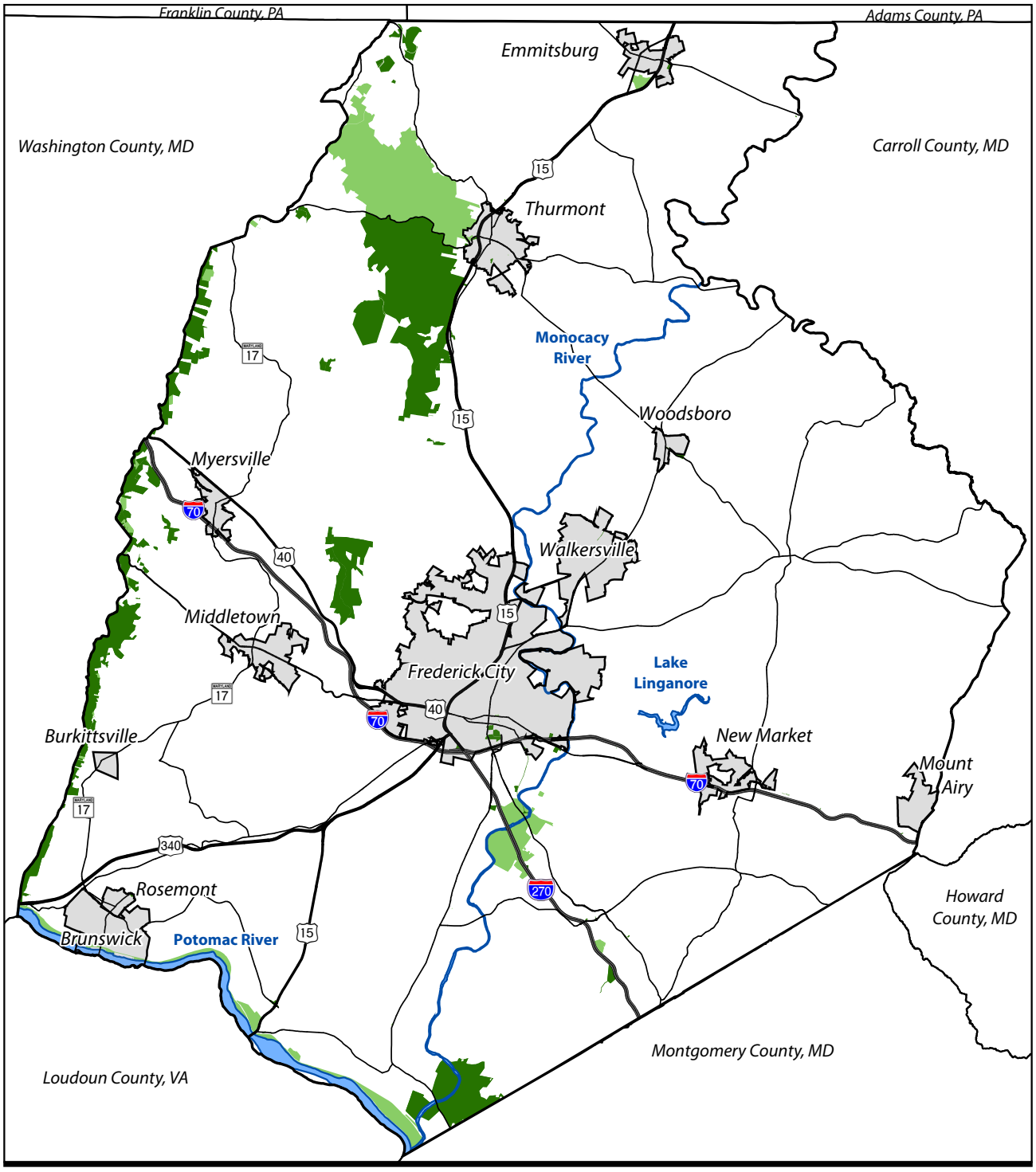
Greenbrier State Park spans over 1,000 acres in Washington County, Maryland, offering visitors a variety of outdoor activities. Hikers explore roughly 11 miles of trails that wind through diverse wildlife habitats and connect to the Appalachian Trail. Swimmers can enjoy the 42-acre man-made lake with a 1,000-foot-long beach, while boaters and anglers can take advantage of Greenbrier Lake's calm waters. Campers may settle into one of 164 campsites, some equipped with electric hookups and pet-friendly options. Picnickers can relax at gazebos near the lake, and visitors can observe local wildlife on the park's many trails.

South Mountain State Park spans 7,754 acres along the South Mountain ridge in Maryland, offering visitors a wealth of outdoor activities. Hikers traverse the 40-mile-long Appalachian Trail section, reaching breathtaking overlooks like Annapolis Rocks and Weverton Cliffs. Camping is available at designated sites, and history enthusiasts can explore the South Mountain Battlefield, where Civil War soldiers fought in several pitched battles in the mountain gaps in the fall of 1862. South Mountain State Park also offers opportunities for sportsmen, rock-climbers, and mountain bikers.

Gambrill State Park spans just over 1,200 acres, offering visitors breathtaking views from High Knob and a variety of other outdoor activities. Hikers and mountain bikers tackle 16 miles of scenic trails, winding

Image 13: Hog Rock Vista at Catoctin National Park

(Image Credit: Livable Frederick)



Map 13: Federal and State Lands and Easements

State Lands, 15,374 acres

Federal Lands, 9,479 acres

through forests and over rocky terrain. Camping is available at Rock Run Campground; while picnicking opportunities are available in the High Knob area. Fishing opportunities are available at Rock Run Pond in the Rock Run Day Use Area, which is stocked with bass and bluegill. In winter, adventurers can explore snow-covered paths for cross-country skiing and snowshoeing.

Cunningham Falls State Park spans approximately 6,157 acres in the scenic Catoctin Mountains of Maryland, offering visitors a variety of outdoor activities. Hikers can explore more than 25 miles of trails leading to and can access the park's centerpiece—Cunningham Falls, Maryland's largest cascading waterfall at 78 feet. Campers are accommodated in sites at the William Houck and Manor areas, while swimming opportunities abound at the beach on Hunting Creek Lake. The lake also provides boating and fishing opportunities. Additionally, due to the proximity of Cunningham Falls State Park to Catoctin Mountain Park, hikers can take advantage of trail connections between the two parks.

The Monocacy River Natural Resources Management Area is comprised of approximately 1,800 acres of natural areas and farmlands along the Monocacy River. Recreational use is primarily hunting, fishing, hiking, and horseback riding, but most trails are unmarked. Fishing access and small watercraft launches are available at parking areas at Park Mills Road and Route 28 road crossings of the Monocacy River.

Municipal Parks

Frederick County's municipal parks system offers a diverse range of recreational spaces, providing residents and visitors with opportunities to enjoy nature, sports, and community events. The County's municipal parks include neighborhood green spaces, athletic fields, and larger community parks designed for outdoor activities. Parks such as Baker Park in Frederick and Middletown Community Park feature walking trails, playgrounds, and picnic areas, making them ideal for family outings. Many parks also host seasonal events, including concerts, farmers' markets, and holiday celebrations, fostering a strong sense of community.

In addition to traditional parks, Frederick County's municipalities maintain specialized recreational facilities that cater to various interests. Skate parks, dog parks, and sports complexes offer designated spaces for active recreation, while nature centers provide educational programs about local wildlife and ecosystems. The County's municipal parks also include waterfront areas, such as Carroll Creek Linear Park in the City of Frederick, where visitors can enjoy scenic views and fishing in designated areas. Many municipalities also own and maintain a variety of outdoor athletic fields and sports courts that support local sports leagues, encouraging residents to participate in soccer, baseball, basketball, pickleball, and tennis.

The City of Frederick also owns and maintains a Municipal Forest that spans over 7,000-acres northwest of the city. The Municipal Forest provides a vital green space for outdoor recreation and environmental conservation between Gambrill State Park and Cunningham Falls State Park to the north. Hikers and mountain bikers can explore its extensive trail network, while anglers can cast their lines in Fishing Creek, which is known for its excellent trout fishing. The forest also serves as a certified tree farm, supporting sustainable forestry practices.

County Parks

Frederick County owns and operates approximately 2,169 acres of public parkland, offering a diverse range of recreational opportunities for residents and visitors alike. The County's park network is designed to provide a variety of outdoor experiences such as hiking, fishing, and picnicking. Facilities like Pinecliff

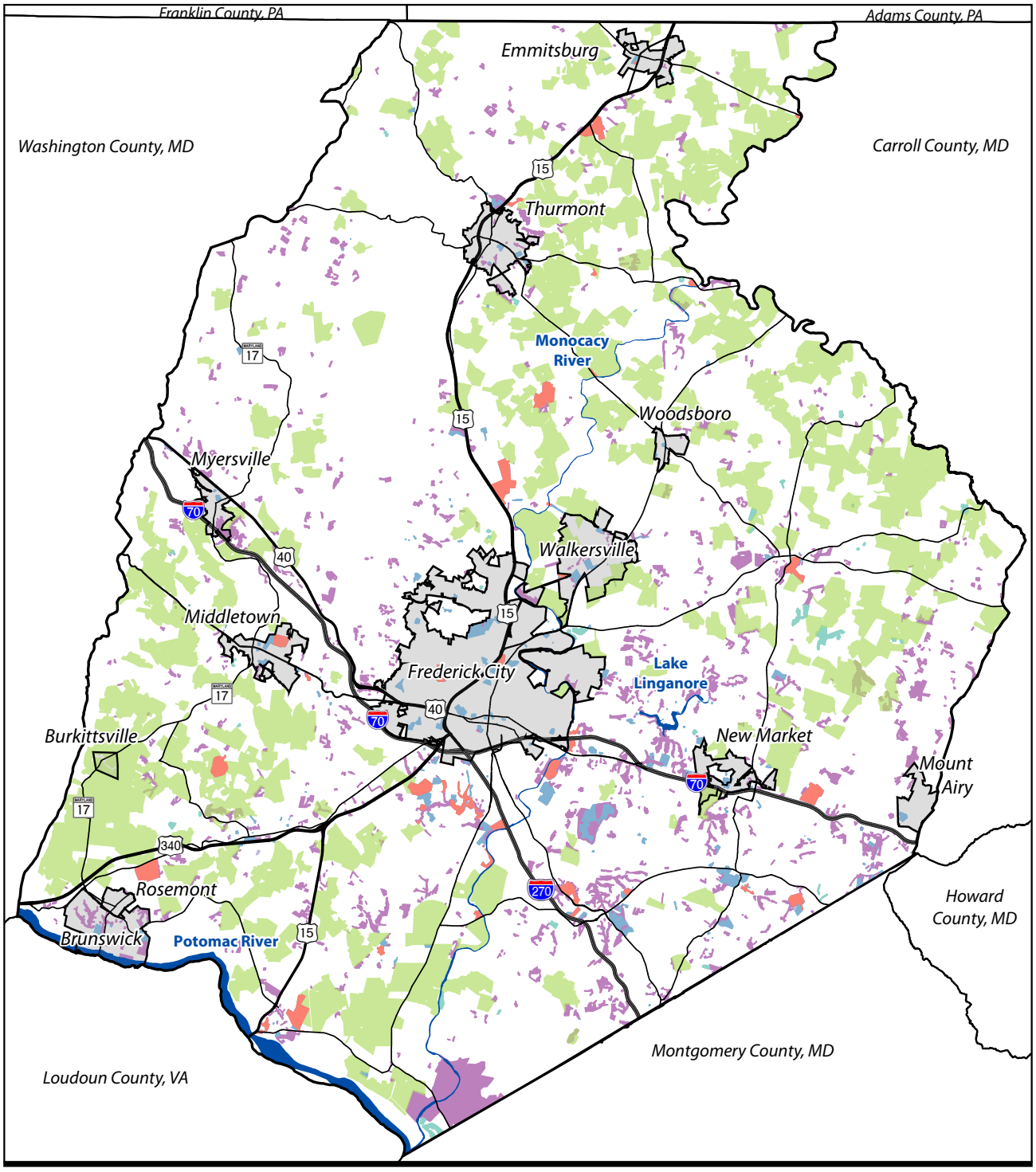
Park, the Ballenger Creek Linear Trail, and Othello Regional Park feature scenic trails, open fields, and playgrounds, making them ideal for family outings. County park facilities also host classes, seasonal events, nature programs, and historical reenactments, to enrich the community's connection to the outdoors and local history.

In addition to traditional parks, Frederick County offers specialized recreational facilities that cater to various interests. The Catoctin Creek Nature Center provides interactive exhibits and educational programs focused on local ecosystems. Fountain Rock Park features historic lime kilns and a fishing pond, allowing visitors to explore both nature and history. Athletic venues, including soccer fields and baseball diamonds, support local sports leagues and community activities. The County also maintains picnic shelters and pavilions, which are available for rental, making them perfect for gatherings and celebrations.

Image 14: Former Maryland Governor Thomas Johnson's Rose Hill Manor is located within Rose Hill Manor Park, a County Park in the City of Frederick.

(Image Credit: Livable Frederick)

Frederick County's parks system continues to evolve, with ongoing efforts to improve recreational facilities and enhance programming. A full list of facilities and programs, as well as interactive maps and online program registration are available to anyone interested in learning more about Frederick County parks through the Division of Parks and Recreation website at: https://www.recreater.com/.



Map 14: County Held Lands and Easements

County Held Easements

- Forest Resource Ordinance Easements
- County Creek ReLeaf Easement on Public Lands
- Creek ReLeaf Easements
- Ag Preservation Easements

County Properties

- County Parks
- County Owned Properties

Land Preservation, Parks, and Recreation Plan

In the State of Maryland, any jurisdiction seeking to receive state funding through Maryland's Program Open Space must contribute to the state's Land Preservation and Recreation Plan effort through the preparation of a County-specific plan. Accordingly, Frederick County has updated its Land Preservation, Parks, and Recreation Plan (LPPRP) roughly every 5 years since the first version of the LPPRP was released in 1983. The LPPRP aids the County in developing an integrated and coordinated approach to the provision of park and recreation facilities, of identifying land for natural resource protection, and of coordinating those efforts with the County's agricultural land preservation programs. The LPPRP can viewed online on the County's website at: https://frederickcountymd.gov/DocumentCenter/View/337459/2022-Land-Preservation-Parks-and-Recreation-Plan-LPPRP-2022-03-11.

FRO, CREP, and Creek ReLeaf

Frederick County oversees several programs because of federal or state law that are intended to both conserve and preserve forest resources within the County. These programs include the Forest Resources Ordinance (or FRO), the Conservation Reserve Enhancement Program (or CREP) and the Creek ReLeaf Program. A similarity between all these programs is that they require existing or newly established forest and forest plantings to be placed in a permanent protective easement that is granted to the County to ensure the long-term preservation of high priority forest communities. A brief description of each program follows.

Frederick County Forest Resources Ordinance (FRO)

Frederick County adopted the Forest Resource Ordinance (FRO) on December 15, 1992, following Maryland's statewide effort to protect and enhance forest resources enshrined in the Maryland State Forest Conservation Act (FCA) of 1991. The FRO was developed in response to state legislation accompanying the FCA requiring counties with less than 200,000 acres of forest to implement local conservation measures.

The ordinance requires anyone subdividing a property, disturbing more than 40,000 square feet of land through activities that expose or remove topsoil, or clearing more than 20,000 square feet of existing forest community to assess those forest resources, submit conservation plans, and implement measures to preserve existing trees or replant forests when necessary.[50] The FRO aims to stabilize soil, reduce stormwater runoff, improve air quality, and create habitats for wildlife while maintaining the County's aesthetic and environmental health. The FRO also establishes protective agreements, banking options for forest conservation, and guidelines for mitigating deforestation impacts. By enforcing these regulations, Frederick County promotes sustainable growth while safeguarding its natural landscapes.

As noted in Chapter 1 and earlier in this chapter, the FRO has undergone multiple revisions to reflect legislative changes over the years, including adjustments to exemption thresholds, priority retention areas, and mitigation banking options, with the most recent change occurring in 2020 – as discussed earlier in this chapter under the topic of tree cover.

Updates to the FRO are anticipated to occur concurrently with work on this Green Infrastructure Plan as new regulations under Maryland's Forest Conservation Act, effective July 1, 2025, introduce several

key changes. They refine the definition of "qualified conservation" for forest mitigation banks, update afforestation and reforestation requirements to implement the policy of "no net loss" statewide and expand the definitions for priority areas for forest retention and protection. Under the revisions to the state's Forest Conservation Act, the Department of Natural Resources must work with local governments in the State of Maryland to ensure that their ordinances are brought into compliance with state requirements by July 1, 2026.

Image 15: A reforestation planting incorporating staked tree shelters.

(Image Credit: Livable Frederick)

Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program (CREP), a partnership between the Farm Service Agency (FSA) of the United States Department of Agriculture, states, tribal governments, and non-governmental organizations supports farmers and landowners in protecting environmentally sensitive land through long-term conservation contracts. Participants receive financial incentives, including annual rental payments and cost-share assistance, to implement conservation practices like planting native vegetation to improve water quality, control erosion, and enhance wildlife habitats. CREP targets high-priority conservation areas, helping to reduce environmental impacts while maintaining agricultural economic stability, with enrollment periods varying by project and applications processed through local FSA offices or by contacting the Frederick County Soil Conservation District.

Participation in CREP is voluntary, and the program offers a one-time signing bonus of up to $1,000 an acre (through 2031) for establishment of riparian forest buffers for new enrollees, the potential for annual rental and incentive payments, and cost-share assistance to install streamside buffers, watering systems, livestock fencing, and more. The Frederick County Office of Agriculture reports that since the program was implemented in 2009, over 3,500 acres in Frederick County have been permanently preserved in the CREP program.

More information on the CREP program is available through the Farm Service Agency website at: https://www.fsa.usda.gov/resources/programs/conservation-reserve-enhancement-program-crep.

Frederick County Creek ReLeaf

The Creek ReLeaf Program is funded, in part, by Maryland's Chesapeake & Atlantic Coastal Bays Trust Fund, and it expands forested areas in Frederick County through permanent conservation easements on eligible parcels of at least two acres. The program provides landowners with a land assessment, a forest plan, native tree and shrub installation, and five years of maintenance, reducing property management challenges like mowing and erosion control. After the County's five-year support period, landowners assume maintenance responsibilities, with County staff conducting inspections every three years to ensure forest health.

To participate, property owners must review the County's conservation easement requirements, identify eligible land, and ensure it is free from existing easements or septic fields. The County prioritizes reforestation projects based on size, connectivity to existing forests, proximity to degraded streams, and accessibility for maintenance. Since its inception, the program has successfully reforested over 575 acres, enhancing environmental quality and watershed health while supporting landowners in sustainable land management.

The Creek ReLeaf Program is managed by the Frederick County Division of Energy and Environment, and more information can be found on the County's website at: https://frederickcountymd.gov/7572/Creek-ReLeaf-Reforestation-Program.

Agricultural Preservation

The Agricultural Land Preservation office administers a variety of local, state, and federal land preservation programs focused on protecting agricultural lands. The preservation programs offered through Frederick County, the State of Maryland, and the federal government provide many opportunities to the farmers of Frederick County to protect the future of their farmlands and promote natural resource industries. The Livable Frederick Master Plan 5-Year evaluation indicates that Frederick County has preserved over 75,051-acres of farmland (approximately 78,680 acres including MALPF Foundation Program Districts) through various agricultural preservation programs, making it one of the leading counties in Maryland for farmland protection.

Frederick County offers several agricultural preservation programs to support farmers and protect farmland from development. The Critical Farms Program helps farmers purchase land by providing upfront financial assistance, which can later be repaid through state or local easement programs. The Installment Purchase Program (IPP) allows farmers to sell development rights while receiving tax-free interest payments over 10 to 20 years, followed by a lump-sum payment, ensuring farmland remains in agricultural use. The Maryland Agricultural Land Preservation Foundation (MALPF), a state initiative, permanently preserves prime farmland by purchasing easements that restrict development, with over 23,300 acres protected in Frederick County since 1980.

The relationship between the preservation of working lands and green infrastructure will be discussed in more detail later in the Green Infrastructure Plan. The Frederick County Office of Agriculture has produced a reference for agricultural land preservation programs in Frederick County that can be accessed on the County's website at: frederickcountymd.gov/DocumentCenter/View/353865/FCG-OA-Land-Preservation-Booklet-6-24-P4-FINAL?bidId=.

Maryland Rural Legacy

Maryland's Rural Legacy Program, established in 1997, protects large, contiguous areas of farmland, forests, and natural habitats from development while promoting sustainable land use. Created as part of the state's Smart Growth initiatives, the program encourages conservation by designating Rural Legacy Areas, where landowners can voluntarily place their properties under permanent easements. Over the years, the program has preserved more than 125,000 acres statewide, ensuring that Maryland's agricultural and ecological landscapes remain intact for future generations. Frederick County has two designated Rural Legacy Areas—the Mid-Maryland Rural Legacy Area and the Carrollton Manor Rural Legacy Area—where over 6,700-acres have been permanently protected.

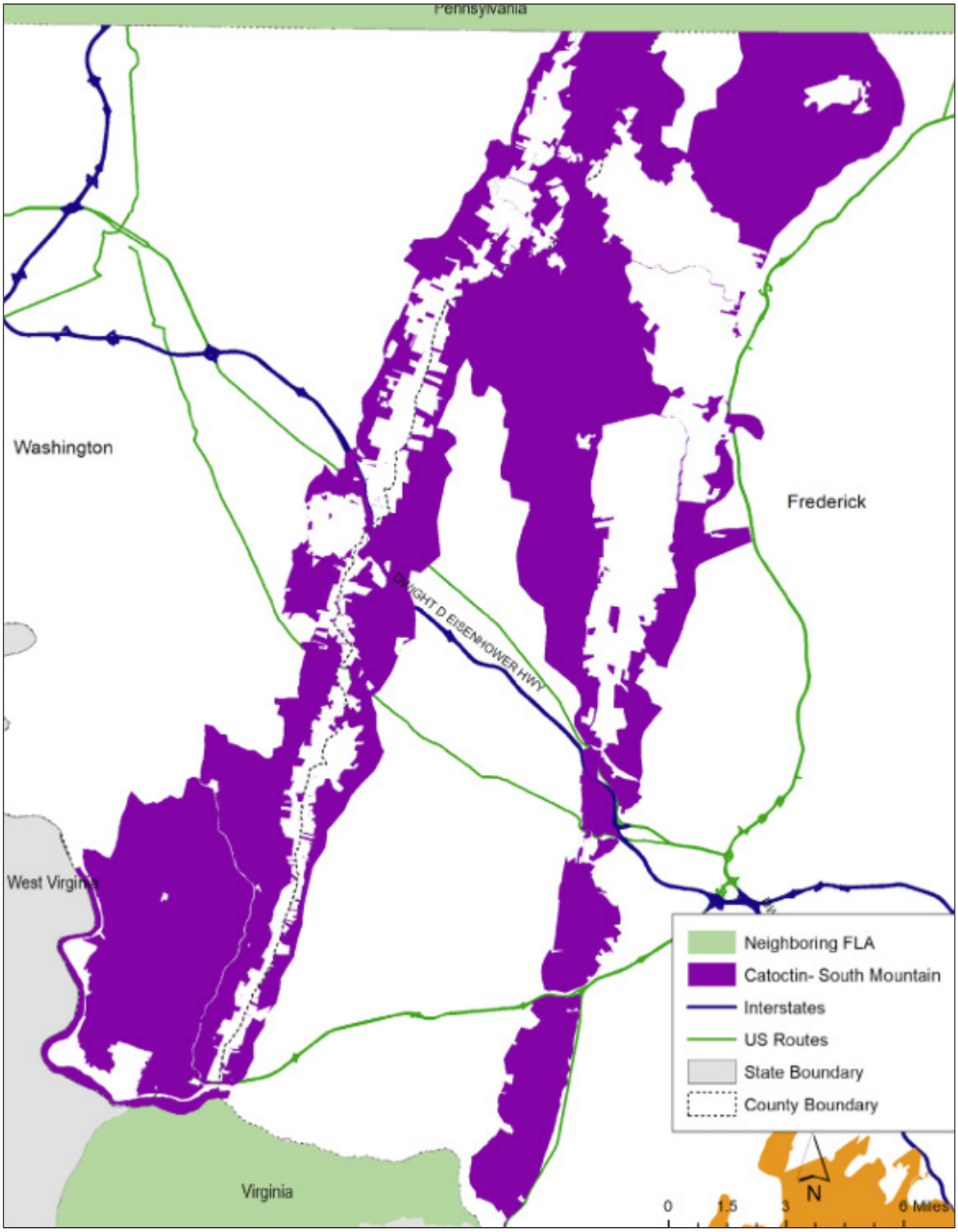
The Mid-Maryland RLA borders the South Mountain on its east side and is within the viewshed of the Appalachian Trail and South Mountain State Park. The area focuses on protecting two contiguous blocks of preserved land near the Town of Burkittsville and near the Town of Myersville. Some of Frederick County's most productive agricultural lands, including dairy operations and livestock farms, are protected within the Mid-Maryland RLA and these farms support the local resource-based economy of the area.

The intent of the Carrollton Manor RLA is to provide a bridge of preservation land between the Mid-Maryland Montgomery RLA and Mid-Maryland Frederick RLA. This Area includes farmland, river systems, scenic byways, and historic communities and supports the local agricultural economy, which produces beef, milk, hogs, horses, turkeys as well as corn, wheat, soybeans, alfalfa, and a variety of vegetables. The Potomac National Heritage River and Monocacy Scenic River are within the RLA, as are two scenic byways – Route 15 and Route 28. Civil War battlefield sites, the C & O canal, and the land of Declaration of Independence signer Charles Carroll are part of the historic significance of Carrollton Manor.

Maryland Forest Legacy

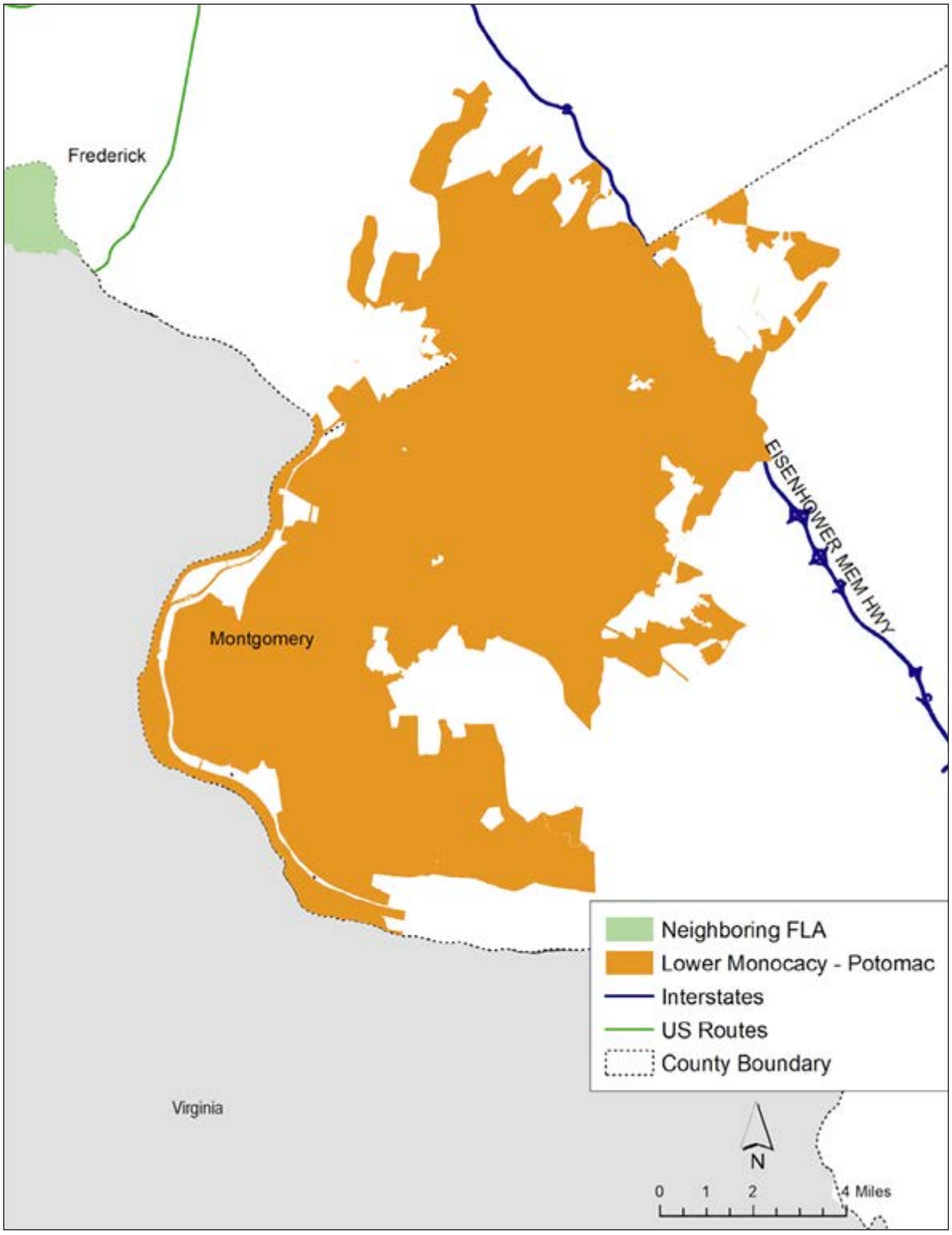
The Forest Legacy Program (FLP), administered by the U.S. Forest Service, works with state governments to protect forests threatened by development. The program funds conservation easements and direct land purchases in Forest Legacy Areas (FLAs), often supplementing state initiatives like Maryland's Rural Legacy Program and Program Open Space. By leveraging both federal and state resources, Maryland had secured easements on 2,014 acres of productive forestland across five counties as of the publishing of the 2020 Maryland State Forest Action Plan, helping to maintain wildlife habitats, water quality, and sustainable forestry practices.

Maryland uses Geographic Information Systems (GIS) and detailed eligibility criteria to identify FLAs, prioritizing forests with ecological significance, economic potential, and recreational value. Areas are selected based on factors like proximity to scenic byways, public lands, and intact green infrastructure. The state refines FLAs using composite scoring models and public feedback, ensuring that conservation efforts effectively target the most vulnerable and valuable forest regions. Since 2013, FLAs have expanded statewide, demonstrating Maryland's commitment to preserving forests against development pressures.



Map 15: The Catoctin South Mountain Forest Legacy Area in Washington County and Frederick County.

Map Source: Maryland Department of Natural Resources Forest Service. (2020). 2020 Forest Action Plan, Part II: Forest Strategy. Maryland Department of Natural Resources. Retrieved June 6, 2025, from https://dnr.maryland.gov/forests/Documents/Maryland-State-Strategy_wAON%20 2020FINALpages.pdf



Map 16: The Lower Monocacy-Potomac Forest Legacy Area in Montgomery County and Frederick County.

Map Source: Maryland Department of Natural Resources Forest Service. (2020). 2020 Forest Action Plan, Part II: Forest Strategy. Maryland Department of Natural Resources. Retrieved June 6, 2025, from https://dnr.maryland.gov/forests/Documents/Maryland-State-Strategy_wAON%202020FINALpages.pdf

There are currently two FLAs in Frederick County. The first is the Catoctin-South Mountain FLA, which focuses on the coincidence of forested land with state-mapped Habitat Connectivity Network hubs and corridors, forests with high Maryland BioNet values, forests with moderate- to high-site index values, and on forests with proximity to state scenic routes or other protected lands. [51]

The second is the Lower Monocacy-Potomac FLA that also focuses on the coincidence of forested land with state-mapped Habitat Connectivity Network hubs and corridors, on forests with moderate- to high-site index values, on forests with proximity to state scenic routes or other protected lands, and on focal areas for Program Open Space, Rural Legacy or Targeted Environmental Areas.

Land Trusts and Conservation Easements

The Maryland Environmental Trust (MET) was established in 1967 by the Maryland General Assembly to conserve the state's natural, agricultural, scenic, and cultural resources for future generations. Originally created as a free-standing agency, MET later became part of the Maryland Department of Natural Resources, working alongside local land trusts and government partners to protect land through conservation easements. Over the decades, MET has grown into one of the nation's most successful land trusts, holding more than 1,100 easements and preserving over 140,000 acres statewide. Through its Land Conservation, Monitoring and Stewardship, and Land Trust Assistance Programs, MET continues to safeguard Maryland's landscapes while inspiring public engagement in environmental preservation.

Maryland Environmental Trust (MET) conservation easements provide a lasting way for landowners in Frederick County to protect their properties from development while maintaining ownership. These legally binding agreements ensure that scenic open spaces, farmland, forests, and natural habitats remain preserved for future generations. When landowners donate easements, they relinquish certain rights—such as the ability to subdivide or commercially develop the land—but retain the ability to live on and use the property for agricultural or recreational purposes. MET evaluates easement offers case by case, ensuring that the protected land provides a public benefit, such as wildlife conservation, water quality improvement, or scenic preservation.

Preservation efforts in Frederick County also benefit from the work of other non-governmental conservation and preservation organizations. The American Battlefield Trust, the Burkittsville Preservation Association, the Central Maryland Heritage League, the Maryland Historic Trust, and the Nature Conservancy each own land or have partnered with other organizations to secure conservation easements in the County. Map 17 illustrates the locations of land that has been conserved or preserved through the work of trusts and other organizations. Map 17 also shows the extent of land held by Stronghold, Inc., which preserves and manages Sugarloaf Mountain as a privately held natural retreat that is open to the public, offering scenic trails, educational opportunities, and ecological stewardship.

Frederick County is also a central focus of the Catoctin Land Trust; a local non-profit officially incorporated in 2002 that focuses on the Appalachian Mountain landscape. The Catoctin Land Trust has protected over 2,200 acres of land in Frederick County through acquisition, creation of new easements, and co-holding easements with some of the other organizations described previously.

Conservation easements offer significant advantages, including tax benefits, reduced estate taxes, and protection from government condemnation at local and state levels. Although easements may lower

market value by restricting development potential, they allow landowners to maintain the integrity of their land while ensuring it remains in its natural state indefinitely. Future owners of easement-protected properties remain bound by the agreement, as the restrictions are recorded in County land records. MET regularly monitors these properties to ensure compliance and accepts easement donations year-round, giving landowners flexibility in securing long-term environmental preservation.

More information on the program can be found on the Maryland Department of Natural Resources website at: https://dnr.maryland.gov/met/pages/land_conservation.aspx. More information on the Catoctin Land Trust can be found on the Trusts' website at: https://catoctinlandtrust.org/.

Historic Preservation

Historic preservation and the preservation of the natural environment are closely linked, as preserving existing neighborhoods, structures, or other public spaces may help mitigate environmental impacts when compared to new construction. Reusing historic buildings reduces resource consumption, waste generation, energy use, and aligns with many common, sustainable practices. Furthermore, historic communities often possess characteristics that support environmental goals, such as walkability and access to public transportation. In Frederick County, Historic Preservation also represents another mechanism for the long-term preservation of natural and cultural resources.

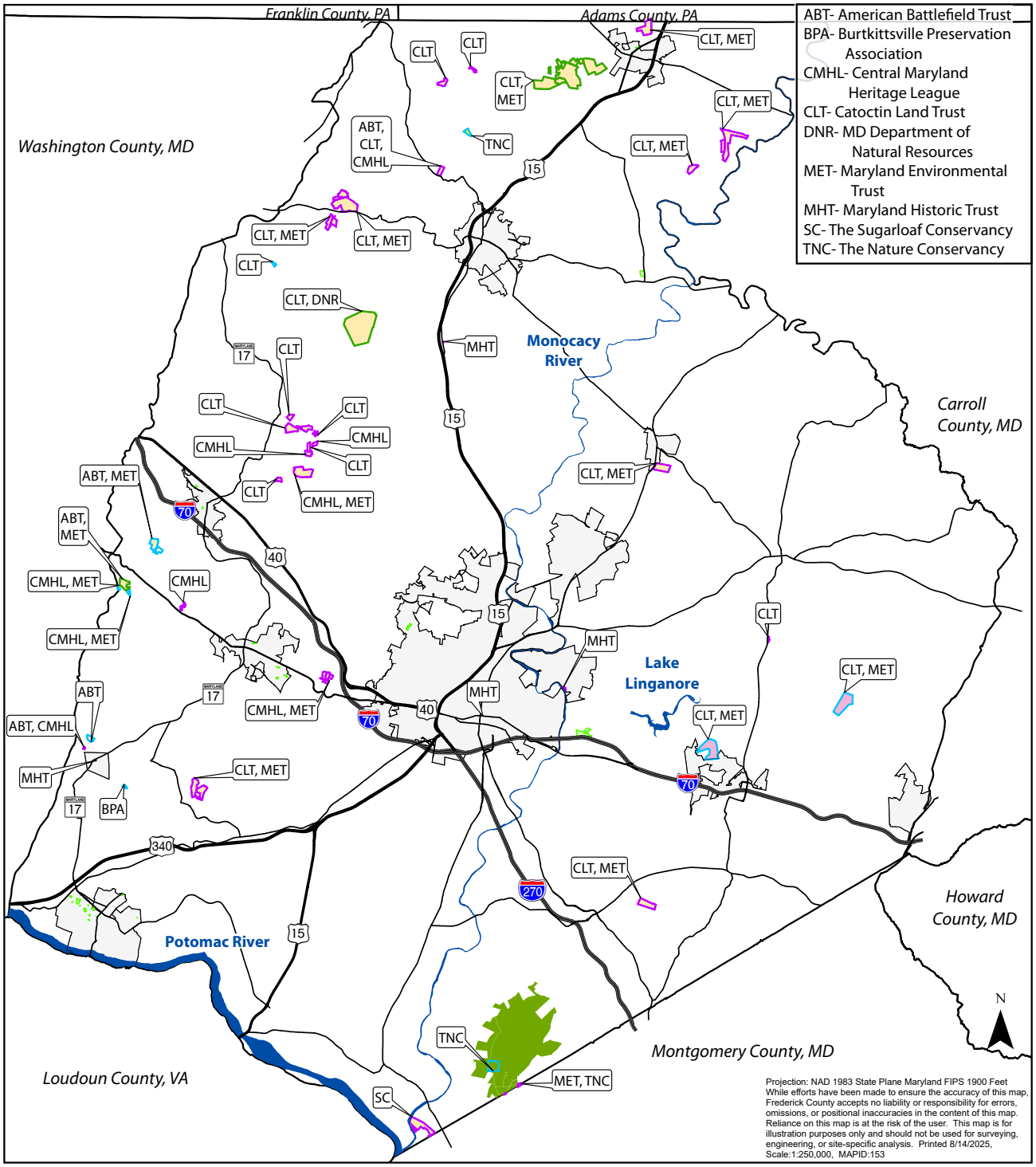
The Historic Preservation Ordinance

Frederick County updated its Historic Preservation Ordinance (HPO) in 2024. The HPO establishes the process for designating and protecting landmarks, sites, structures, and districts of historic, cultural, or architectural significance. The County Council may designate properties for the Frederick County Register of Historic Places based on their historical importance, architectural features, or connection to key events or individuals in the County's history. Property owners can petition for historic designation, and the Historic Preservation Commission evaluates applications to ensure compliance with established criteria. If approved, designated properties receive long-term protection.

Historic Sites and Structures

The HPO also outlines procedures for delisting properties, ensuring that removal from historic designation occurs only if a site has lost the qualities that warranted its original status. In cases where entire districts are considered for removal, property owners must provide approval matching the original percentage required for designation. The regulation prevents delisting due to demolition by neglect or self-created hardships, maintaining the integrity of Frederick County's historical preservation efforts.

Frederick County also regulates the relocation or demolition of non-designated historic sites that are 50 years old or older to ensure the preservation of historically significant properties. When a demolition or relocation request is submitted, Historic Preservation staff assess whether the site holds cultural, architectural, or archaeological significance. If deemed to have unusual historic value, the Historic Preservation Commission attempts to develop a feasible plan with the owner for preservation. If no agreement is reached, the commission has 90 days to negotiate a solution before the application can proceed unless the property is officially designated as historic.



Map 17: Private Conservation Lands & Easements

Private Easements*

On Lands Owned By:

- Government
- Private
- Private Conservation/ Preservation

Quasi-Public Lands

- Seymour B. Cooper Ornithological Sanctuary
- Audubon Society of Central MD
- Stronghold
- Private/HOA Parklands

Maryland Historic Trust Easements

- Private Land

*Private Easements Layer represents land in easement holders by: both public and private entities or only private entities.

Image 16: Point of Rocks Station

(Image Credit: Mark F. Levisay via FlickR. https://www.flickr.com/photos/31395633@N08/9116966717)

Additionally, the ordinance prevents demolition by neglect, ensuring that owners of designated historic properties maintain their buildings and landscapes to prevent deterioration. If neglect occurs, the County may issue corrective notices, require repairs, or impose a tax lien on the property to cover restoration costs. Economic hardship exemptions are available, but property owners must prove their inability to comply with preservation requirements through clear and convincing evidence.

Archaeology

Frederick County's HPO also requires the identification, evaluation, and preservation of archaeological resources that reflect the region's historical and cultural heritage. Any development project requiring a site plan, zoning amendment, or reclassification must undergo archaeological review if it has the potential to impact land with historical significance.

Before submitting land development plans in Frederick County, applicants must consult with the County's Professional Archaeologist to assess the archaeological potential of the property to be developed. If an area is identified as having potential historical significance, developers must conduct Phase I (reconnaissance) and Phase II (eligibility) studies and assess it using the National Register of Historic Places Criteria to determine their significance. If a significant site is identified, the applicant must submit an Archaeological Resource Management Plan to mitigate impacts.

The Archaeological Resource Management Plans can include different evaluation measures, including excavation (Phase III), conservation, and/or ongoing site monitoring, depending on the site-specific situation. The County treats archaeological site locations with discretion and ensures compliance with Maryland Standards & Guidelines for Archaeological Investigations to safeguard irreplaceable historical assets.

To learn more about Historic Preservation in Frederick County and to view a listing of protected, County Register properties, visit the Historic Preservation pages on the County's website at: https://frederickcountymd.gov/7981/Historic-Preservation.

Chapter Endnotes

36 <https://thediggings.com/usa/maryland/frederick-md021>

37 Lisa Mroszczyk Murphy Special to the News-Pos. (2020b, November 1). Quarries played important role in early Frederick. The Frederick News Post. <https://www.fredericknewspost.com/places/local/frederick_county/frederick/quarries-played-important-role-in-early-frederick/article_fee0a37b-1ce6-5f4c-ae99-738d252d3a82.html>

38 <https://mde.maryland.gov/programs/water/DamSafety/Documents/MDE%20Thermal%20Guidance%20Document%20August%202023.pdf>.

39 <https://mde.maryland.gov/programs/water/DamSafety/Pages/small_pond_approval.aspx>.

40 Kays, J. S. & Western Maryland Research and Education Center. (n.d.). Maryland's Forests: past, present, and future. <https://extension.umd.edu/sites/extension.umd.edu/files/2021-03/FS627_MDForestsPPF.pdf>

41 <https://frederickcountymd.gov/DocumentCenter/View/804/History-of-Forest>.

42 Chesapeake Bay Program, U.S. Forest Service, & Chesapeake Conservancy. (2025). Frederick County. County Tree Cover Fact Sheet. Retrieved September 24, 2025, from <https://chesapeaketrees.net/understand-your-canopy/>.

43 Wheeler, T. (2020, July 23). Frederick County, MD, protects forests with new law for 'no net loss.' Bay Journal. https://www.bayjournal.com/news/growth_conservation/frederick-county-md-protects-forests-with-new-law-for-no-net-loss/article_c57451cc-cd25-11ea-bfa1-8318c8328640.html

44 Projects initiated prior to the enacting date of the legislation may be vested under prior regulations.

45 <https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/mdwllists.aspx>.

46 Current GreenPrint mapping also displays information about four of Maryland's most active State operated land conservation programs: Program Open Space (POS) - Stateside, the Maryland Agricultural Land Preservation Foundation (MALPF), the Maryland Environmental Trust (MET), and the Rural Legacy Program.<https://geodata.md.gov/greenprint/>

47 <https://md.audubon.org/conservation/important-bird-areas-0>

48 U.S. Fish and Wildlife Service. (2024). Range-wide Indiana bat and northern long-eared bat survey guidelines. U.S. Fish and Wildlife Service, Region 3, Bloomington, MN.

49 <https://www.fws.gov/story/2022-09/saving-tricolored-bat>.

50 Specific conditions apply. Please see Chapter 1-21 of the Frederick County Code for more information. https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-9121.

51 BioNet is a digital map (GIS shapefile) that systematically identifies and prioritizes areas for terrestrial and freshwater biodiversity conservation based on predictions (but not necessarily verified observations) of habitat utilization. The map files can be accessed at: <https://data.imap.maryland.gov/datasets/maryland::maryland-biodiversity-conservation-network-bionet/about>.

Chapter 3

Green Infrastructure Explained & Explored

PLANNING FOR GREEN INFRASTRUCTURE

Chapter 3 of the Green Infrastructure Plan will serve several purposes. First, it will provide a detailed description of how green infrastructure is frequently implemented across regions, neighborhoods, and at the site (or property) scale. This chapter will also propose a Frederick County Green Infrastructure Network and identify a "toolkit" including policies and regulations to help support creation of the Network. Finally, it will conclude with a discussion of the role working (agricultural) lands can play alongside the Green Infrastructure Network in conserving and preserving land in Frederick County in recognition of their economic, ecological, and conservation value.

COMPONENTS OF A GREEN INFRASTRUCTURE NETWORK & GREEN INFRASTRUCTURE PRACTICES

As noted in Chapter 1 of this Plan, green infrastructure can be defined in several ways, with differences often depending on the scale of implementation or the type of social or ecological need being fulfilled. This section of the Plan discusses, in more detail, the various forms green infrastructure can take at the regional, neighborhood, and site scales—as Illustrated in Figure 4 on Page 1-9 of the Plan.

Green Infrastructure at the Regional Level

At a regional scale, green infrastructure is typically defined as "[a] strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains ecological processes, sustains air and water resources, and contributes to the health and quality of life for America's communities and people." [52] This large-scale, strategically planned network is often comprised of two types of building blocks first introduced in Chapter 1 of this Plan—hubs and corridors. It should be noted that both building blocks benefit from—and function best—in communities that implement more compact patterns of development that limit sprawl and maximize open space. A third component of habitat connectivity, not as widely recognized as hubs or corridors and known as "patches" or "stepping stones", is also described in this section and was identified by landscape ecologists in response to studies about the impacts of fragmentation on natural ecosystems.

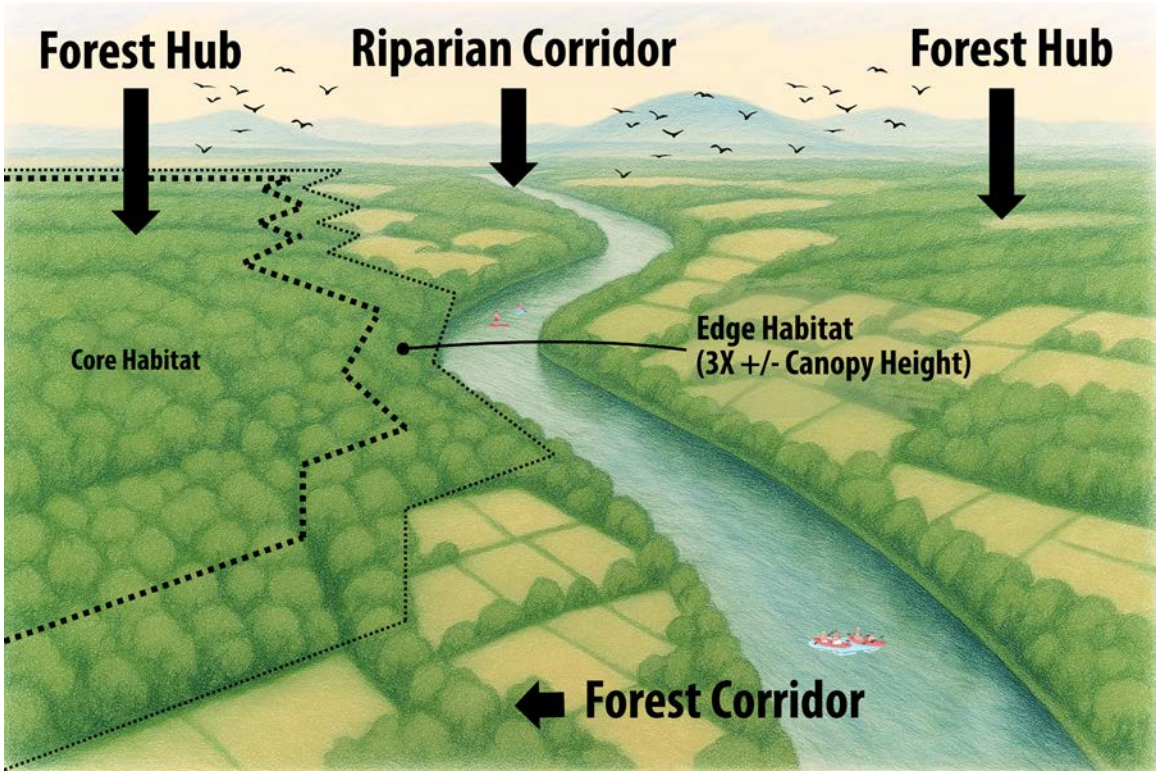
Hubs

The first incarnation of green infrastructure to be described are "hubs." Hubs are defined as large blocks of intact forest or wetland habitat that provide shelter for wildlife and perform a variety of important ecological functions. Due to their relatively large size, hubs may also excel in the provision of certain ecosystem services like carbon sequestration or flood mitigation. The size of certain hubs can also result in varying, unique habitat conditions that can be critical to certain, specific communities of plants and animals.

These habitat conditions have been sorted into two different categories, first identified by landscape ecologist R. T. T. Forman, Professor Emeritus with the Harvard Graduate School of Design, and subsequently expanded upon by other researchers and authors, and they include: [53, 54, 55]

- Core (Habitat): Areas of intact habitat that are sufficiently large to support more than one species. Core habitats are exclusively found in the interior of hubs and are sufficiently isolated from those lands outside of the hub to be distinct. For this reason, they are also often referred to as "interior habitat." In Maryland, certain species of birds rely exclusively on these types of habitats to maintain their lifecycles, and they are identified as Forest Interior Dwelling Species, or FIDS. In the case of forest cores, they are often delineated at a distance of three times (3X) the height of the tree canopy, as measured from the ground surface to the predominant canopy crown. In much of Maryland, mature forest canopy can reach 100 feet in height, so a transition to core or interior habitat would be anticipated at around 300 feet from the forest edge. Hubs that are rounder or squarer in shape tend to have more core or interior habitat as a percentage of their total area than those that are longer or narrower.
- Edge (Habitat): Edge habitat is the transition area between the outer limit of a hub and the core. In the case of forests, edges are typically exposed to more light and wind than cores, and this can result in changes in available moisture and vegetative composition. Edges are also often subject to more disturbance, through both natural processes and human influences, than core or interior habitat. Disturbance in the form of noise can affect wildlife, and repeated intrusion from vehicles or, other forms of "mechanical disturbance", can also result in high concentrations of invasive or exotic plant species. Hubs that are more irregular in shape, or longer and narrower in shape, tend to have more edge habitat as a percentage of their total area than hubs that are rounder or squarer in shape.

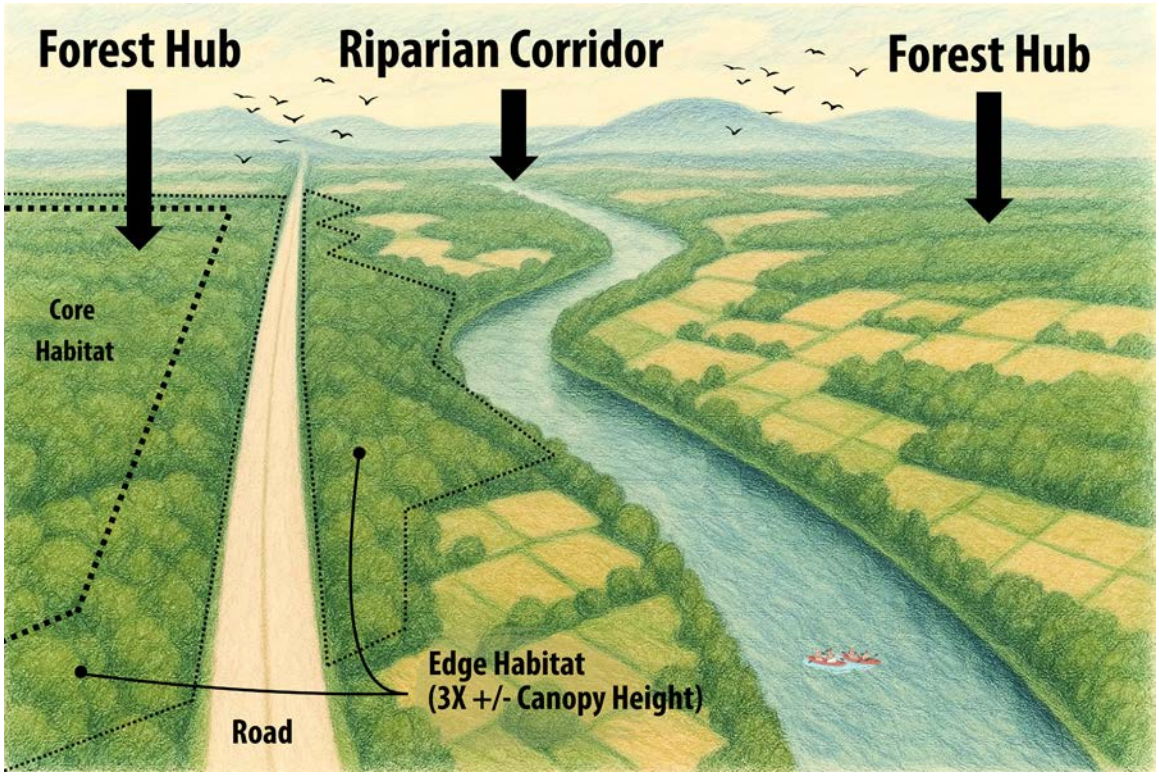
Figure 10: The relationship between habitat hubs, cores, and edges.



Adapted from Microsoft. (2025). Response to "create an aerial perspective of a landscape in Maryland with a river running through it, mountains in the distance, and several large patches of forest in the style of a colored pencil sketch at a 16:9 image ratio." Copilot (GPT-4). Retrieved July 27, 2025, from https://copilot.microsoft.com/.

It is important to note that disturbance of core or interior habitats, whether natural (i.e., storms, severe floods) or man-made (i.e., roads, utility corridors, development) can and likely will result in the introduction of new edge habitat into areas that previously functioned as core or interior habitat. In the face of such disturbance, connectivity between a disturbed hub and other surrounding hubs becomes much more important.

Figure 11: The effect of disturbance on hubs, cores, and edges.



Adapted from Microsoft. (2025). Response to "create an aerial perspective of a landscape in Maryland with a river running through it, mountains in the distance, and several large patches of forest in the style of a colored pencil sketch at a 16:9 image ratio," and "add a road to the landscape on the left side of the image only running from the background to the foreground and bisecting the large patch of forest but keep the graphic elements and style otherwise unchanged." Copilot (GPT-4). Retrieved July 27, 2025, from https://copilot.microsoft.com/.

Corridors

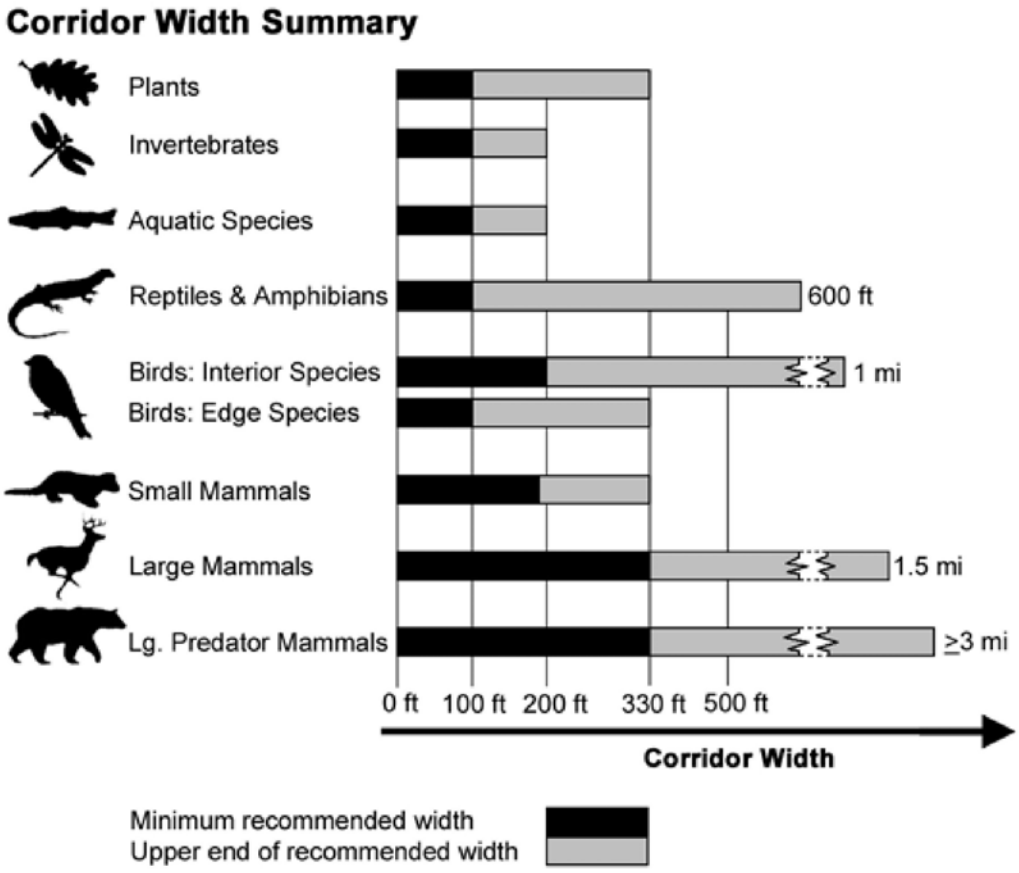
Corridors are the second component of a regional green infrastructure network. They are often comprised of forested stream valleys, ridgelines, and other land features that are predominantly linear in arrangement and that provide connections between hubs to form a network. Corridors can also provide wildlife habitat, facilitate wildlife migration, and perform some of the same important ecological functions performed by hubs. Additionally, as is the case with hubs, wider is better when evaluating the size and function of a corridor.

When corridors are wide enough to provide core or interior habitat, they can increase the amount of habitat available to certain interior dwelling species, and they can also help facilitate migration or prevent the isolation of populations of those species. In *Strategic Green Infrastructure Planning*, authors Karen Firehock and R. Andrew Walker note that streams and rivers represent natural corridors within a regional

landscape, and that the width of habitat buffers should increase, correspondingly, with the size or "order" of the stream or river.

The U.S. Department of Agriculture (USDA) Forest Service published design guidelines specifically for "conservation buffers" in 2008. They define conservation buffers as, "strips of vegetation placed in the landscape to influence ecological processes and provide a variety of goods and services to us. The USDA states that they are called by many names, including, "wildlife corridors, greenways, windbreaks, and filter strips to name just a few," and in much the same way that larger order streams and rivers benefit from wider corridors, the same can be said for larger species of wildlife. A chart provided by the USDA Forest Service, indicating recommended corridor widths necessary to support specific plant and animal species is provided in Figure 12.

Figure 12: Minimum and Upper-End Recommended Widths for Corridors from U.S Forest Service



Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station. 110 p.

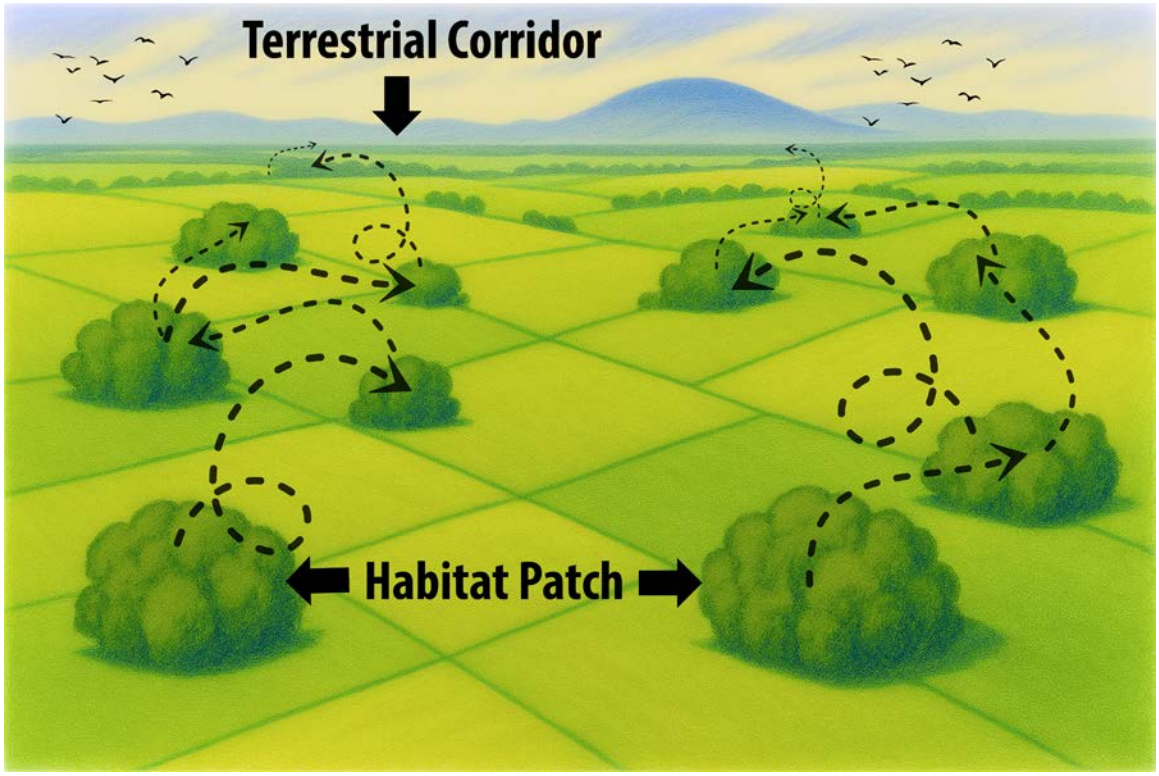
Patches (or Stepping Stones)

In the absence of intact corridors, a third component of regional networks may also serve an important role in maintaining network and habitat connectivity. Patches are identified as habitats that are relatively small and homogeneous in terms natural cover, but that still distinctly differ from their surroundings. Due to their relatively small size and irregular shape, patches may offer limited benefits in terms of habitat for

some species and tend to reflect “edge-like” conditions in their susceptibility to disturbance. Patches also represent a form of fragmented habitat that can result from development or other forms of active land management.

The USDA Forest Service and Firehock and Walker both discuss how patches and hubs may stand in for continuous corridors by functioning as “stepping stones” for wildlife and plant species. Firehock and Walker define a stepping stone as a “smaller intact habitat that may not be large enough to sustain a species on its own but is vital to a population’s success over the network as a whole.”[56] The spaces between stepping stones, as well as between hubs are corridors are often referred to as “gaps.” It should be noted that the size and spacing of stepping stones and the gaps between them are often critical to their functionality and that stepping stones only function for those species that are able to utilize them. They may not be an option for certain aquatic species like brook trout (particularly if the gaps are terrestrial), and they may not help in sustaining certain forest interior dwelling species that have evolved to avoid forest edges and the world beyond. The USDA Forest Service provides the following guidelines for the functionality of stepping stones in habitat connectivity.

Figure 13: Stepping stones in the landscape.

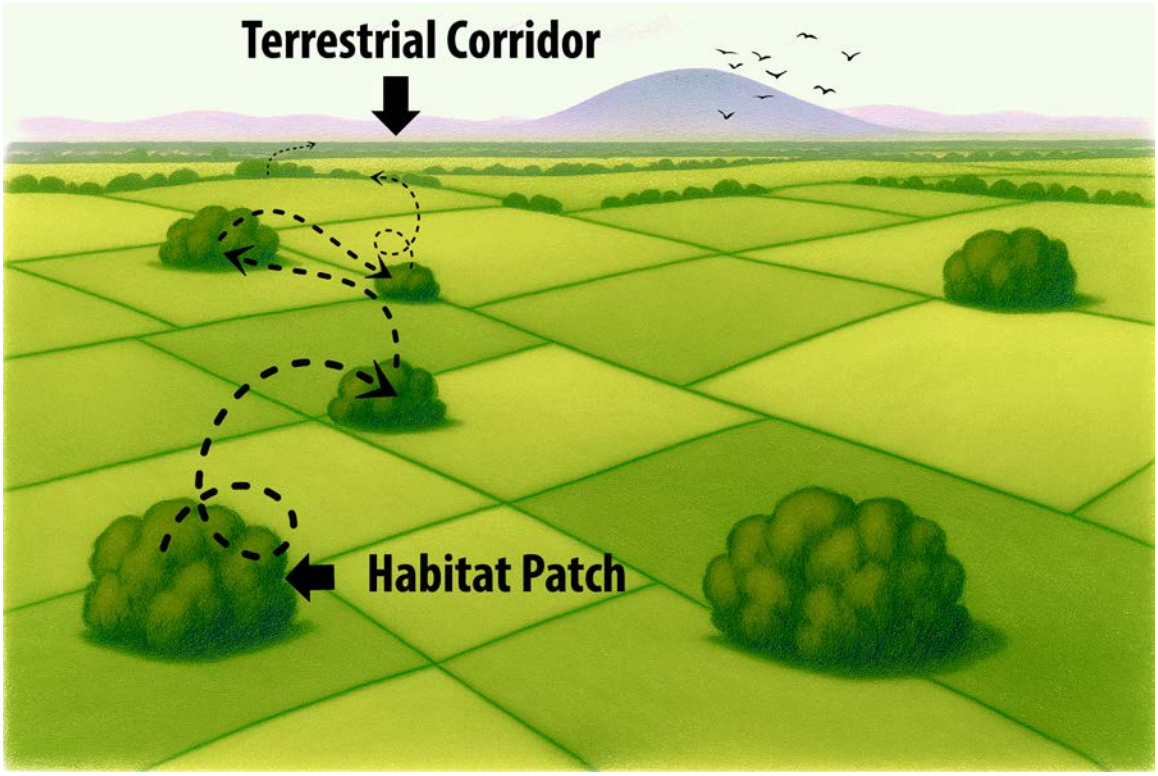


Adapted from Microsoft. (2025). Response to “create a similar image [to Fig’s. 3-2 and 3-3] with no river and open agricultural farms and fields with several isolated stands of forest.” Copilot (GPT-4). Retrieved July 27, 2025, from https://copilot.microsoft.com/.

- The greater the contrast between the gap and the hub or corridor plant community, the narrower the gap must be in order not to be a barrier.[57]
- Smaller species will generally have smaller gap thresholds.

- Species requiring specialized habitats will have smaller gap thresholds.
- For visually-orientated species, gap thresholds may be determined by the ability to see the next stepping stone or across the gap.
- In riparian corridors, restore gaps in and along larger waterways first--through establishment of buffers and the planting of streamside forest--to provide the greatest benefit for biodiversity.

Figure 14: The effects of stepping stone removal on connectivity.



Adapted from Microsoft. (2025). Response to "create a similar image [to Fig's. 3-2 and 3-3] with no river and open agricultural farms and fields with several isolated stands of forest," and "create a duplicate version of the image but with 1/2 of the forest stands removed." Copilot (GPT-4). Retrieved July 27, 2025, from https://copilot.microsoft.com/.

Lastly, when considering gaps, it should be noted that man-made gaps should not be confused with gaps created in hubs or corridors by the presence of rivers, mountains, or natural disturbances like storms, fire, or tree falls. Natural gaps are a vital part of healthy ecosystems and should not always be targeted for restoration.[58]

IDENTIFYING, CREATING, AND MAINTAINING HUBS AND CORRIDORS

Hubs and corridors are currently found on land in Frederick County that is owned or maintained by federal, state, local, and municipal governments, by businesses, individuals, and by non-profits. Hubs and corridors can also be found in municipalities or community growth areas, as well as in more rural parts of the County. Long-term goals for land may differ based on the owner, but there are several land ownership or use categories that currently include hubs and corridors or that may help facilitate the establishment of new hubs and corridors.

Park Land and Other Public Land

As noted in Chapter 1, and as of the publishing of Frederick County's most recent Land Preservation, Parks, and Recreation Plan, Frederick County boasted approximately 24,267 acres of parklands, between federal, state, county, and municipal facilities. This represents approximately 6% of the County's total land area and, as we will see later in this chapter, some of the County's most important hubs and corridors. Each category of park land is governed by rules or policies unique to the agency that owns or oversees the land. Each has different approaches to how natural lands are managed that can also influence how hubs and corridors are managed as well as the availability of public lands to meet other important social needs.

Natural resource management in federal parks is governed by Chapter 4, Natural Resource Management, of the National Park Service (NPS) Management Policies.[59] The National Park Service actively preserves and protects the natural resources, processes, systems, and values within national parks to maintain their integrity for current and future generations. It manages these resources—including air, water, soil, native species, ecosystems, and natural soundscapes—in their natural condition, meaning as they would exist without human dominance. The NPS allows natural evolution and ecological processes to continue with minimal human interference. The National Park Service also follows mandates from the Organic Act, the National Parks Omnibus Management Act, and other environmental laws like the Clean Air Act and Endangered Species Act. When necessary, it collaborates with federal, state, tribal, and local partners to address external threats that could impair park resources.

The Maryland Department of Natural Resources (DNR) manages land through the Maryland Park Service, which oversees state-owned land throughout Frederick County and the state. All lands are managed with a focus on sustainability, public access, and environmental stewardship. DNR applies green practices across its park operations, including the use of environmentally preferable purchasing policies and "green cleaning" and waste reduction in all state parks. Each park is managed according to its designated land unit type—such as State Parks, Natural Environment Areas, Natural Resource Management Areas, State Forests, Wildlife Management Areas, Fish Management Areas, and Heritage Conservation Fund Sites—based on their existing or intended natural features and programmed level of recreational use. DNR also integrates conservation goals into park management, ensuring that development is balanced with the protection of natural and cultural resources.

Frederick County Parks and Recreation (FCPR) actively manages its parklands through a comprehensive sustainable natural resource strategy that benefits both the environment and residents. Partnering with the Division of Energy and Environment (DEE), FCPR has planted nearly 40,000 trees across over 110 acres in multiple parks to enhance canopy coverage and air quality. The division embraces low-impact land management by eliminating synthetic pesticides and minimizing fertilizer and herbicide use, in an attempt to align stewardship practices with natural ecosystem processes. FCPR also prioritizes habitat protection, stormwater management, and ecological restoration. It maintains 63 sites, oversees wetland conservation, and integrates porous pavement to reduce runoff and recharge groundwater. Notable efforts completed by FCPR include the Middletown Park Pond dredging project and the creation of native wildflower meadows and Monarch Waystations to support pollinator species.

Managed, Privately-Held Land

Privately held conservation land in Frederick County also plays a vital role in preserving the region's rural character, agricultural productivity, and ecological health. These lands are typically protected through conservation easements—legal agreements that restrict development while allowing landowners to retain ownership and continue compatible uses like farming, forestry, or habitat restoration.

Image 17: A completed Creek ReLeaf tree planting.

(Image Credit: Frederick County Division of Energy and Environment)

As highlighted in Chapter 1, one standout initiative is Frederick County's Creek ReLeaf program, which supports reforestation on private lands through permanent conservation easements. Landowners receive assistance with site planning, native tree planting, and maintenance for five years, after which they assume stewardship of the newly forested land. As of 2024, this program has reforested over 575 acres, enhancing water quality, wildlife habitat, and climate resilience. Along with waterbody buffers, stream buffers, and Forest Resources Ordinance (FRO) easements, these privately conserved lands, while not typically open to the public, contribute significantly to the county's green infrastructure network and long-term sustainability goals.

Preservation Easements

Programs such as the Maryland Agricultural Land Preservation Foundation (MALPF), Rural Legacy, and the Maryland Environmental Trust (MET) have enabled landowners to voluntarily conserve thousands of acres in the county, often in exchange for financial compensation or tax benefits. The Rural Legacy Program, as discussed in Chapter 2, plays a pivotal role in preserving a wide range of habitat types by protecting large, contiguous tracts of land that support both ecological and agricultural functions. The program targets areas with high ecological value, including forests, wetlands, riparian corridors, and prime farmland throughout the state by offering funds to property owners located within mapped "RLAs" to record protective easements. The easements not only safeguard biodiversity but also maintain the integrity of watersheds and the character of Maryland's rural landscape.

(facing page) Image 18: Mountain-Side Trails in Catoctin Mountain Park near Thurmont.
(Image Credit: Livable Frederick)

In Frederick County, the Carrollton Manor RLA connects agricultural lands with the Monocacy and Potomac Rivers, potentially enabling the creation and long term protection of hubs and corridors that support both wildlife movement and rural heritage. The Mid-Maryland RLA is located on the eastern slopes of South Mountain and extends from the Potomac River near Knoxville all the way to the Town of Myersville to the north.

Trail Systems

Frederick County, Maryland offers a rich network of hiking and multi-use trails that invite residents and visitors to explore its diverse landscapes—from mountain ridges to river valleys. The Appalachian Trail Conservancy, the National Park Service, the Maryland Department of Natural Resources, Frederick County, and many incorporated municipalities actively maintain both paved and natural surface trails throughout the County's park systems.

In recent years, trails have been increasingly recognized as potential structures for supporting both recreational opportunities and habitat connectivity. Their linear form and frequent alignment with riparian corridors, forest edges, mountain ridges, and utility rights-of-way can make them well-suited to also function as wildlife corridors. When incorporating habitat connectivity into trail systems, however, it is critical that trails be designed to minimize disturbance of sensitive areas or to fragment habitats or migration routes. Maintenance programs should also be mindful of potential impacts. Practices that utilize or enhance native vegetation along trails can greatly improve their habitat connectivity function.

When proper care and planning are exercised, collaborative efforts between jurisdictions located along a connecting trail system represent excellent opportunities to improve large-scale ecosystem health and connectivity. Recently, the states of Maryland and Pennsylvania publicized efforts at sites like Fair Hill Natural Resources Management Area in Cecil County, MD, and Big Elk Creek State Park in Chester County, PA, to demonstrate how restoration projects adjacent to a trail system that connects both parks can improve water quality and habitat connectivity while reinforcing the multifunctional value of trails in regional conservation strategies.[60]

Lastly, multi-use trails can also play a key role in local and regional connectivity. The Ballenger Creek Linear Trail, a paved 4.2-mile path to the south of the City of Frederick, supports walking, biking, and running between Ballenger Creek Park and Buckeystown Pike (MD 85) and connects multiple businesses and residences along the way. The Chesapeake & Ohio (C&O) Canal National Historical Park provides 15.7 miles of level towpath along the Potomac River, blending natural beauty with historic infrastructure and connecting communities like Point of Rocks, Brunswick, and Knoxville to each other and to Washington County to the west and Montgomery County to the south.

Riparian Buffers

Riparian buffers represent one of the more common forms of corridors in the landscape. With sufficient width and adequate habitat structure, they might also provide some of the benefits typically associated with hubs. Independent of their habitat function, riparian buffers in Maryland and Frederick County are also critical to the quality of the County's many streams and rivers.

To improve water quality, land managers often target specific landscape features for riparian buffer placement. Typically, riparian buffers perform best in filtering and cooling water along small, low-order

streams where upland runoff first enters water channels, but they can provide benefits wherever they are implemented. Critical areas like groundwater recharge zones, ephemeral channels, and saturated storm-prone fields—especially those with steep slopes or fine soils—often require riparian buffering to intercept pollutants before they can enter surface waters. Positioning buffers close to pollution sources and aligning them with contouring of the land enhances their ability to prevent the concentration of runoff and subsequent erosion and enhances their capability for pollutant filtration. The USDA Forest Service recommends that, when water delivery varies across a site, buffer width should be adjusted accordingly to maintain effectiveness.[61]

Image 19: Kayakers float between forested buffers on the Monocacy Scenic River in Frederick County.

(Image Credit: Matt Moran, Sustainable Monocacy Commission)

Riparian buffers also excel at trapping sediment, particularly coarser particles. Finer sediments typically demand a broader buffer zone. To improve the overall effectiveness of buffers, sediment control should begin with proactive erosion measures before relying on buffers as a final barrier. While buffers help reduce pathogens from agricultural and urban runoff, they rarely meet water quality standards on their own and must be paired with other best practices. Denitrification within buffers plays a key role in removing excess nitrogen, converting nitrate[62] to harmless nitrogen gas through microbial action in a low-oxygen environment, especially in areas with suitable soil and hydrologic conditions. Buffers are also very important for reducing thermal impacts to streams by cooling runoff.

Maintaining Water Quality in Frederick County

The Frederick County Water Resources Element states that nutrients (nitrogen and phosphorous), along with sediment, the bacteria E. Coli, and elevated temperatures are some of the most common contributors to impaired water quality in the County. The presence of each impairment in County waterways is managed by the State of Maryland, which has jurisdiction over surface waters in the County under the Clean Water Act, through the implementation of measures such as Total Maximum Daily Loads, or TMDLs. More information about the impacts of nutrients, sediment, and E. Coli and current TMDLs can be found in the Water Resources Element on the County website at: https://frederickcountymd.gov/8707/Water-Resources-Element.

The Chesapeake Bay Program's 2022 *Quick Reference Guide for Best Management Practices (BMPs)* includes descriptions of different types of buffers that can be implemented to reduce nitrogen, phosphorous, and sediment inputs to waterways. The effectiveness of each type of buffer will vary based on site specific conditions, and the Chesapeake Bay Program recommends use of available tools like the Chesapeake Assessment Scenario Tool (CAST) to develop reasonable estimates of the effectiveness of each practice. That being stated, the following buffer types serve as examples of types of riparian buffers that can be implemented in Frederick County:[63]

- Forest Buffer: Linear wooded areas that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 feet minimum width required.
- Forest Buffer – Narrow: Linear strips of wooded areas maintained on agricultural land between the edge of fields and streams, rivers or tidal waters that help filter nutrients, sediment, and other pollutants from runoff. Narrow forest buffer strips are between 10 and 35 feet in width.
- Grass Buffer: Linear strips of grass or other non-woody vegetation maintained to help filter nutrients, sediment, and other pollutants from runoff. The recommended buffer width for buffers is 100 feet, with a 35 feet minimum width required.
- Grass Buffer – Narrow: Linear strips of grass or other non-woody vegetation maintained on agricultural land between the edge of fields and streams, rivers or tidal waters that help filter nutrients, sediment, and other pollutants from runoff. Narrow grass buffers are between 10 and 35 feet in width.

In areas adjacent to pastures, or where there may be a tendency to vehicle, foot, or hoof traffic within riparian buffers, they can be combined with exclusions fencing to protect them and maintain their functionality. As a rule of thumb, the wider a riparian buffer is, the more benefits it will provide for water quality and for habitat connectivity, and the buffer widths indicated represent recommended minimums, not medians or maximums. It should also be noted that the two types of buffers listed above can vary in function and effectiveness based on their structure. For example, forest buffers can provide treatment and shading of surface runoff during the spring and summer and can also remove nutrients from groundwater, while grass buffers provide limited shade and focus almost entirely on surface water. Due to their rapid growth during warmer months, grass buffers can exceed the capacity of forest buffers to uptake nutrients.

Combining separate, but directly adjacent, grass and forested buffers in a series in the path of surface water is one way to ensure more comprehensive treatment before that water enters Frederick County's streams and rivers.

Image 20: A female Yellow Warbler (Setophaga petechia) resting in a Black willow tree (Salix nigra) within a riparian buffer.

(Image Credit: Livable Frederick)

Pastures and Grasslands

Grasslands play a crucial role in the global carbon cycle by acting as both sources and sinks of greenhouse gases. Globally, soils store twice as much carbon as the atmosphere and three times more than vegetation, making soil management vital for addressing climate change and food security. Grasslands, which cover 8.6 billion acres of the planet and contain about 20% of the world's soil carbon stocks, offer significant potential for carbon sequestration. Effective practices such as improved grazing management, restoration of degraded lands, and strategic fertilization can enhance carbon storage in grasslands. Grassland plants, especially herbaceous species, contribute to soil carbon through root growth and decomposition, particularly under grazing conditions that stimulate root turnover. Grassland ecosystems store carbon, primarily in soil rather than vegetation, unlike forests. Their high soil organic matter content supports nutrient cycling, water retention, and erosion control. [64]

Frederick County is currently home to approximately 72,600 acres of naturally succeeding herbaceous cover, pasture, and hayed land (17.2% of the County's land area).[65] Frederick County's grasslands and pastures not only help sequester carbon in the soil, but they also serve as vital habitats for a wide range of wildlife, particularly ground-nesting birds, pollinators, and small mammals. Native warm-season grasses like big bluestem, little bluestem, and switchgrass thrive in the County's climate and provide essential cover, nesting sites, and food sources for species such as wild turkeys, field sparrows, and grasshopper sparrows. These ecosystems also support raptors like American kestrels, which hunt insects and small mammals that live in the grasses.

With proper management Frederick County's grassland soils could potentially contribute to a world-wide network that could sequester, globally, between 0.2 to 0.8 gigatons of CO_2 annually by the year 2030. While fertilization and fire management contribute to this potential, studies show strong correlations between biomass production and total organic carbon in legume species, highlighting the importance of plant selection and management in boosting carbon sequestration.

The Maryland Department of Natural Resources encourages landowners to plant warm season grasses to restore declining grassland habitats and support diverse wildlife populations. These native grasses—such as big bluestem, switchgrass, and Indiangrass—thrive in summer, stabilize soil, and offer essential cover and food for upland game birds, songbirds, and small mammals. Raptors like kestrels and harriers hunt in these areas, drawn by the abundance of prey. By mixing grasses with wildflowers and legumes, landowners can further enhance biodiversity. The site provides detailed planting guidelines and species recommendations to help establish thriving habitats. The full guide can be explored on the Department of Natural Resources website at: https://dnr.maryland.gov/wildlife/Pages/habitat/warmseason.aspx.

Wildlife Sanctuaries

The United States Fish and Wildlife Service identifies multiple ways in which wildlife refuges benefit everyone, and many of the benefits can also be derived from smaller, regional or local refuges and sanctuaries. Wildlife refuges and sanctuaries boost public health by encouraging outdoor activity and offering opportunities for walks, yoga, birding, photography, and family recreation. They can enhance community resilience by absorbing floodwaters and buffering coastal or riverfront communities from storms, and they connect urban residents to green spaces through interconnected trails and sponsored outdoor events. They can also enrich education with hands-on science programs and outdoor classrooms that raise test scores and spark lifelong curiosity. Most importantly, they help conserve endangered wildlife, promote biodiversity, and protect clean air and water by filtering pollutants and supporting healthy ecosystems.[68] Due to their size, many can also provide the types of "core" or interior habitat mentioned in the discussion of "hubs" earlier in this chapter.

Image 21: Wetland habitats provide basking sites for Eastern Painted turtles (Chrysemys picta).

(Image Credit: Livable Frederick)

The Eastern Meadowlark

The Eastern Meadowlark is a native songbird of the eastern United States and Frederick County, commonly found in open grasslands, meadows, and pastures. Known for its bright yellow breast and melodic whistle, this species plays a vital role in the region's grassland ecosystems by controlling insect populations and helping to maintain diverse vegetation structure. While their songs may be familiar or nostalgic to older residents, their populations in Maryland have experienced a steep decline, mirroring broader regional trends. From 1996 to 2019, their numbers fell by approximately 2.6% annually, resulting in a cumulative population loss of around 75%. This dramatic drop reflects widespread habitat degradation and other pressures affecting grassland birds across the eastern United States.[66]

An Eastern Meadowlark.

(Image Credit: Mike's Birds via Wikimedia Commons.)

Threats facing Eastern Meadowlarks include habitat loss, primarily driven by intensive agricultural practices that include the removal of historic hedgerows, early mowing, overgrazing, and urbanization. Large-scale farming and the shift from small family farms to monoculture row crops have also reduced the availability and of grassland habitats. Early mowing of grasslands and pastures, especially before mid-August, destroys nests and kills young birds, while overgrazing by livestock can degrade the land and diminishes suitable nesting areas. Urban expansion further fragments and eliminates grassland ecosystems critical to the species' survival.[67]

Additional pressures include pesticide use, which can kill breeding females and nestlings, and predation from raptors, foxes, raccoons, feral cats, coyotes, and snakes. Cowbird nest parasitism also poses a serious threat, as female Cowbirds replace Eastern Meadowlark eggs with their own, reducing reproductive success. Climate change compounds these challenges through extreme weather events like droughts, blizzards, forest fires, and spring heat waves that threaten both adult birds and nestlings. Human disturbance, especially during nesting, can cause females to abandon their eggs, further jeopardizing population stability. With over 95% of their range existing on private lands, conservation efforts must prioritize sustainable land management and habitat protection to ensure the Eastern Meadowlark's future.

As noted later in the appendices of this Green Infrastructure Plan, under the discussion of the 10 principles of green infrastructure—and specifically of landowners and stakeholders—these types of facilities can be located on both publicly and privately owned land. Frederick County benefits from all types of refuges and sanctuaries, though they vary in terms of their mission and management.

In addition to the federal and state parks mentioned in Chapter 2, public wildlife refuges and sanctuaries in Frederick County consist largely of four Wildlife Management Areas (WMAs) and one Natural Resources Management Area (NRMA) managed by the Maryland Department of Natural Resources (DNR) or through a partnership between DNR and the City of Frederick. The WMA system aims to conserve and enhance diverse wildlife populations and habitats while providing public access for hunting and other nature-based recreation. NRMAs are managed for the conservation and sustainable use of natural resources, including wildlife, forests, and recreational areas. DNR's Wildlife and Heritage Service manages WMAs and NRMAs through practices like prescribed burns, wetland management, planting native grasses, and habitat restoration. It also maintains infrastructure to support public use, including trails, parking lots, and boat access points. The system places a strong emphasis on sustainable recreation by regulating popular sites with permit lotteries and reservations to avoid overuse.

Wildlife and Natural Resources Management Areas

Ridenour Swamp WMA: Ridenour Swamp is comprised of 82 acres in the Catoctin Mountains that provide protection to a large wetland complex in the headwaters of Middle Creek.

Heater's Island/Islands of the Potomac WMA: The Islands of the Potomac WMA is comprised of 30 islands in the Potomac River. One of the largest is Heater's Island, located near Point of Rocks. It is accessible only by boat. Heater's Island is a former home to the Piscataway-Conoy tribe and is now a nesting place for many bird species, particularly waterfowl.

Gravel Hill Swamp WMA: Gravel Hill Swamp is located in the Catoctin Mountains, at the headwaters of Buzzard Branch. The swamp provides important habitat for several rare, threatened, or endangered plant species.

Frederick City Watershed CWMA: The Frederick City Watershed CWMA coincides with the City of Frederick's Municipal Watershed. Over 7,000 acres in size, it is the largest WMA in the County. It is home to many native species of wildlife in Frederick County and two branches of Fishing Creek.

Monocacy (River) NRMA: The Monocacy River Natural Resources Management Area encompasses 1,800 acres of natural areas and farmland along the Monocacy River, near the confluence with the Potomac River. Recreational use is primarily hunting, fishing, hiking, and horseback riding.

More information regarding Wildlife Management Areas in Frederick County, including directions and WMA use regulations, can be found on the Maryland Department of Natural Resources website at: https://dnr.maryland.gov/wildlife/Pages/publiclands/home.aspx. More information on the Monocacy NRMA can be found here: https://dnr.maryland.gov/publiclands/pages/western/monocacy.aspx.

Frederick County is also home to three Audubon designated Important Bird Areas or IBAs, and each is associated with a unique type of habitat found within the County, including grasslands, forested mountain ridges, and significant regional waterways (i.e., the Potomac River). While the IBAs do not confer any direct protection to lands or wildlife located within them, Frederick County is also home to three sanctuaries that permanently protect wildlife habitat under private ownership. Two are operated by the Audubon Society of Central Maryland (Audrey Carroll and Frederick Archibald), and one by the Maryland Ornithological Society (Seymour B. Cooper).

The Audrey Carroll Audubon Sanctuary near Mt. Airy spans 129 acres of diverse habitats, including meadows, wetlands, streams, and woodlands. It was established in 1991, and the sanctuary welcomes visitors year-round with events like guided nature walks. Audrey Carroll offers exceptional birdwatching opportunities, hosting 173 documented species throughout the seasons. The Fred Archibald Sanctuary is located on Boyers Mill Road near the Town of New Market. It was established in 2002, is 140 acres in size, and includes many of the same types of habitats as the Audrey Carroll Sanctuary. Approximately 146 different species of birds have been documented at Fred Archibald throughout the seasons. It should be noted that both sanctuaries require visitors to remain on designated trails, and they prohibit pets, hunting, littering, foraging, and bikes, ATVs, or any other type of vehicle.

The Seymour B. Cooper Sanctuary was established in 1978 and encompasses 14.3 acres of land on Eylers Valley Flint Road to the north of the Town of Thurmont. Although smaller in size, habitat within the sanctuary benefits from many adjoining, forested parcels of significant size on the slopes of Piney Mountain. Like the Audrey Carroll and Fred Archibald sanctuaries, the Seymour B. Cooper also limits activities that could disturb wildlife and is prominently posted to indicate that hunting is not permitted on the property. All facilities are open to the public, free of charge.

Green Infrastructure at the Neighborhood Level

Identifying hubs and corridors that comprise a network addresses just one of the “levels” or “scales” of green infrastructure implementation first mentioned in Chapter 1 and depicted in Figure 4 on Page 1-9. The creation and long-term management of a green infrastructure network depends upon the participation of a variety of stakeholders and agencies who either own land or who influence land management decisions at a variety of those levels.

As we transition from the regional level discussion of green infrastructure to the neighborhood level, the focus of this discussion shifts the composition of the regional landscape to how land is managed, most often within our communities. The discussion of the neighborhood level of green infrastructure implementation focuses heavily on two aspects of green infrastructure implementation that strongly influence the quality of life in our neighborhoods—the management of impervious surfaces as it pertains to stormwater runoff, and the presence (or absence) of tree canopy.

Stormwater Infrastructure

The use of green infrastructure practices to intercept, treat, and, generally, reduce the negative impacts of severe precipitation events as well as the negative impacts of precipitation in highly developed communities is well documented. In 2019, the United States Congress enacted the Water Infrastructure Improvement Act, which federally defined green infrastructure as “the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest

and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters."[69]

The State of Maryland actively works to mitigate the impact of development on water quality by requiring the use of stormwater best management practices (BMPs) on most new construction and many redevelopment projects. These practices are intended to address the runoff generated by impervious surfaces like roofs and roads, which prevent rain from infiltrating the soil. Instead of soaking in, stormwater that falls on roofs and roads flows rapidly off these surfaces, increasing the volume and velocity of discharge into drains, streams, and rivers. To reduce flooding and pollution, Maryland's stormwater program targets both the flow of stormwater and the contaminants carried within it.

First implemented in 1982, the state's stormwater laws emphasized centralized stormwater controls to reduce flooding within and downstream of new developments. These "structural" BMPs, constructed facilities such as detention basins intended to provide temporary storage and treatment, managed water at a distance from the pollution source and did not effectively replicate pre-development conditions in which vegetation and soils absorbed and infiltration precipitation. In response, the Maryland Department of the Environment shifted regulations toward the principle of Environmental Site Design (ESD), a strategy that uses localized, small-scale practices to intercept, treat, and infiltrate runoff near its origin. The 2007 Stormwater Management Act mandated the use of ESD practices to the "maximum extent practicable" (or MEP), reserving structural controls for cases where they're necessary to address flooding concerns. ESD practices permitted by the state generally include those practices typically thought of as green infrastructure for stormwater management, like permeable pavements, green roofs, rainwater harvesting or dispersal, constructed wetlands, rain gardens, and swales.

Image 22: A Constructed Bioretention Facility in an Urban Condition.

(Image Credit: U.S. Environmental Protection Agency via Flickr)

It should be noted that the Maryland Department of the Environment is currently updating the state's stormwater management regulations following the passage of SB 227 in 2021, which responded to severe flooding events like those that occurred in Ellicott City, MD, in 2018. SB 2021 directed MDE to bolster resiliency in stormwater regulation. After forming the Advanced Stormwater Resiliency in Maryland (AStoRM) Committee in 2022, MDE shifted from expanding Environmental Site Design (ESD) alone to a more balanced strategy that includes structural systems—such as detention ponds and sand filters—to better handle short, intense storms. The new approach aims to correct a potential overreliance on ESD, and reduce local regulatory confusion by clarifying guidelines. MDE expects to release draft regulations in the near future following the completion data collection regarding flood management in the state and a watershed prioritization study among other activities.

Green Infrastructure and Stormwater Resources

A full and thorough discussion of the reasons and methods for utilizing green infrastructure to manage stormwater is beyond the scope of this Green Infrastructure Plan. The United States Environmental Protection Agency provides a wealth of resources focused on the stormwater management using plants and soils to soak up and treat rain where it falls, while replenishing local groundwater supplies and reducing runoff to surface waters. The full suite of EPA "green infrastructure as stormwater management" resources can be accessed on the EPA's website at: https://www.epa.gov/green-infrastructure.

It should also be noted that the State of Maryland implements stormwater management locally, through Counties and municipalities, with the Maryland Department of the Environment providing regulatory oversight and technical support. The Department offers guidance through the Maryland Stormwater Design Manual, which lays out performance standards and criteria for BMPs. Stormwater management implementation in Frederick County is provided by Environmental Compliance and Stormwater Engineering staff in the Division of Planning and Permitting. Stormwater Engineering Staff enforce the regulations set forth in Chapter 1-15.2 of the Frederick County, Maryland, Code of Ordinances.

Chapter 1-15.2 requires, generally, any development project that disturbs more than 5,000 square feet of land within the County to provide stormwater management for the disturbed area. Certain exemptions are provided for agricultural activities (given supporting documentation from the Frederick County Soil Conservation District) or, in the case of the redevelopment of a previously developed property, a reduction in the amount of impervious area in the development area (also identified as the site) of 50% after the completion of work. The Livable Frederick Master Plan's focus on Community Growth Areas (CGAs) and on compact development within established municipalities and CGAs is significant as it relates to stormwater management implementation in Frederick County. By placing an emphasis on growth within or adjacent to established municipalities and designated CGAs, the LFMP fosters redevelopment in areas where stormwater management may not have been required when they were first developed, or where development could help improve conditions by prompting the installation of new BMPs where obsolete or poorly functioning facilities previously existed.

More information regarding stormwater design requirements in Frederick County can be found on the Stormwater Engineering section of the County website at: https://frederickcountymd.gov/8750/Stormwater-Engineering.

Beyond stormwater engineering review, the Frederick County Division of Energy and Environment's Department of Stormwater also works to safeguard local waterways by restoring stream corridors scoured by excessive runoff, reducing pollutant loads where possible, and generally enhancing flood resilience along County waterways. Guided by the Clean Water Act and state-issued National Pollution Detection and Elimination System (NPDES) permits, including the Municipal Separate Storm Sewer (MS4) permit, the Department of Stormwater undertakes legally mandated actions like stream restoration, environmental enforcement, and even the upgrade and enhancement of existing stormwater BMPs. To meet its goal of restoring approximately 1,027 equivalent impervious acres each year—to achieve the required pollutant reductions—staff conduct watershed and feasibility assessments that identify and prioritize selected projects. More information regarding the Division of Energy and Environment's work related to stormwater management can be found on the County website at: https://frederickcountymd.gov/8465/Department-of-Stormwater.

Image 23: A completed structural stormwater facility retrofit intended to prolong facility function.

(Image Credit: Frederick County Division of Energy and Environment)

Tree Planting and Reforestation

Trees play a vital and underutilized role in managing stormwater and enhancing both urban and rural environments. By capturing rainfall in their canopies and releasing water through transpiration, trees naturally reduce runoff stormwater volume. Their roots and leaf litter improve soil conditions, increasing infiltration, while their ability to absorb nutrients and pollutants makes them efficient at cleaning both soil

and water. Despite these benefits, trees are often overlooked in traditional stormwater infrastructure and labeled incorrectly as ornamental landscaping rather than functional components of stormwater systems. However, when planted in engineered areas, trees can significantly boost the effectiveness of green infrastructure and improve water quality.

Healthy urban forests contribute to stormwater reduction through several biological mechanisms that are illustrated in Figure 15:[70]

- Transpiration: Trees release absorbed water into the atmosphere.
- Interception: Tree surfaces capture rainfall, slowing its descent.
- Reduced Throughfall: Canopies lessen erosion by softening the impact of rain.
- Increased Infiltration: Root systems enhance soil absorption rates.
- Phytoremediation: Trees transform harmful chemicals into less toxic forms or store them safely in their tissues.

Figure 15: How trees help manage stormwater.

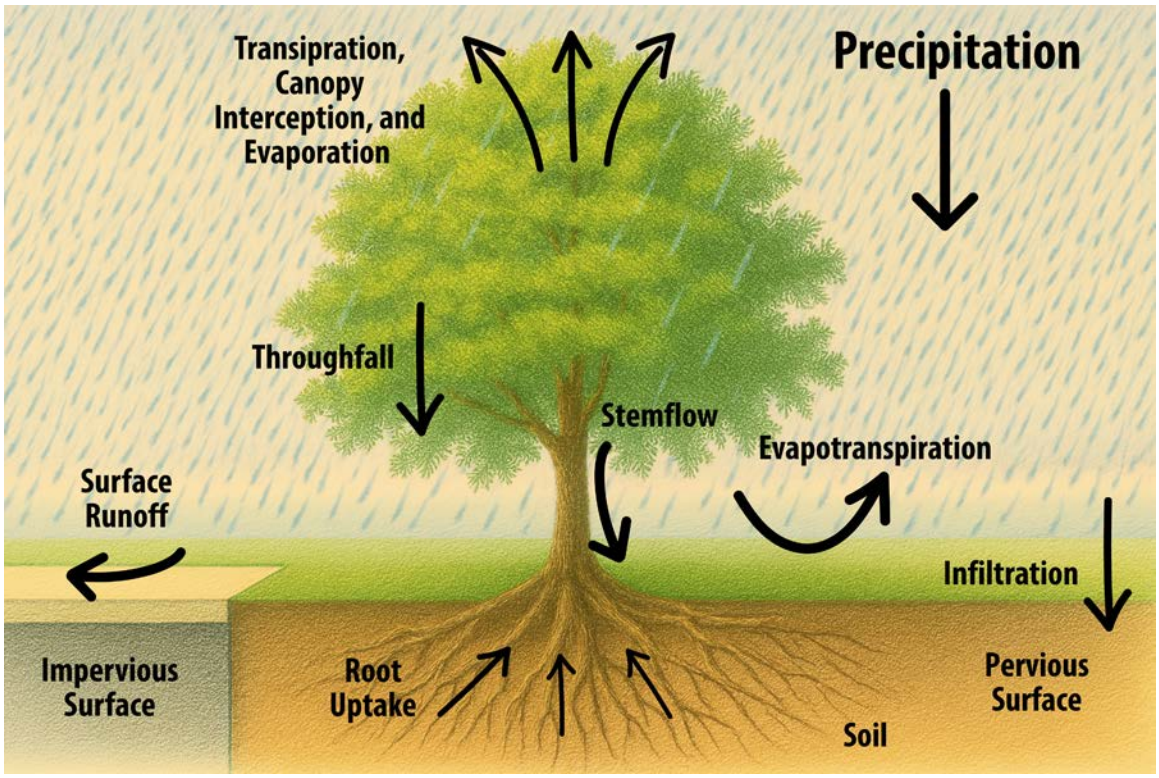


Image adapted from: U.S. Environmental Protection Agency and Microsoft. (2025). Stormwater to Street Trees: Engineering Urban Forests for Stormwater Management. EPA 841-B-13-001, 2013. EPA website. Response to "recreate in the style of a colored pencil sketch at a 16:9 image ratio with labels removed." Using Copilot (GPT-4). Retrieved July 27, 2025, from https://copilot.microsoft.com/.

Urban runoff, if unmanaged, gathers pollutants from streets and rooftops—like oil, fertilizers, bacteria, sediment, and detergents—which are funneled into storm drains and discharged into natural water bodies via storm sewer systems. To counteract this, communities can support planting trees with proper installation techniques that maintain adequate soil volume, permeability, and drainage, which are

essential. Installation failures like compacted soil, undersized tree pits, and impervious surfaces hinder tree performance and stormwater uptake.

Innovative practices, such as using structural soils and permeable pavements beneath and around trees, improve root health and infiltration capacity. These features can also integrate with overflow systems to accommodate larger storms. An example of these root zone improvement practices can be seen regionally in the City of Cumberland, Maryland. The City utilized structural cells to support street trees as part of a renovation project for the Baltimore Street corridor completed in 2024. The tree pits visible in Image 24 extend beneath the pavement (supported by the structural cells) to greatly expand the area available for root growth, and trees also receive water from the trench drains that line each side of the vehicle travel lane. Such measures ensure that stormwater is captured close to the point at which it reaches the ground, and that ample soil volume and moisture are available to the trees.

Image 24: Baltimore Street in the City of Cumberland, Maryland, following streetscape improvements.

(Image Credit: Livable Frederick)

Locally, the Town of Emmitsburg bid a contract for improvements to North Seton Avenue, between North Avenue and Provincial Parkway in late Summer 2025 intended to upgrade water infrastructure and establish the Town's first "green street." The project will replace an existing water line and incorporate multiple bioretention facilities into the North Seton Avenue right-of-way, directly adjacent to the road, to treat rainwater as closely as possible to where it falls. The bioretention facilities will be planted with

predominately native and naturalized trees, shrubs, perennials, and grasses intended to provide aesthetic value and many of the services described in this section of the Plan.

Trees also play a vital role in improving air quality through several mechanisms. First, they absorb carbon dioxide (CO_2) during photosynthesis and release oxygen. Trees also act as natural air filters by capturing airborne pollutants such as particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and ground-level ozone (O_3) through their leaves and bark. In urban areas, small forests can remove thousands of tons of these pollutants each year, significantly reducing health risks associated with poor air quality. Additionally, vegetation near highways has been shown to reduce soot by 37% and ultrafine particles by 7%, highlighting the effectiveness of trees in mitigating traffic-related pollution.[71, 72, 73]

When communities design and implement tree installations intentionally, mature canopies provide extensive environmental and stormwater benefits, plus additional ecological and social perks:

- Air Quality: Trees filter gases and particulates from the air.
- Energy Efficiency: Trees provide shade during the warmest months of the year and reduce cooling needs.
- Property Value: Trees enhance neighborhood appeal.
- Carbon Reduction: Trees sequester CO_2 and can help mitigate climate change.
- Community Well-being: The mere presence of trees can foster feelings of safety and positive perceptions for communities.
- Water Protection: Canopies and roots intercept and clean urban runoff.

Communities that recognize and integrate trees as essential green infrastructure can simultaneously advance stormwater resilience and elevate urban livability. The City of Frederick is an example of a community in Frederick County publicly committed to improving its tree canopy coverage, with a goal of reaching 40% canopy coverage within the City by the year 2030. The City's Department of Urban Forestry is responsible for maintaining trees on City property and provides guidelines for public tree management. The City also conducts the "Tree Frederick" cost-share program to support the purchase and planting of trees on private property in the City each spring.[74] Additionally, the City welcomes the work of non-profit organizations, like Mobilize Frederick, whose Cooler Neighborhoods project utilizes funding from the Maryland Department of Natural Resources' Community Forestry Catalyst Fund to hire and train residents to help plant 240 new trees throughout the City in 2025 and 2026. The goals of the Cooler Neighborhoods project are to empower the next generation of community forestry experts, help the City of Frederick reach its 40% canopy coverage goal, and further the mitigation of climate change in Frederick County.[75]

Site Level

Much like the regional and neighborhood levels, green infrastructure implementation at the site level relies on thoughtful planning, community collaboration, and responsiveness to local conditions. Planners, designers (typically architects, engineers, and landscape architects), developers, and property owners can—and should—engage the public in the design process through visioning exercises like charrettes to align site level implementation with larger green infrastructure goals. This discussion of green infrastructure implementation at the site level will look at ways in which specific land management practices can improve wildlife habitat, stormwater infiltration capacity, water quality, and access to nature on most any property.

Green Infrastructure, Stormwater, & Urban Tree Canopy

Other communities throughout the Mid-Atlantic Region and the country have undertaken similar efforts. The following programs include a variety of actions that can be undertaken at different scales:

City of Chicago, IL- Green Alleys: Chicago's Green Alley Program, launched by the Chicago Department of Transportation (CDOT) in 2006, is a pioneering environmentally focused initiative aimed at retrofitting the city's expansive public alley network—spanning approximately 1,900 miles—to better manage stormwater, reduce urban heat, and conserve energy. The program replaces traditional impervious alley surfaces with permeable pavements (such as porous asphalt, concrete, and pavers), high-albedo (light-reflecting) materials, recycled content (like slag or recycled tire aggregates), and enhanced grading for improved drainage. It also incorporates features like underground detention systems, dark-sky-compliant lighting, and designs that reduce maintenance costs and environmental impact. Since its inception, Chicago has installed hundreds of green alleys—estimates range from over 300 to more than 400—making it one of the largest citywide green infrastructure programs of its kind in the United States (https://www.chicago.gov/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html).

City of Lancaster, PA – Green It! Lancaster: Lancaster's green infrastructure program is a forward-looking 25-year strategy designed to safeguard the Conestoga River and enhance urban livability by managing stormwater with nature-based solutions. The city implements green infrastructure like rain gardens, porous pavements, bioswales, tree trenches, permeable surfaces, and bioretention features that incorporate trees and other plants to reduce combined sewer overflows (CSOs), improve water quality, and meet Clean Water Act and Chesapeake Bay regulations in a cost-effective way. Under this plan, Lancaster has crafted supporting tools—including a GI Design Manual, Monitoring Plan, and O&M Plan—while leveraging grants, fee credits, and community programs like Save It! and Tree Tenders to engage residents in installing and maintaining GI. Since 2010, these efforts have helped intercept millions of gallons of stormwater annually, deliver economic, environmental, and community benefits, and establish the city as a statewide and national model for sustainable stormwater management (https://www.cityoflancasterpa.gov/stormwater-information/greenit-lancaster/).

City of Philadelphia, PA - Green City, Clean Waters: Launched in 2011, Green City, Clean Waters is the Philadelphia Water Department's 25-year initiative to dramatically reduce combined sewer overflows (CSOs) by prioritizing green stormwater infrastructure (rain gardens, tree trenches, bioswales, porous pavement, and more). The program aims to cut CSO pollution by 85% by 2035, while delivering wide-ranging benefits: cleaner rivers, more green space, reduced urban heat, increased community engagement, local jobs, and enhanced resilience. Over the first decade alone, the city installed thousands of green tools across hundreds of sites, keeping billions of gallons of polluted runoff out of waterways, engaging residents as active partners, and setting a nationally recognized model for sustainable urban water management (https://water.phila.gov/green-city/).

Of note, successful site scale green infrastructure projects should also consider long-term maintenance as part of implementation and installation. Site level green infrastructure can incorporate native vegetation while allowing space for equipment access to ease upkeep and reduce maintenance and replacement costs. Much like the maintenance of any property, planners, designers, and property owners should factor in labor, frequency, and resource demands for different green infrastructure elements to ensure they can manage them effectively over time.

Low- or No-Mow Landscapes

Turfgrass lawns can be an important source of green space within communities, supporting many types of play and organized sports. However, they can also require significant inputs of water (1.0 to 1.5 inches per week in Maryland), fuel (for maintenance equipment), manpower, and pesticides or fertilizers to maintain. The organization Bee City USA states that turfgrass lawns cover approximately 40 million acres within the US, making them the single largest irrigated crop grown today.[76]

While they can be aesthetically pleasing, turfgrass lawns also offer little to no support for wildlife. They are typically grown as monocultures, and they lack the structural and species diversity necessary to sustain (feed and shelter) many species of native insects, birds, and other animals. Studies have shown that turfgrass lawns contribute to ecological homogenization, reducing biodiversity across urban and suburban landscapes. The U.S. Forest Service has noted that traditional lawn care practices can create "anemic habitats" that diminish wildlife populations, whereas converting turf to native plantings can significantly enhance biodiversity.[77] Furthermore, the National Wildlife Federation emphasizes that many native insects, such as monarch caterpillars and specialist bees, rely on specific native plants that turfgrass simply does not provide.

Signed into law in 2021, Maryland House Bill 322 empowers property owners in Maryland to use low-impact landscaping by prohibiting unreasonable restrictions on such practices in real estate agreements, including deeds, HOA rules, and condominium bylaws. This relatively new law defines low-impact landscaping as environmentally beneficial techniques like rain gardens, pollinator gardens, xeriscaping, and bio-habitat features that conserve water, reduce maintenance, and support wildlife.

It also ensures that property owners who maintain and regularly tend their landscaping can implement these practices, even if existing covenants or rules might otherwise limit them. However, it also does allow for reasonable guidelines to ensure aesthetic or safety standards. Historic properties are exempt from the law's provisions. This legislation reflects Maryland's broader commitment to sustainable land use and ecological resilience. The Frederick County Division of Energy and Environment has developed a comprehensive website, including facts and guidance for the establishment and maintenance of low-impact landscaping. The website can be accessed here: https://frederickcountymd.gov/8674/Weedy-or-Wonderful.

In March of 2025, the City of Frederick also adopted a new ordinance (G-24-21) establishing a definition for low-impact landscaping within city limits and guidelines for implementation. Starting April 1, 2025, residents can now opt to install low-impact landscaping in lieu of traditional lawns. The City's standards require that a low-impact landscape includes at least 85% native plant species, an intentional planting pattern that includes groupings of plants, clusters, or drifts, and supports pollinator species or provides, manages rainwater (i.e., rain garden), and requires little or no irrigation (i.e. xeriscaping).[78]

No Mow May

Another option for property owners who may not wish to undertake full-scale replacement of a turfgrass lawn is "No Mow May." No Mow May encourages people to pause lawn mowing during the late spring and early summer to support early-season pollinators. The movement was launched by the organization PlantLife in the UK and has spread around the world to communities like Appleton, Wisconsin, where it has been met with strong public participation and advocacy. The Bee City USA program (an initiative of the Xerces Society for invertebrate conservation) has embraced the idea, drawing attention to broader pollinator conservation efforts. Research has demonstrated that mowing less frequently boosts insect diversity, reduces pests, and lowers maintenance costs, with some studies recording dozens of bee species visiting common lawn flowers. While reduced mowing helps, experts also urge homeowners to create "bee lawns" by replacing low-nutrient weeds like dandelions with more beneficial flowering plants such as clover, thyme, and native violets to improve nutrition for pollinators and support butterflies as well (as promoted by low-impact landscaping). More information on No Mow May can be found on the Bee City USA website at: https://beecityusa.org/no-mow-may/. (Image Credit: https://beecityusa.org/no-mow-may/)

Invasive Species Management

Invasive plants and animals threaten ecosystems by displacing native species, altering habitat structures, and disrupting the key ecological processes that make a region unique. They can also reduce native plant cover and species diversity, which can, in turn, impact insects, birds, and other wildlife. While native vegetation can often recover if invasive plants are removed, some species fundamentally alter ecosystems to the point where restoration requires major intervention, such as reestablishing soil chemistry or rebuilding habitat structure.

Invasive Animal Species

The Green Infrastructure Plan is focused more on invasive plants than invasive animals, because invasive plants tend to be easier to control due to their static habit (once established) and their dispersal methods. That being stated, there are avenues to seek assistance when encountering invasive animals in Frederick County. The Maryland Department of Agriculture (https://mda.maryland.gov/plants-pests/pages/default.aspx) and the Maryland Department of Natural Resources (https://dnr.maryland.gov/Invasives/pages/default.aspx) are responsible for monitoring and for enforcing laws related to invasive animal species. More information regarding regulations and mechanisms for reporting observations is included on the respective agency websites. [79, 80]

The University of Maryland Extension states that invasive plants can alter environments in many ways:[81]

- Invasive vines like kudzu and wisteria strangle trees and collapse forest canopies;
- Cheatgrass increases wildfire risk by producing early-season tinder;

- Species like Callery pear accelerate succession and eliminate crucial meadow phases;
- and others, like Japanese barberry and common reed, modify soil nutrients and pH, encouraging their own spread while disrupting native plant and animal communities;
- And aquatic invasives like hydrilla clog waterways, reduce oxygen levels, foster mosquito breeding grounds, and poison wildlife.

Frederick County's Forest Resources Ordinance (or FRO) focuses on removing invasive plant species—like Tree of Heaven, Multiflora Rose, and Japanese Honeysuckle—to help native forests thrive. To ensure effectiveness in management of invasive species, it allows contractors to implement mechanical or chemical methods to eliminate these species while protecting the growth of desirable vegetation. Areas of concern must be treated at least twice a year, while being careful to stabilize any bare ground resulting from mechanical removal and to clearly flag targeted plants to avoid mistakenly removing native species.

Before planting new forest under the FRO, contractors must also begin suppression efforts, especially in zones where existing forest are to be maintained and where new forest habitat "edges" are created. Chemical treatments follow federal and state regulations, and only licensed applicators may apply herbicides near wetlands or streams. Mechanical controls, such as mowing or pulling, may cause soil disturbance and require sediment control and careful soil repair. Contractors must follow up three times during a three-year maintenance window to treat potential invasive regrowth and to ensure long-term control. Recommended herbicide treatments and methods—specific to each invasive species—are available through Maryland's Department of Natural Resources. The overarching goal of the FRO is to create canopies of native tree species that naturally suppress invasive growth over time.

Independent of moderate or large scale habitat restoration efforts like those undertaken as part of the FRO, there are things residents can do to help reduce the impact of invasive plants in Frederick County. These activities include the following practices quoted directly from the Extension's website:[82]

Don't introduce invasive plants.

- Don't plant them. Learn what plants to avoid buying and planting in your yard and garden.
- Don't share them with others and be careful what you bring home from plant sharing events.
- Don't accidentally transport them. Remove seeds from muddy shoes and burs stuck on clothes. Avoid mixing their root pieces or seeds in soil with other plants.
- Avoid disturbing soils unnecessarily; invasives are quick to colonize them. Quickly replant or cover vacant soils.

Encourage native plants.

- Increase use of native plants in home landscapes to increase the native seed and gene pool.
- Set aside some untouched natural areas to preserve native plants.
- Support deer control where deer overpopulation is decimating native plants.
- Replace invasive plants with a native plant or, at least, a non-invasive plant.

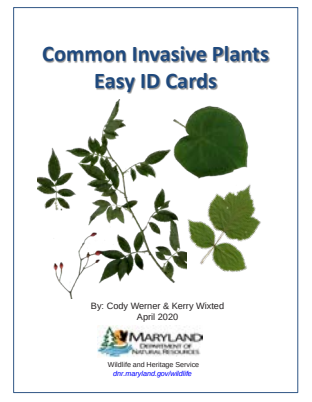
Educate yourself and others.

- Encourage local nurseries to stock native plants, particularly local genotypes, and buy them.
- Bring nurseries' attention to invasive stock and invasive weeds hitchhiking in on stock, for example, invasive weeds in a container.
- Share the news about invasive plants with friends, neighbors, and family!

Remove invasive plants.

- Familiarize yourself with invasive species in local parks and natural areas.
- Report sightings of invasive plants in parks to the managing agency, or submit photos of the plants on the iNaturalist app.
- Support community efforts to clear invasive plants and restore native plants. Look into "Weed Warrior" volunteer projects typically organized by Frederick County's Parks and Recreation Department[83]

Invasive Plant ID Cards



The Maryland Department of Natural Resources created a series of Easy ID Cards for common invasive plants in 2020. This document is available for download from the Maryland Department of Natural Resources website at: https://dnr.maryland.gov/wildlife/Documents/Invasive_plants_cards.pdf.

Invasive plants also thrive along many roadsides because these areas are frequently disturbed by mowing, construction, and vehicle traffic, creating ideal conditions for opportunistic species to establish and spread. The harsh conditions and lack of competition from native trees and shrubs—often removed or suppressed by maintenance activities—further encourage the growth of fast-spreading, non-native plants. Frederick County is actively working to reduce mowing as a primary maintenance mechanism along road rights-of-way by adopting more sustainable vegetation management practices. The County's Office of Highway Operations currently mows each road approximately every 4 to 6 weeks during the growing season, with a single 5-foot-wide pass early in the season and two passes during slower growth periods.[84] However, to reduce environmental impact and maintenance costs, the County is exploring strategies such as selective mowing, use of boom mowers only once or twice a year for hard-to-reach areas, and integrating herbicide spot treatments to control invasive species and woody vegetation without widespread mowing. These efforts align with broader statewide goals outlined in Maryland's Integrated Vegetation Management

Manual, which promotes the use of plant growth regulators and targeted herbicide applications to reduce mowing frequency while maintaining safety and visibility.

In addition, Frederick County has recently updated its approach to managing its "Rustic Roads"—those scenic, historic, and minimally altered rural routes that contribute to the county's rural character. The newly established Rustic Roads Commission, formed in 2023, is tasked with overseeing maintenance standards that preserve the aesthetic and ecological integrity of these roads. This includes developing tailored mowing and vegetation management practices that minimize disturbance, support native plant growth, and enhance wildlife habitat. The Commission is also working with the Division of Public Works on new Standard Operating Procedures for designated Rustic Roads that emphasize context-sensitive maintenance, such as reduced mowing widths and frequencies, and replanting native trees within the right-of-way to restore canopy lost to disease or weather events. These changes reflect a shift toward more ecologically responsible stewardship of Frederick County's rural transportation corridors with an eye toward managing native species and preserving historic and rural character.

Wildlife Habitat Revisited

It should be noted that opportunities exist for many landowners in Frederick County, not only those with large enough holdings to support sanctuaries, to support local wildlife through the establishment of wildlife habitat on smaller properties. Whether it's through low- or no-mow landscape management, or a variety of other programs that offer guidance or certifications to help support local wildlife at most any scale. Entomologist, ecologist, professor, speaker, author, and Co-Founder of the Homegrown National Park program, Doug Tallamy has stated that, if the owner of every property in the United States that is maintained as a turfgrass lawn were to turn half of that area into a garden featuring productive, locally native plants that support local insect and animal species, biodiversity and ecosystem function would be greatly improved throughout all our communities.[85]

The Maryland Department of Natural Resources has developed the *Maryland's Wild Acres* program to assist property owners in the creation (and construction) of nest boxes and supportive landscapes. The website includes fact sheets and identification guides to further aid property owners in developing the right types of habitats to suit wildlife in their area. All materials are available on the Department of Natural Resources website at: https://dnr.maryland.gov/wildlife/pages/habitat/wildacres.aspx.

The following list includes several additional programs related to the establishment of "backyard" habitat in the Mid-Atlantic region:

- National Wildlife Habitat Federation Backyard Habitat (https://www.nwf.org/Native-Plant-Habitats/Create-and-Certify)
- Homegrown National Park (https://homegrownnationalpark.org/)
- Monarch Watch Waystations (https://monarchwatch.org/waystations/)
- North American Butterfly Association Butterfly Garden (https://naba.org/butterfly-gardens/certification-program/)
- Penn State Extension Master Gardener Pollinator Habitat (https://pollinators.psu.edu/landscaping-for-pollinators/pollinator-habitat-certification)
- Alliance for the Chesapeake Bay Native Plant Finder (https://www.allianceforthebay.org/native-plant-center/)

Stormwater Revisited

As noted in the earlier discussion of stormwater management at the regional level, developers and property owners are required to comply with stormwater management regulations when subdivision and development activities meet certain pre-determined thresholds. Many of the regulations and policies mentioned in the neighborhood level discussion also apply at the site level.

The Frederick County Division of Energy and Environment has prepared and published electronic resources to assist anyone with their efforts to capture and treat more precipitation on their property—even on properties that are not seeking to develop or would like to voluntarily improve local water quality. Practices described include:

- Bioswales
- Dry Wells
- Micro-Bioretention Facilities
- Porous Pavement
- Rain Gardens
- Stormwater Management Ponds
- Rain Barrels

Downloadable brochures include schematics of the various BMPs, recommended maintenance schedules, troubleshooting information, and contact information for knowledgeable inspectors with Frederick County Government. Copies of the brochures can be found on the County's website at: https://frederickcountymd.gov/7577/Best-Management-Practices.

Tree Canopy Revisited

As noted in the earlier discussion of tree canopy at the neighborhood level, planting trees provides an incredible range of benefits to property owners and the County as a whole. Tree planting can occur as part of a larger urban canopy initiative, or whenever someone feels inspired to make an investment in their community's future. Local programs supporting tree planting were discussed earlier in this Plan and in this chapter. This discussion of tree planting is intended to provide specific information for property owners who want to make their own long-term contribution to wildlife habitat and resiliency where they live.

Planting a tree does require some knowledge of local conditions to ensure that the right tree and a proper site are selected. This selection process has become more complicated in recent decades in recognition of the fact that climate change is affecting the ability of native trees to thrive and reproduce throughout what have been recognized as their native ranges for generations. Staff at botanic gardens, like the Mt. Cuba Center in Hockessin, Delaware, have dedicated time and effort in the last year to predicting which native trees might fare best in a warming Mid-Atlantic Climate Scenario. The Center's Resilient Canopy Project analyzes native eastern temperate forest species using climate projections and pest-and-disease vulnerability assessments to determine which trees are likely to thrive in regions climate by 2100—under both moderate and high warming scenarios. It categorizes species into six levels, ranging from those expected to remain resilient under intense warming (Level 1) to those considered unsuitable for current or future conditions (Level 5), as well as experimental candidates (Level 6).[87]

Green Roofs

Green roofs are engineered systems that transform traditional rooftops into thriving green spaces, offering a range of environmental, economic, and social benefits. These systems typically include layers such as waterproofing, root barriers, drainage, filter cloth, lightweight growing media, and vegetation. They can be modular—pre-assembled in movable grids—or built in place, and are designed to function independently from the ground, whether installed below, at, or above grade. Green roofs help extend urban ecosystems by managing stormwater, improving air quality, reducing urban heat island effects, and enhancing biodiversity.[86]

While green roof technologies are well-established in Europe—thanks to strong government support and policy incentives—their adoption in North America has been slower. Organizations like Green Roofs for Healthy Cities (GRHC) are working to advance the industry by promoting research, policy development, and public awareness. GRHC emphasizes that each green roof is unique, with performance varying by climate, building type, and design. The organization also supports local initiatives and symposia to foster regional markets and encourages further research to unlock the full potential of green roofs as green infrastructure.

Image 25: The Green Roof at Catoctin Creek Nature Center.

(Image Credit: Frederick County Division of Parks and Recreation)

The following list of tree species native to Frederick County has been compiled as a reference to aid anyone interested in planting a tree in selecting a native tree species that is known for supporting native insect and wildlife populations and that stands a good chance of adjusting to future climatic conditions in Frederick County, whatever they may be. These species include:

Recommended Native Trees for Frederick County, MD (Wildlife-Supportive)

- White Oak (*Quercus alba*): Maryland's state tree, White Oak, supports an enormous range of wildlife. Its acorns feed songbirds, squirrels, deer, and other mammals, while its branches and cavities offer nesting and roosting sites. Entomologists underscore oaks' unmatched ability to support food webs, with hundreds of caterpillar species relying on them. It grows best in moist to dry, well-drained soils with full sun to partial shade, and thrives in acidic pH (below 6.5).
- Eastern Red Cedar (*Juniperus virginiana*): A hardy evergreen, this cedar offers winter shelter and berry-like cones that sustain birds such as cedar waxwings. It tolerates dry, rocky, or limestone soils and grows best in full sun.
- Eastern Redbud (*Cercis canadensis*): This small flowering tree produces deep pink spring blossoms that feed early pollinators and support butterflies. It grows well in partial shade to full sun with moist, well-drained soil.
- Serviceberry (*Amelanchier spp.*): Serviceberry delivers white spring flowers for pollinators, followed by sweet berries that birds devour. It prefers full sun to part shade in moist, well-drained soil.
- Black Cherry (*Prunus serotina*): A keystone species, Black Cherry hosts hundreds of moth and butterfly species and provides fruit for birds and mammals. It grows best in upland, well-drained soils with full sun to part shade.
- American Holly (*Ilex opaca*): This evergreen tree produces red berries that feed birds through winter and offers excellent shelter. It tolerates shade to full sun and thrives in moist, well-drained soils.
- Blackgum / Tupelo (*Nyssa sylvatica*): Blackgum features nectar-rich spring flowers, berries loved by birds, and brilliant red fall foliage. It grows in wet to average soil and tolerates full sun to part shade.
- Tulip Poplar (*Liriodendron tulipifera*): One of Maryland's tallest native trees, Tulip Poplar produces nectar-filled tulip-like flowers that attract hummingbirds and bees in late spring and early summer. It grows fast in full sun and moist, well-drained soil.
- Mockernut Hickory (*Carya tomentosa*): This sturdy hickory supports wildlife with nut crops eaten by birds, squirrels, bears, and foxes. It grows best in well-drained soils with full sun and space for its broad crown.
- Shagbark Hickory (*Carya ovata*): Another wildlife-rich hickory, Shagbark produces nuts prized by wildlife and has bark that creates roosts for endangered bats. It prefers moist, fertile soils in full sun to part shade.
- Red Maple (*Acer rubrum*): Highly adaptable, Red Maple provides early spring flowers for pollinators, seeds for small mammals and birds, and fiery fall foliage. It tolerates wet to dry soils and grows in full sun to partial shade.

- Northern Catalpa (*Catalpa speciosa*): Known for its large heart-shaped leaves and showy white flowers, Northern Catalpa attracts bees, hummingbirds, and sphinx moths. It thrives in moist, well-drained soils and full sun, but adapts to poorer soils.
- Fringetree (*Chionanthus virginicus*): This small understory tree produces clouds of fragrant white flowers that support pollinators in spring, followed by fruit eaten by birds. It prefers moist, well-drained soil and full sun to partial shade.
- Green Hawthorn (*Crataegus viridis*): Hawthorn offers spring flowers for pollinators, berries for birds, and thorny shelter for nesting. It thrives in sun to part shade, tolerates clay soils, and withstands urban conditions.
- Sycamore (*Platanus occidentalis*): One of the largest eastern hardwoods, Sycamore provides cavities for nesting owls and wood ducks, and seeds eaten by finches. It thrives in wet bottomlands and streamside soil but tolerates a range of sites.
- Pawpaw (*Asimina triloba*): A unique understory tree, Pawpaw produces edible fruits enjoyed by both wildlife and humans and is the exclusive host plant for zebra swallowtail butterflies. It prefers moist, fertile, slightly acidic soils in partial shade to full sun.

Many of the tree species included in this list are readily available in the nursery trade in Maryland and at many garden centers. Certain trees, like Mockernut and Shagbark hickory are not as common in cultivation, but their fruit can often be found in parks and along trails in late summer through early fall, provided wildlife doesn't locate them first. The following table, Table 4, is intended as a handy, quick-reference for the species listed above.

Table 4: Recommended Wildlife Supportive Trees

Tree	Key Wildlife Benefit	Best Conditions
White Oak	Acorns, caterpillars, nesting	Full sun, well-drained acidic soils
Eastern Red Cedar	Evergreen shelter, berries in winter	Sun, dry to moist soils
Eastern Redbud	Early nectar, butterfly host	Part shade/sun, dry to moist soils
Serviceberry	Early flowers, bird-edible berries	Sun/part shade, moist soils
Black Cherry	Insect host, fruits for birds/mammals	Upland soil, sun/part shade
American Holly	Evergreen, winter berries	Shade–sun, moist soils
Blackgum	Pollinator flowers, bird berries, fall color	Wet to average soils, part shade/sun
Tulip Poplar	Nectar flowers, seed food, nesting cavities	Sun, moist soils
Mockernut Hickory	Nuts for wildlife	Sun, well-drained soils
Shagbark Hickory	Nuts, bat roosting bark	Sun/part shade, moist fertile soils
Red Maple	Early flowers, seeds, fall foliage	Wet to dry soil, sun/part shade
Northern Catalpa	Large flowers for pollinators	Sun, moist well-drained soils
Fringetree	Pollinator flowers, bird fruit	Sun/part shade, moist soils
Green Hawthorn	Flowers, bird berries, nesting cover	Sun/part shade, clay soil tolerant
Sycamore	Nest cavities, finch food	Wet/streamside soils, adaptable
Pawpaw	Fruit for wildlife, Zebra Swallowtail host	Part shade/sun, moist fertile soils

GREEN INFRASTRUCTURE IN FREDERICK COUNTY

Having discussed various forms that green infrastructure may take in Frederick County and some of the ways in which it may be implemented; it is now time to turn to the Frederick County Green Infrastructure Network. This section of the Plan is intended to address the various goals for the Green Infrastructure Network, provide the rationale for the Network, explain how it is constructed, and discuss the relationship of the Green Infrastructure Network to another significant conservation and preservation mechanism in the Livable Frederick Development Framework—the Agricultural Infrastructure Sector.

Goals for the Green Infrastructure Network

Goals for a Frederick County Green Infrastructure Network have been considered for some time. Prior to the adoption of the LFMP in 2019, green infrastructure and the creation of a Green Infrastructure Plan were considered in the County's 2010 Comprehensive Plan. Several policies were identified for implementation as part of the 2010 County Comprehensive Plan, and the County worked with the Department of Natural Resources Forest Service and the EPA on green infrastructure mapping and habitat connectivity that has helped guide the implementation of certain County programs since that time. While this work was conducted in furtherance of the 2010 Comprehensive Plan's policies, the topic and the network remained the subject of policies and recommendations rather than a fully-developed component of the County's Comprehensive Plan.

The LFMP built upon many of the policies from the 2010 Comprehensive Plan and expanded the role of green infrastructure in planning for growth in Frederick County through the Green Infrastructure Sector of the Development Framework discussed in Chapter 1. Ideas first described in the 2010 Comprehensive Plan were expanded and refined in the LFMP and, subsequently, in the County Executive's 2023 Transition Report, the 2023 – 2026 Livable Frederick Work Program, and in the work of the Green Infrastructure Advisory Group discussed in Chapter 1. A summary of how each step in the planning process has shaped the Green Infrastructure Network follows.

LFMP

With the adoption of the Livable Frederick Master Plan, in 2019, the creation of the Green Infrastructure Plan was identified in the Action Framework, under the "Our Environment" theme, in support of the following State of Maryland Visions: Quality of Life and Sustainability, Public Participation, Community Design, Growth Areas, Infrastructure, Transportation, Housing, Economic Development, Environmental Protection, Resource Conservation, and Stewardship, Implementation.[88] It was explicitly described as the primary initiative to be undertaken in Goal 4.1.1 of the LFMP.

Goal 4.1.1: Natural Resources and Green Infrastructure The natural environment and its habitat provision and ecosystem services are critical to our quality of life, and so they should be the primary consideration in all land planning and governmental decision-making processes.

The LFMP, in describing the Green Infrastructure Network as part of the Green Infrastructure Sector of the Development Framework, states that, "the development of a county green infrastructure network must:

- Enhance and complement the statewide network;
- Identify gaps in a green infrastructure network and strategies to fill the gaps; identify and highlight the County's natural resources and sensitive areas to garner support for—and generate—protective measures;
- Support the achievement of state and county natural resource conservation goals;
- Support the desired development pattern of the county described in the Livable Frederick Master Plan;
- and facilitate Maryland's Smart Growth policies."

Transition Report

To build on the goals outline in the LFMP, County Executive Jessica Fitzwater's 2023 Transition Report states that, "the County Executive should develop a comprehensive greenway corridors and infrastructure plan which should connect green infrastructure hubs, reduce fragmentation of natural areas, provide more options for wildlife migration, adapt as climate changes, identify forest conservation and afforestation opportunities, reduce vehicle miles traveled, and increase outdoor recreation opportunities for low- to moderate-income families."[89]

Work Program

The Livable Frederick Work Program states that the Green Infrastructure Plan will focus on the preservation, enhancement, and connectivity of the County's natural and environmentally-sensitive areas, and that it should identify existing large-scale, ecologically-significant habitats (or hubs) and environmentally-important linkages (or corridors) that can be utilized to connect hubs. It also states that Corridors and hubs will comprise a Green Infrastructure Network that provides a wide array of benefits to people and wildlife, such as sustaining clean air and water, storing and cycling nutrients, filtering and cooling streams and aquifers, conserving and generating soils, sequestering carbon, mitigating storms and flooding, providing habitat and migratory routes, and facilitating recreational opportunities. Lastly, it notes that the Green Infrastructure Plan should also consider issues related to the equitable distribution of access to nature and the potential for green infrastructure to mitigate the environmental impacts associated with growing communities.

Advisory Group Themes

At the outset of Frederick County's Green Infrastructure Plan development, the Green Infrastructure Advisory Group participated in an exercise to help shape the Green Infrastructure Plan's direction. County staff asked the group to reflect on four key questions focused on:

- The values or themes should guide the plan based on the goals and objectives outlined in the LFMP, the Transition Report, and the Work Program;
- (Green) Infrastructure, conservation, or recreation goals that remain unmet in the County;
- Threats or impediments to green infrastructure in Frederick County that exists today;
- and the scale at which conservation and restoration efforts should occur—countywide or in targeted areas.

Advisory Group members responded with a wide range of insights that Livable Frederick Staff synthesized into eight "themes" for the Green Infrastructure Plan and the Green Infrastructure Network. To further streamline the potential framework for the Plan and Network, and to mitigate the potential redundancy between themes, Livable Frederick refined those eight themes into five core principles. These five principles now serve as the backbone of the Green Infrastructure Network to align it directly with the goals outlined in the Livable Frederick Master Plan, the Transition Report, and the Work Program. The five core principles include:

Community Connectivity

The Green Infrastructure Network should focus on creating connections within and between communities, enhancing access to lifestyle amenities without requiring residents to rely solely on automobiles. In other words, a central goal should be to ensure that everyone, regardless of socioeconomic situation, can connect to outdoor spaces from their residence as well as the places they shop and work. Additionally, resulting reductions in vehicle miles travelled in the County also help improve local air quality and address contributing factors to a changing climate.

Equity of Accessibility

The Green Infrastructure Network should stress the importance of equity in access (particularly) to natural areas and green space. In contrast to the first core principle's focus on the ways in which we travel to green space, this theme involves the physical siting of parks, trails, and other types of green space throughout communities, thus promoting inclusivity of access through proximity. Community Connectivity supports the idea that one should be able to bike, walk, or ride transit to reach green space, and Equity of Accessibility means that no one should be required to do so over long distances.

Biodiversity, Wildlife Habitat, and Local Ecosystem Health

The Green Infrastructure Network should include measures to protect critical habitat from fragmentation, and also to support biodiversity through efforts like sustainable landscaping practices and implementing functional wildlife crossings where they are needed to ensure the safety of fauna and residents and to maintain or enhance connectivity in potential migration corridors. Additionally, the Network should address ongoing concerns about local water sources, stream temperatures, and the effects of human activities on the ecosystem. The Green Infrastructure Advisory Group highlighted the need for careful study and management to protect natural and community-sustaining resources.

Public Health, Outreach, and Education

The Green Infrastructure Network should incorporate opportunities for educating the public and engaging in outreach to raise awareness about environmental issues identified in the Plan. The Plan should highlight sustainable practices crucial for achieving long-term goals identified within it.

Climate Change, Sustainability, and Long-Term Management

The Green Infrastructure Network should help ensure the longevity of sustainable policies and practices within government and the community at large, including efforts to address stream and storm induced flooding, rising temperatures, and community resiliency.

Composition of the Network (Sub-Sectors)

The five core principles also represent a way to logically organize and communicate information about the network that limits confusion and alleviates the need for overly complicated maps of the Green Infrastructure Sector. For explanatory purposes, each core principle has been associated with a mapping Sub-Sector, which allows it to be discussed in the Plan in a way that is topic-specific. Table 5 illustrates the relationship between each Core Principle, its associated Sub-Sector, and the sources of data that were utilized in mapping the Sub-Sector.

Table 5: Core Principles, Sub-Sectors, and Mapping Data

Core Principle	Community Connectivity	Equity of Accessibility	Biodiversity, Wildlife Habitat, & Ecosystem Health	Public Health, Outreach, & Education	Climate Change, Sustainability, & Long-Term Management
Sub-Sector Name	Multi-Modal Accessibility Sub-Sector	Environmental Equity Sub-Sector	Habitat Connectivity Sub-Sector	Outdoor Recreation & Education Sub-Sector	Climate Change Sub-Sector
Mapped Layers	County Designated Bikeways and Trails Green Infrastructure Advisory Group Linkages MARC Service Routes MTA Bus Routes TransIT Service Routes	Overburdened Census Tracts (Per MD Environment Article, §1–701) Census Tracts with "Low" Park Equity Score (MD DNR/UMD Park Equity)	Audubon Important Bird Areas Maryland Trout (Coldwater) Watersheds Tier II Watersheds Wetlands (National Wetland Inventory) Targeted Ecological Areas Hubs and Corridors (Maryland Habitat Connectivity Network) Significant County Surface Waters (Catoctin Creek, Little Catoctin Creek, Tuscarora Creek, Glade Creek, Big Hunting Creek, Owens Creek, Ballenger Creek, the Potomac River, and the Monocacy River Significant County Natural Features (Sugarloaf Mountain, Lake Linganore, Lake Marion, Lake Merle, Lake Anita Louise, and Lilypons Water Gardens)	County Designated Bikeways and Trails Parks (Federal, State, County, Municipal) Environmental Education Facilities	FEMA 100-Year Floodplain Pluvial Floodplain (Frederick County Hazard Mitigations and Climate Action Plan, 2022) Census Tracts Under 30% Tree Canopy Cover

Sources of Data

Mapping data for Green Infrastructure Network mapping was sourced from multiple locations and agencies, including the USDA Forest Service, the Federal Emergency Management Agency (FEMA), the Maryland Department of the Environment (MDE), the Maryland Department of Natural Resources (DNR), the Maryland Transit Authority, the Frederick County Division Interagency Information Technology's (IIT) GIS Department, Frederick County TransIT, or the Frederick County Government Division of Emergency Management. All mapping was prepared using Frederick County's Geographic Information Systems (GIS) software by Livable Frederick or Frederick County IIT/GIS staff.

Mapping Methodology

The mapping methodology for each Sub-Sector map is inspired by the work of planner, educator, and landscape architect, Ian McHarg. Born in Clydebank, Scotland in 1920, he pioneered the field of ecological planning. After serving as a paratrooper in World War II and rising to the rank of Major, he studied landscape architecture and city planning at Harvard University. In 1954, he joined the University of Pennsylvania, where he founded the Department of Landscape Architecture and developed the influential course "Man and Environment." McHarg championed an interdisciplinary approach, integrating science, ethics, and design to promote harmony between human development and nature. McHarg also co-founded the firm Wallace, McHarg, Roberts, & Todd, contributing to major planning projects like Baltimore's Inner Harbor and The Woodlands in Texas. His work earned numerous honors, including the American Institute of Certified Planners (AICP) Pioneer Award, the National Medal of Arts, and the Japan Prize.[90]

In his most famous book published in 1969, *Design with Nature*, McHarg created a two-step planning technique that begins with mapping natural and physical features—such as geology, hydrology, soils, vegetation, and climate—into layered visual representations known as the "layer cake." These layers, when superimposed, reveal how environmental components interact to form the natural landscape. McHarg emphasized the relationships among these layers rather than their individual characteristics. In the second step, planners assess the suitability of land for development by identifying areas with favorable natural conditions, thereby minimizing environmental disruption resulting from human intervention. Many credit Ian McHarg's "layer cake" process as the inspiration for modern Geographic Information Systems (GIS).

McHarg later evolved this method into human ecological planning, recognizing the need to include human interactions within ecological systems. He defined human ecology as the study of relationships between organisms—including humans—and their environments. He also distinguished ecological planning from ecological design: planning identifies suitable locations based on biophysical and social processes, while design introduces form, requiring creative and visual skills to shape environments that harmonize with natural processes. McHarg's work fused the disciplines of city planning and landscape architecture, advocating for a holistic approach that respects both human needs and the integrity of nature. [91]

Mapping the Frederick County Green Infrastructure Network does not mimic McHarg's methodology in its entirety, but it draws inspiration from it. In each of the Sub-Sector maps, various relevant data sources are compiled in the same manner as Ian McHarg's layer cake to reveal patterns in the landscape of Frederick County. Network mapping is intended to highlight the relative presence (or absence) of various factors central to each of the Sub-Sector themes.

Sub-Sector Maps and Descriptions

A brief description of each of the Sub-Sectors and the corresponding Core Principles, including more information on the data sources used in their development, is provided in the following pages.

Multi-modal Accessibility Sub-Sector ("Community Connectivity" Core Principle)

The Livable Frederick Master Plan prioritizes multi-modal accessibility as a cornerstone of its vision for sustainable and inclusive growth in Frederick County.[92] Leveraging existing infrastructure—such as rail lines, transit services, and major highways—to create compact, walkable, and transit-ready communities underlies the growth strategy outlined in the LFMP. Through scenario planning, the LFMP explores development patterns that reduce auto dependency and promote mixed-use centers where residents can live, work, and access services without relying solely on cars. These multi-modal corridors aim to revitalize aging commercial zones, support infill development, and attract diverse job sectors by offering improved connectivity and mobility options. They can also facilitate access to green space for residents of Frederick County.

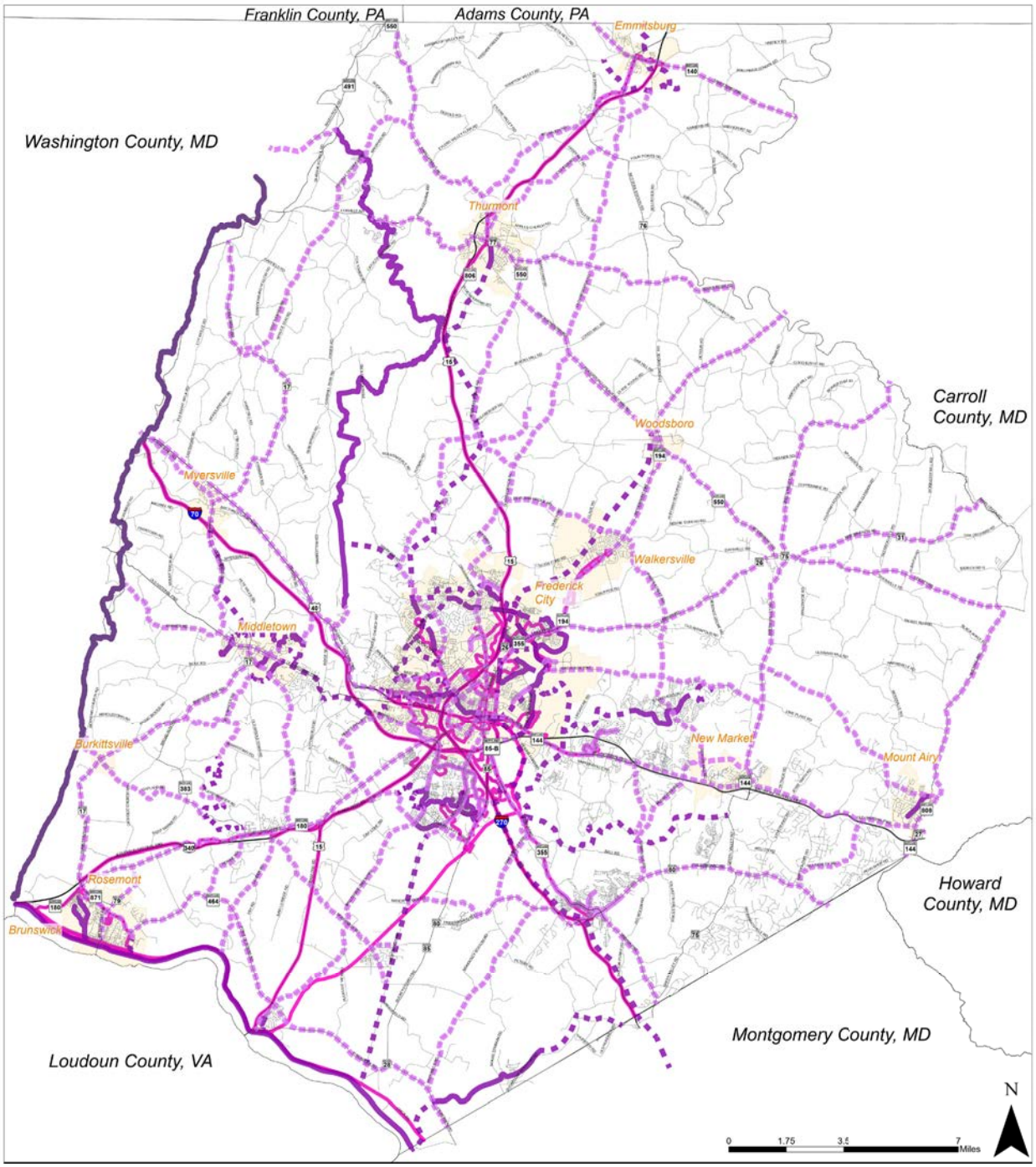
The Multi-Modal Accessibility Sub-Sector map highlights both existing and proposed connections between communities and growth areas in Frederick County that utilize public transit, bicycling, or hiking and walking routes. The following programs are highlighted and mapped for this Sub-Sector:

County Designated Bikeways and Trails: As noted in Chapter 1, the Bikeways and Trails Plan serves as a conceptual guide for aligning broader regional and state initiatives with County transportation planning to ensure connectivity for bicycle and pedestrian travel ways within the and with surrounding jurisdictions: Inclusion of designated bikeways and trails indicates the extent of current bike and pedestrian facilities, indicates where future facilities are planned, highlights areas that may be well served in the future, and identifies areas within the County that may need additional consideration.

Green Infrastructure Advisory Group Linkages: The Green Infrastructure Advisory Group identified several potential bike and pedestrian connections that have been discussed at the grassroots level. In certain locations, these connections establish new routes between communities and outdoor recreation destinations or extend already mapped routes from the Bikeways and Trails Plan to create cross-county or regional, multi-modal connections that focus on bicycling and hiking.

TransIT Service Routes: Frederick County operates TransIT Services, a free public transportation system that connects urban and rural communities across the region. The county runs 10 fixed-route Connector buses in the City of Frederick and surrounding areas, along with commuter shuttles and demand-response services for seniors and individuals with disabilities. Frederick County TransIT also provides information on regional transit options including MARC Commuter Rail, MTA Commuter Bus, Metrobus and Metrorail, and other commute alternatives. TransIT is also a member of Commuter Connections, a program of the Washington Metropolitan Council of Governments. This computerized carpool and vanpool matching service is offered free to Frederick area commuters.

MTA Bus Routes: MTA Commuter Bus service is available in Frederick County via Route 515, which connects Frederick to Shady Grove and Rock Spring.



Map 18: The Multi-Modal Accessibility Sub-Sector Map

Existing Public Transportation
- MTA Commuter Bus Lines
- TransIT Bus Lines
- MARC Lines

Bikeways and Trails
- Proposed On-Street
- Existing On-Street
- Proposed Off-Street
- Existing Off-Street

GI Advisory Group Recreation Connections
- Proposed On-Street
- Proposed Off-Street
- Appalachian Trail

MARC Service Routes: Maryland operates the MARC Train Service as a commuter rail system connecting Washington, D.C., Baltimore, and surrounding regions. Frederick County is located on the Brunswick Line, which provides commuter rail service primarily on weekdays and connects the City of Brunswick, the City of Frederick, and Point of Rocks to the Washington D.C. Metro Area.

Multi-modal Accessibility Sub-Sector Discussion

Frederick County currently possesses several notable existing assets as far as this Sub-Sector is concerned—in addition to free bus transportation made possible on Frederick County TransIT. The Appalachian Trail and the C & O Canal towpath both represent regionally significant recreational and transportation resources that connect communities in Frederick County with each other and with the wider region. While their location on the southern and western periphery of the County may limit their utility for all of Frederick County's residents, they should be kept in mind when building out the County's future multi-modal transportation and recreation planning efforts.

The Catoctin National Recreation Trail is another significant resource located in the heart of the County and is proximate to the Towns of Middletown and Thurmont and the City of Frederick. Many smaller trail segments exist throughout the County and within park facilities, but an assessment of the Sub-Sector map does indicate that a significant portion of the depicted network remains to be built-out with a "future" designation.

Efforts are currently under way through work on the New Design Side Path and the Frederick & Pennsylvania Railroad Trail to establish a pedestrian and bicycle connection between the City of Frederick and the C & O Canal (New Design Side Path) and the Towns of Walkersville and Woodsboro (Frederick & Pennsylvania). Segments of both projects are currently in the Initial Design phase, and several other connections currently have completed feasibility studies.[93] Work is also ongoing for the addition of bike facilities to Crestwood Boulevard between New Design Road and Westview Drive, where the conversion of the existing shoulder to be bike lane is anticipated to begin in 2026.

The Green Infrastructure Advisory Group also identified additional potential connections that could further expand multi-modal connectivity within the County, to connect communities to other communities and communities to recreational opportunities. The Advisory Group noted several potential future connections in the Middletown Valley and through a corridor from the Town of New Market through the south-central County along Bush Creek, Ballenger Creek and over Catoctin Mountain to Jefferson and eventually on to Burkittsville with alternate routes to Adamstown, Buckeystown and destinations like the Monocacy National Battlefield. Frederick County's Rustic Roads also represent an opportunity to leverage existing road infrastructure to facilitate connections between communities and recreational opportunities in more rural areas of the County, and some of the connections proposed on the Sub-Sector map leverage these designated "rustic" roadways.[94]

It is the intent of this plan to propose that these connections be carried forward and considered as part of Frederick County's ongoing bike and pedestrian planning efforts. The incorporation of these connections into the Bikeways and Trails Plan would allow for their consideration for future funding and their consideration as part of the Adequate Public Facilities Ordinance (APFO) review for future development projects on (or adjacent to) their alignments. APFO is one mechanism to ensure that appropriate rights-of-way are established, and multi-modal transportation facilities are constructed alongside future

development. Additionally, the City of Frederick is working on a comprehensive bicycle and pedestrian plan called, “Let’s Move Frederick,” concurrently with the development of the Green Infrastructure Plan. The City represents a central hub for transportation in the County, and it is also recommended that the final “Let’s Move Frederick” network also be incorporated into future multi-modal transportation planning efforts at the County level to further increase multi-modal access and connectivity between the City and County.

Regarding motorized and rail-based public transit, most existing transit resources are concentrated directly in and around the County’s largest population center, the City of Frederick, and the some of the County’s busiest transportation corridors, the US-15 corridor, and the I-270 Corridor. Currently mapped transit routes (TransIT, MARC, MTA) connect existing neighborhoods in the City of Frederick with existing transit hubs like the Monocacy MARC Station and the Point of Rocks MARC Station on the Brunswick Line. These transportation networks will be integral to the future envisioned in the Livable Frederick Master Plan, by supporting communities that are designed to be walkable and transit-oriented, with a network of walkways, bikeways, and transit routes that crisscross major corridors. Ultimately, the LFMP frames public transit not as an afterthought but as a core component of its vision for compact, accessible, and health-promoting communities across Frederick County.

Image 26: TransIT buses in service.

(Image Credit: Frederick County Transit / City of Frederick)

A recent step toward this future occurred in July 2025, when the Maryland Sustainable Growth Subcabinet officially designated the area surrounding Monocacy MARC Station off Urbana Pike as a Transit-Oriented

Development (TOD) site, as recommended by the Secretary of the Maryland Department of Transportation. This designation unlocks valuable state financial incentives, planning tools, and bonus weighting for tax credit applications, empowering Frederick County and its development partners to pursue dense, walkable, mixed-use redevelopment in alignment with the South Frederick Corridors Plan. Moreover, it streamlines access to a "Sustainable Communities" designation, expanding eligible funding programs. This TOD designation remains in effect for 10 years, with MDOT convening annual reviews to monitor progress and optimize state support.

Additionally, in late August of 2025, Frederick County TransIT announced the establishment of a pilot service stop at Cunningham Falls State Park as part of the Emmitsburg Thurmont Shuttle service from the City of Frederick. The pilot provides for three weekday trips and two Saturday trips to further the goals of the Livable Frederick Master Plan and make the benefits of Frederick County's natural environment accessible to all.

Environmental Equity Sub-Sector ("Equity of Accessibility" Core Principle)

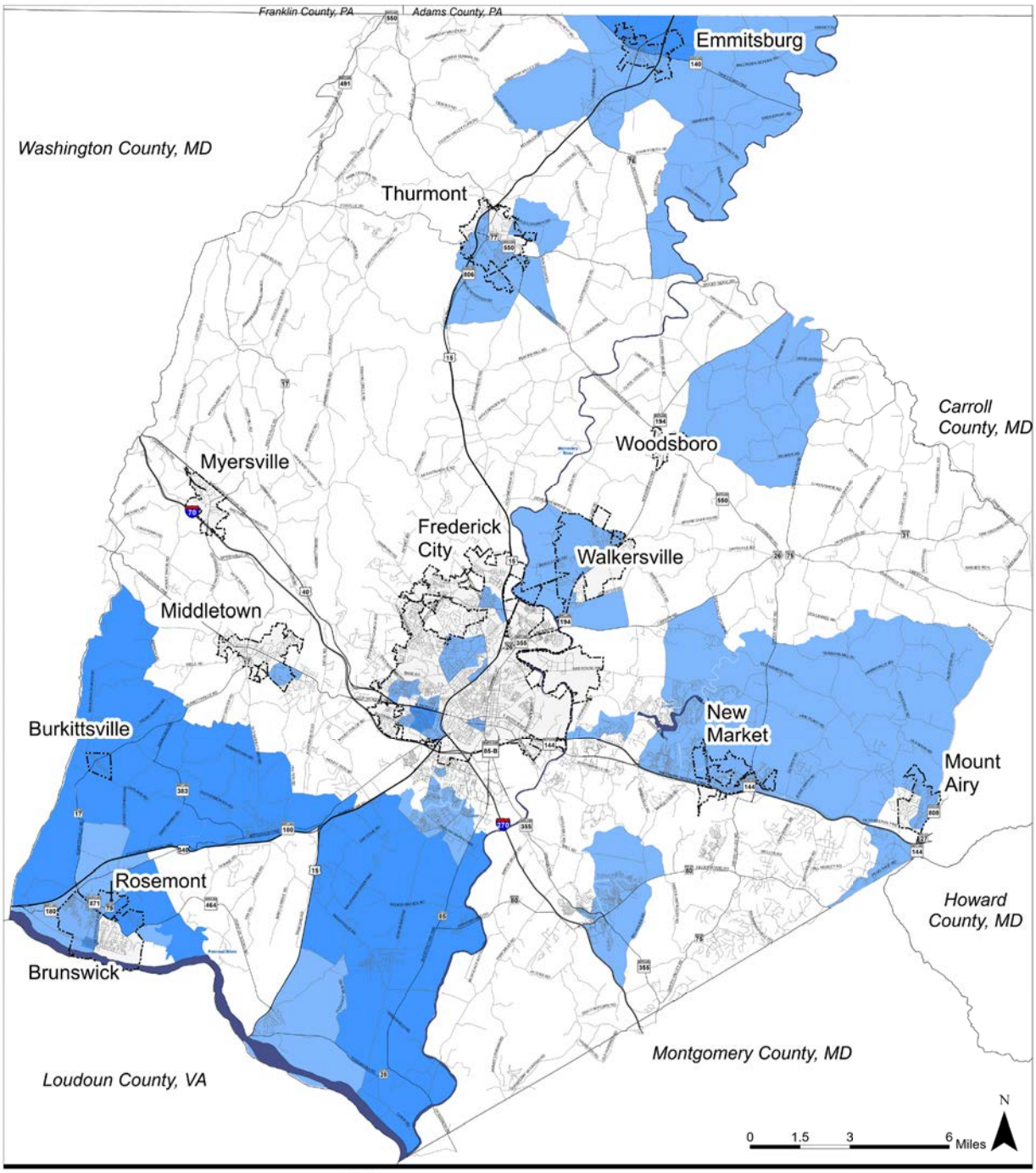
Access to nature and outdoor recreation opportunities have a well-studied history of positive impacts on human health. Studies have indicated that the visual presence of trees can help people recover from acute stress and that increasing tree canopy cover in a community has been associated with reduced risk of diabetes, hypertension, and cardiovascular disease. Additionally, studies have shown how critical unstructured time spent outdoors is to growing children. It can improve cognitive function and has been shown to reduce symptoms of attention deficit/hyperactivity disorder (ADHD) in children across a wide range of individual, residential, and other case characteristics.

The Livable Frederick Master Plan recognizes that preserving natural lands and ensuring residents have access to nature—through parks, open spaces, and healthy environments—strengthens community health, environmental quality, and overall livability. As noted in the description of the Equity of Accessibility Core Principle, this Sub-Sector looks at factors involving the physical siting of parks, trails, and other types of green space throughout communities, in ways that could promote inclusivity through proximity.

To map the Environmental Equity Sub-Sector, the following sources of data were utilized:

Maryland Greenspace Equity – Overburdened Communities: To address disparities in access to nature, the Maryland Department of Natural Resources created the Greenspace Equity Program, which funds projects that preserve, create, and enhance public greenspace in these areas. Through grants to land trusts, nonprofits, and local governments, the state seeks to expand green infrastructure in communities most affected by environmental stressors and least served by recreational space. The program relies on mapped, state-defined, overburdened communities (at the census tract level) where three or more environmental health indicators—such as air pollution, hazardous waste proximity, or asthma rates—rank above the 75th percentile statewide.

Maryland Park Equity Mapping: The Maryland Department of Natural Resources launched the Park Equity Mapping initiative to address disparities in access to green spaces across the state. In collaboration with the University of Maryland School of Public Health, the Department developed a data-driven tool that identifies communities with limited park access and environmental challenges. This effort began as part of Maryland's Project Green Classrooms, aiming to connect underserved populations with nature and



Map 19: The Environmental Equity Sub-Sector Map

Municipality

Rivers and Lakes

Greenspace Equity (MD DNR)

Overburdened

Overburdened and Underserved

Park Equity Total Score (UMD)

Park Equity Score Range

0.300001 - 0.45

promote environmental stewardship. By integrating environmental justice metrics and local demographic data, the DNR seeks to guide park planning and resource allocation to ensure equitable access for all Maryland residents. Data for Park Equity was aggregated and processed at the census block level but has been analyzed at the tract level to be consistent with the scale of analysis for the Green Space Equity program.

Environmental Equity Sub-Sector Discussion

Specifics regarding the sources of data used in establishing the Environmental Equity Sub-Sector are discussed in more detail in Chapter 4 of the Green Infrastructure Plan, which focuses exclusively on equitable access to nature and the outdoors in Frederick County. The development of the Equity Sub-Sector is intended to highlight those communities or areas within Frederick County that are currently identified as facing one or more potential burdens or that may have resident populations that could benefit from improved access to nature or recreational opportunities.

The results of Equity Sub-Sector mapping will also be evident in the final Green Infrastructure Network Map in the form of "Green Equity Areas," which will be explained in more detail later in this chapter.

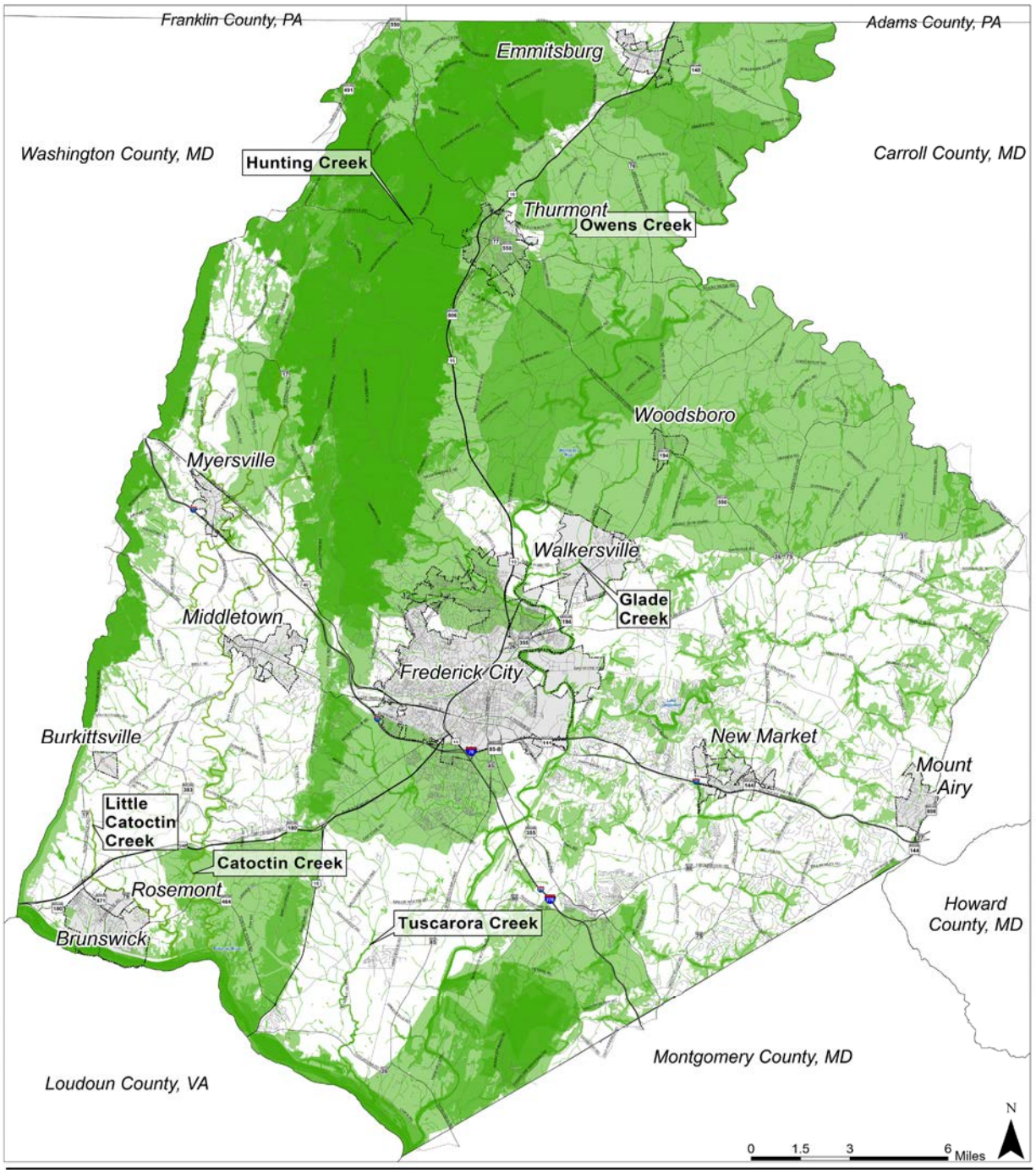
Habitat Connectivity Sub-Sector ("Biodiversity, Wildlife Habitat, and Ecosystem Health" Core Principle)

The LFMP states that, as the amount of developed land has increased in Frederick County, natural areas have not only decreased in quality and quantity but have undergone significant fragmentation. The Green Infrastructure Sector of the Development Framework was identified to support the conservation of natural resources and environmentally sensitive areas in the county, to direct urban/suburban growth away from green infrastructure and sensitive areas, and to ensure the protection and integration of green infrastructure where it exists within areas potentially targeted for growth.

While green infrastructure networks may contain a wide variety of environmentally sensitive resources, their primary natural features are mountains, forestlands, wetlands, stream valleys, and floodplains. These function together to conserve the natural ecosystem, sustain clean air and water, and provide a wide array of benefits to people and wildlife, such as storing and cycling nutrients; filtering and cooling water in streams and aquifers; conserving and generating soils; sheltering animals and insects that pollinate crops and other plants; sequestering carbon and purifying the air; protecting areas against storm and flood damage; and providing wildlife habitat. As noted elsewhere in the Plan, these natural features are located on federal, state, county, and municipal parkland, in conservation easements, and also on privately owned property.

The goal of the Habitat Connectivity Sub-Sector is to identify those areas within Frederick County that possess one or more unique criterion that make them suitable for retention as natural areas. Several of the different layers considered of the Habitat Connectivity Sub-Sector have been discussed previously in this plan. A full list of the layers utilized includes the following:

Audubon Important Bird Areas: As discussed in Chapter 2, Audubon identifies and protects Important Bird Areas (IBAs) to conserve habitats critical for breeding, migration, and survival of bird species. Three IBAs are mapped by Audubon in Frederick County.



Map 20: The Habitat Connectivity Sub-Sector Map

List of Layers

Brown or Rainbow Trout Present
Brook Trout Present
Tier II Watersheds
Maryland Green Infrastructure Hubs & Corridors
Audubon Owned Parcels
Stronghold Owned Parcels
Lake Linganore Common Area
Targeted Ecological Areas
Audubon Important Bird Area
Lilypons

Wetlands
Significant Streams & Rivers
Municipalities

Projection: NAD 1983 State Plane Maryland FIPS 1900 FeetWhile efforts have been made to ensure the accuracy of this map, Frederick County accepts no liability or responsibility for errors, omissions, or positional inaccuracies in the content of this map. Reliance on this map is at the risk of the user. This map is for is. Printed

Maryland Trout (Coldwater) Watersheds: As discussed in Chapter 2, Maryland actively protects coldwater trout watersheds to preserve habitats for native brook trout and other coldwater species. The state designates these streams under Use Class III and IV to maintain strict temperature standards and support healthy aquatic ecosystems.

Tier II Watersheds: Maryland actively protects Tier II watersheds, which contain high-quality streams with water quality significantly better than required standards. The state conducts antidegradation reviews to prevent pollution from permitted activities and ensure these waters maintain their ecological integrity.

Wetlands (National Wetland Inventory, MD DNR): The U.S. Fish and Wildlife Service (USFWS) established the National Wetlands Inventory (NWI) to map and monitor the nation's wetland and deepwater habitats. Through its Wetlands Mapper tool, USFWS relies on trained image analysts to identify and classify habitats from aerial imagery and provides geospatial data to support conservation, planning, and environmental decision-making.[95] The Maryland Department of Natural Resources also maintains mapping for wetlands throughout the state, with a focus on Wetlands of Special State Concern (WSSCs). DNR mapped wetlands are also included in this data layer and WSSCs in Frederick County are discussed in the Appendices of this Plan.

Targeted Ecological Areas: Maryland's Department of Natural Resources designates Targeted Ecological Areas (TEAs) to prioritize conservation of the state's most ecologically valuable lands and watersheds. These areas support rare species, protect water quality, and provide critical habitat connectivity. TEAs are mapped by the Maryland Department of Natural Resources.

Hubs and Corridors (Maryland Habitat Connectivity Network, 2024): Maryland's Department of Natural Resources developed the Habitat Connectivity Network (HCN) to identify and protect the state's most vital natural areas and the corridors that link them. By mapping large intact habitat hubs and the forested, aquatic, and wetland corridors that connect them, the state actively supports wildlife movement, ecosystem resilience, and climate adaptation. The HCN network builds on the prior Maryland Green Infrastructure Assessment and uses high-resolution land cover data to guide conservation planning, restoration efforts, and land protection priorities. It should be noted that "gaps" from the HCN are not mapped in this Sub-Sector.

Significant County Surface Waters (Catoctin Creek, Little Catoctin Creek, Tuscarora Creek, Glade Creek, Big Hunting Creek, Owens Creek, Ballenger Creek, the Potomac River, and the Monocacy River): These waterways were identified in work with the Green Infrastructure Advisory Group as having significant habitat or recreational value in Frederick County, and they include:

- The Potomac River and the Monocacy River are two significant regional waterways that provide a variety of recreational opportunities and support a variety of wildlife. Their ample floodplains result in wide, forested buffers in certain areas in the County, which function as both hubs and corridors.
- Catoctin Creek and Little Catoctin Creek form a central corridor in the heart of the Middletown Valley, connecting the Potomac River to the Catoctin Creek Nature Center, the Town of Middletown, and Gambrill State Park.
- Big Hunting Creek and Owens Creek connect the Monocacy Scenic River to the Town of Thurmont and Cunningham State Park and Catoctin Mountain Park.

- Glade Creek connects the Town of Walkersville and Fountain Rock Nature Center to the Monocacy Scenic River. Once a limestone quarry and later a trout hatchery, Fountain Rock Park includes a natural spring, known as Fountain Rock Spring. It releases up to 3.25 million gallons of water per day that flow a short distance west to the Monocacy Scenic River.[96]
- Tuscarora Creek: In May of 2024, the Quantum Frederick campus broke ground on a 600-acre nature reserve near Adamstown, Maryland. Upon completion, the reserve is intended to feature one million trees to provide a visual screen for the campus and improve carbon sequestration. Tuscarora Creek represents a potential riparian corridor connecting the future reserve to the Potomac River.

The significant surface waters listed above have been buffered to an approximate total width of 300 feet (USDA recommended minimum dimension for large mammal migration) as part of the Sub-Sector mapping to reflect their potential importance as corridors in the Green Infrastructure Network.

Significant County Natural Features (Sugarloaf Mountain, Lake Linganore, Lake Marion, Lake Merle, Lake Anita Louise, and Lilypons Water Gardens): Sugarloaf Mountain, the lakes that comprise Lake Linganore, and Lilypons Water Gardens were identified by the Green Infrastructure Advisory Group as unique, regionally significant hubs for both habitat conservation and recreation. Visitors can hike Sugarloaf's rugged trails for panoramic views, and residents of a neighboring planned community can paddle or picnic around the man-made Lakes of Linganore without the need to drive. Just south in Adamstown, Lilypons Water Gardens once welcomed guests to explore aquatic plants and wetlands across 250 acres, blending horticulture with habitat. Prior to closing, this state-significant birding hotspot was approved for a conservation easement under the Maryland Rural Legacy Program in 2024. While the future of the property is yet to be determined, the presence of the conservation easement ensures its continued function as significant wildlife habitat in the future.

Habitat Connectivity Sub-Sector Discussion

Mapping associated with the Habitat Connectivity Sub-Sector reinforces important topics raised previously in this green infrastructure plan, particularly those addressed in Chapter 2 of the Plan. By looking at the coincident occurrence of certain features, the mapping methodology highlights important interrelationships between the County's unique geology, landform, hydrology, and plant communities. The map is intended to illustrate those areas within the County where a concentration of unique or significant resources, necessary to support both "resident" and migrating wildlife can be found.

The importance of the Blue Ridge foothills and the first of the Appalachian Ridges, including Catoctin Mountain and South Mountain, to wildlife (and especially birds), as natural corridors to migrate and access critical habitats for breeding, foraging, and overwintering is readily apparent in the confluence of many different data layers on the map. Significant, concentrated areas of uninterrupted forest habitat, coupled with high-elevation, small-order, cold water streams near ridgelines form two very important migratory corridors from the Potomac River to the northern limits of the County.

Within the rolling piedmont hills and the lowlands of the Frederick Valley and the Middletown Valley, the importance the Monocacy River, Catoctin Creek, Linganore Creek, and contiguous public, semi-public, and privately held lands—such as the former site of Lilypons, the Monocacy Natural Resources Management Area, community held land around Lake Linganore, and a matrix of properties east of the historic Thomas

Farm (Araby) near Bush Creek—create a matrix of green space that maintains ecological connectivity to the East of the City of Frederick.

The Habitat Connectivity Sub-Sector also highlights the importance of northeastern Frederick County as a hub for grassland bird species and for other ecological resources highlighted by the State of Maryland in GreenPrint mapping around the communities of Fourpoints and Creagerstown, both of which are in Stronghold Watersheds. Stronghold watersheds are watersheds containing streams and rivers with high abundance or diversity of species of stream-dwelling fish, amphibians, reptiles, and mussels in Maryland.[97]

As the Green Infrastructure Network Map will illustrate, the Habitat Connectivity Sub-Sector is the single largest contributing Sub-Sector to mapped green infrastructure Frederick County. In many ways, this reflects the geographic, geologic, and hydrologic significance of Frederick County and the fact that natural lands provide so many ecosystem services to all of the County's residents—as listed at the outset of the discussion of this Sub-Sector.

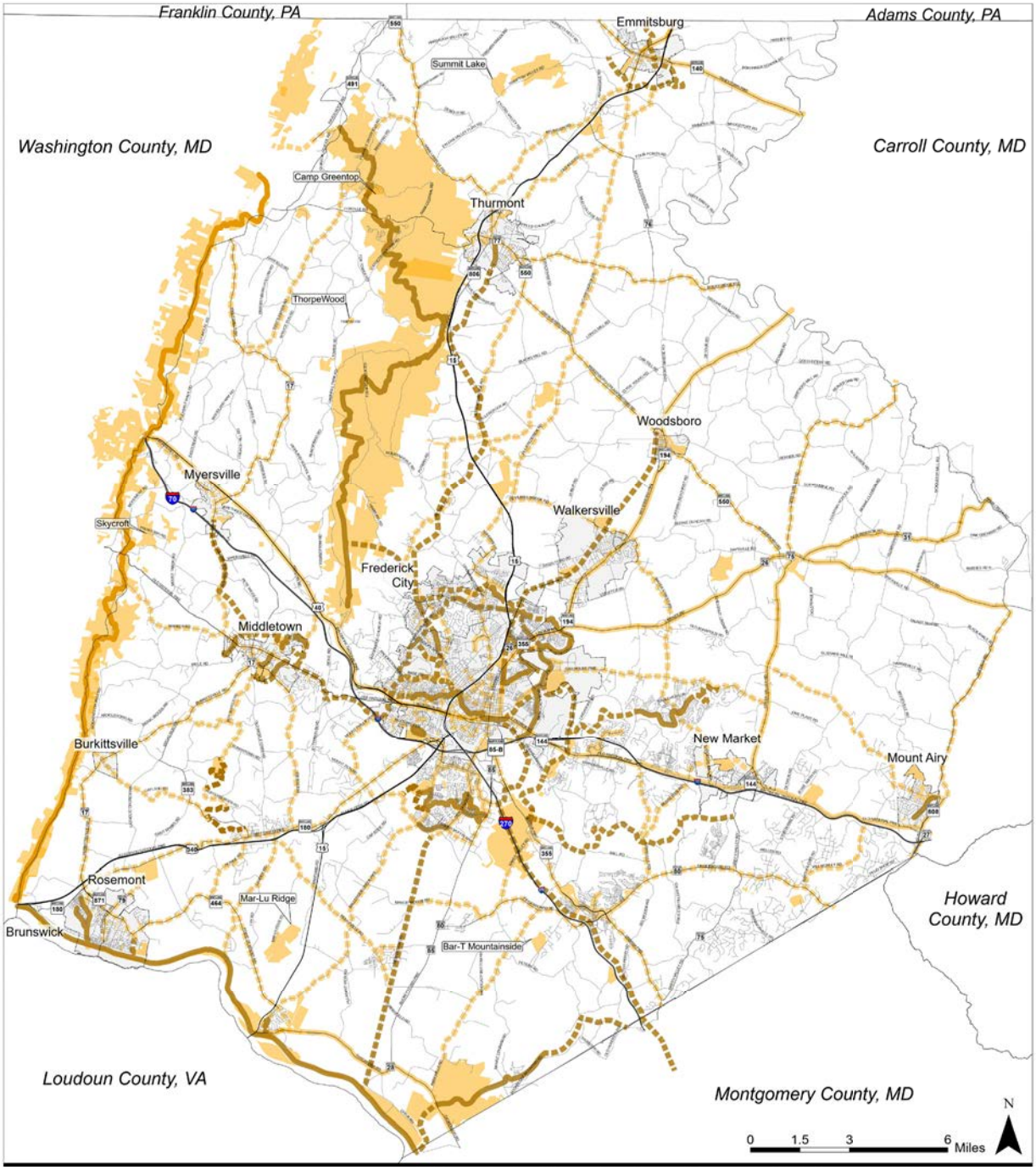
Outdoor Recreation & Education Sub-Sector ("Public Health, Outreach, and Education" Core Principle)

The Livable Frederick Master Plan describes the importance of parklands and open space to the physical and mental health of County residents and to their quality of life. The Outdoor Recreation and Education Sub-Sector is intended to illustrate the geography of the County's primary outdoor recreation facilities and to illustrate the status of multi-modal connections between existing population centers and those facilities. Beyond just parkland, this sector also considers those privately owned and operated facilities in Frederick County dedicated to helping residents and visitors develop a more deep and meaningful connection with the natural environment and a better understanding of their relationship with it. The following data layers and facilities are included in this Sub-Sector:

County Designated Bikeways and Trails: Current and planned bikeways and trails from the County's multi-modal transportation planning efforts have been carried over from the Multi-Modal Accessibility Sub-Sector to indicate the existing and proposed degree of multi-modal connectivity between communities and outdoor recreation and education facilities.

Parks (Federal, State, County, & Municipal): As described in Chapter 2 of this Plan, the County's federal, state, County, and municipal parks play a vital role in strengthening communities by providing accessible spaces for recreation, relaxation, and connection with nature. They actively support physical and mental health, offer safe gathering places for families and neighbors, and preserve green space in urban and rural settings. Parks also promote environmental stewardship by protecting wildlife habitats, improving air and water quality, and serving as living classrooms for outdoor education. When communities invest in public parks, they invest in resilience, equity, and quality of life.

Green Infrastructure Advisory Group Linkages: The Green Infrastructure Advisory Group identified several potential bike and pedestrian connections that have been discussed at the grassroots level. In certain locations, these connections establish new routes between communities and outdoor recreation destinations or extend already mapped routes from the Bikeways and Trails Plan to create cross-county or regional, multi-modal connections that focus on bicycling and hiking.



Map 21: The Outdoor Recreation & Education Sub-Sector Map

County Bikeways & Trails (Off-Street)
- Proposed Off-Street Bikeways & Trails
- Existing Off-Street Bikeways & Trails

County Bikeways & Trails (On-Street)
- Proposed On-Street Bikeways & Trails
- Existing On-Street Bikeways & Trails

GI Advisory Group Recreation Connections, Proposed
- Proposed Off-Street Bikeways & Trails
- Proposed On-Street Bikeways & Trails

Parks & Educational Facilities
- Parks & Educational Facilities
- Environmental Education Facilities

Appalachian National Scenic Trail

Environmental Education Facilities: Frederick County, Maryland is home to a diverse array of day camps and environmental education facilities that actively connect youth and families with nature, history, and community. These programs foster environmental literacy, personal growth, and outdoor adventure across the county's mountains, forests, and farmland. The facilities include:

- Camp Greentop: Located in Catoctin Mountain Park, Camp Greentop has served children and adults with disabilities since 1937. Operated by The League for People with Disabilities, the camp offers accessible cabins, nature trails, and a wheelchair-friendly swimming pool. Campers engage in hiking, crafts, and team-building activities while immersed in the park's historic WPA-built rustic architecture. Facilities can also be rented for extended-stay events, accommodating up to 150 people.
- Summit Lake: Summit Lake Camp is located near Emmitsburg, MD, and spans 200 wooded acres with a five-acre lake. The camp hosts environmental education programs, outdoor recreation, and Christian retreats. Groups explore aquatic ecosystems, hike forest trails, and enjoy seasonal activities like snow tubing and boating. Lodges and a conference center also support overnight stay.
- Mar-Lu-Ridge Camp & Retreat Center: Perched in the Catoctin Mountains near Jefferson, Mar-Lu-Ridge offers summer camps and year-round retreats focused on community, service, and sanctuary. The center provides outdoor ministry programs, confirmation retreats, and inclusive activities for all ages. Its campus includes cabins, a lodge, and the Ridge Inn for overnight stay.
- Bar-T Mountainside Education & Enrichment: Located on 115 acres of forest and meadow near Urbana, Mountainside offers immersive programs in agriculture, stream ecology, and renewable energy systems. Mountainside partners with Bar-T Ranch (of Montgomery County) to host summer camps that combine STEM learning with outdoor play, and their "Lunch Out of Landfills" initiative teaches students how to reduce food waste through composting and recovery programs.
- ThorpeWood: Nestled 1,500 feet up in the Catoctin Mountains near Thurmont, ThorpeWood provides nature-based mental health and environmental education programs on its 156-acre sanctuary. The center offers free ecotherapy retreats, grief support hikes, and animal-assisted learning for underserved populations. Its timber-framed lodge and sustainably designed facilities host workshops, community events, and educational programs that reconnect people with nature. Trails, trout streams, and open-air classrooms create a peaceful setting for healing and discovery.
- Frederick County's Nature Centers: Catoctin Creek and Fountain Rock host hands-on programs that teach ecological stewardship through trail hikes, wildlife observation, and sustainability workshops. Mountainside Education & Enrichment partners with local schools to deliver immersive lessons on pollinators, wetlands, and renewable energy2. The Sabillasville Environmental School blends classical education with agricultural and environmental science, using greenhouses and outdoor classrooms to foster environmental literacy. Mobilize Frederick also supports schools in becoming certified Maryland Green Schools by connecting educators with local parks and sustainability experts.
- South Mountain Inn - In July 2023, the Maryland Department of Natural Resources (DNR) acquired a 3.15-acre property bisected by the border of Frederick and Washington Counties, which includes the Old South Mountain Inn, through Program Open Space funding. The state plans to repurpose the historic stone building—once a tavern, restaurant, and Civil War headquarters—into a regional visitor center. This center will feature interpretive exhibits focused on the Battle of South Mountain and the broader historical significance of the area.

- Day Camps (Located in County Park Facilities): Frederick County Parks and Recreation offers over 300 summer camps, including nature, history, science, and arts-based programs. Camps like Catoctin Creek Nature Camp and Monocacy Day Camp provide full-day outdoor experiences for children of all ages. The YMCA of Frederick County runs more than 40 themed camps—from archery and canoeing in the Catoctin Mountains to arts, swimming, and leadership development at its downtown and Natelli Family branches.

Outdoor Recreation and Education Sub-Sector Discussion[98]

The purpose of this Sub-Sector Map is to illustrate the extent and distribution of park and environmental education facilities throughout the County and to depict the degree of connectivity between these facilities and population centers. When people have access to camps and parks, they move more, spend more time outside, and enjoy better physical and mental health. Many of these facilities also serve as living classrooms, where trails, nature centers, and volunteer opportunities help residents learn about and care for the environment.

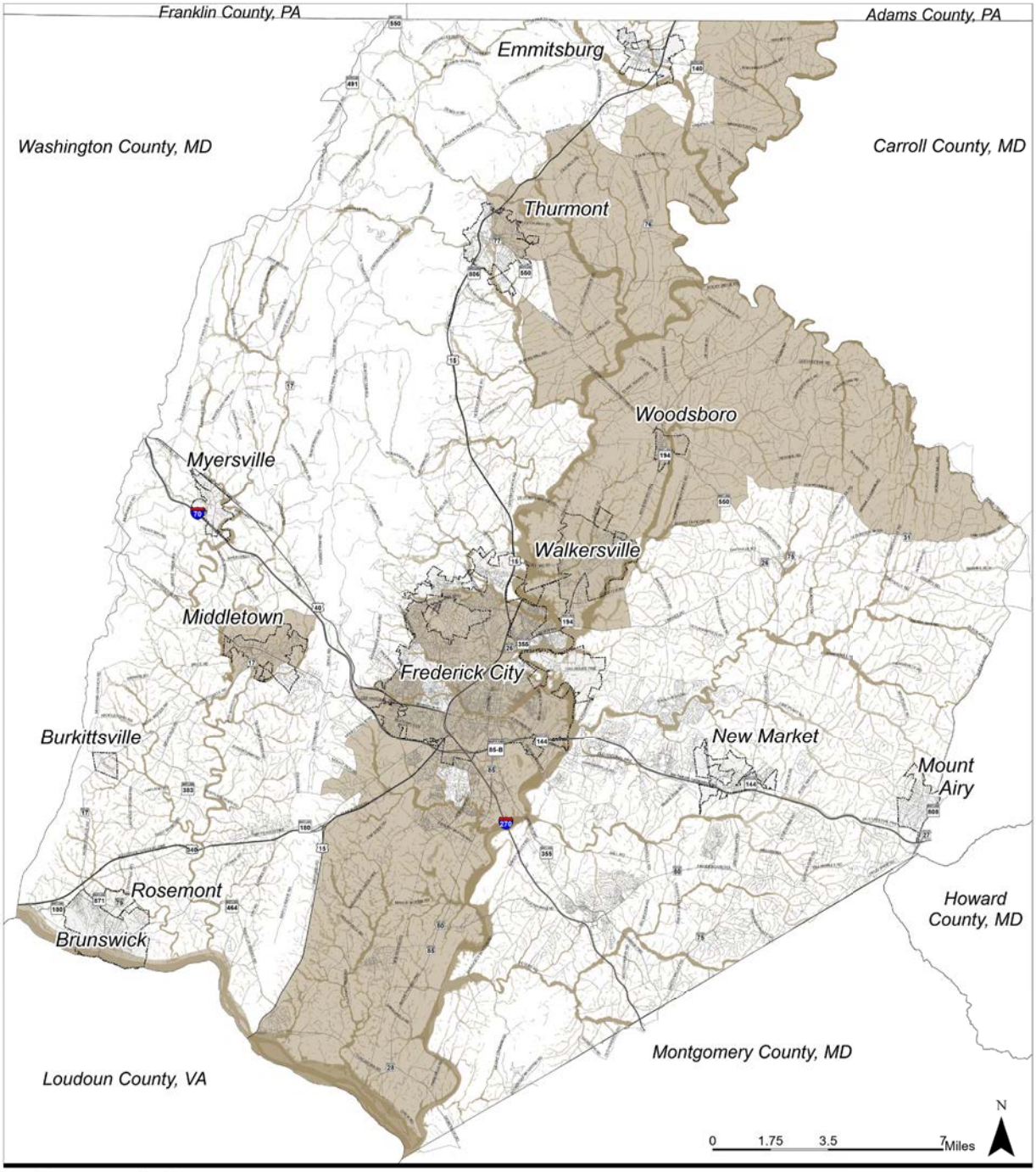
Day or extended-stay camps and environmental education programs extend these opportunities even further. Summer camps and nature-based programs give children hands-on experiences that deepen their understanding of the natural world. At places like Catoctin Creek and Fountain Rock Nature Centers, students learn about local ecosystems by wading in streams, hiking trails, and caring for the land. Residential programs, such as Catoctin Quaker Camp, immerse campers in wilderness adventures that build resilience, confidence, and a lifelong connection to nature. Frederick County's Division of Parks and Recreation has also worked to improve overall accessibility by building inclusive playgrounds, sensory trails, and ADA-compliant facilities, ensuring that everyone—regardless of age or ability—can enjoy the outdoors.

Though the Livable Frederick Master Plan does not specifically name outdoor camps or environmental learning programs, it envisions a future for Frederick County where people thrive—where they play, learn, and grow in settings rich with natural resources. By valuing parks, healthy environments, and inclusive access, the Green Infrastructure Plan implies that outdoor education and immersive experiences not only lead to improved health outcomes but also help develop an understanding of nature and natural processes that will help bolster considerations for natural systems and their integration into communities.

Climate Mitigation Sub-Sector ("Climate Change, Sustainability, and Long-Term Management" Core Principle)

Rising heat and intensifying storms are two of the most dangerous consequences of climate change, and they're reshaping life across Maryland and in Frederick County. As greenhouse gas emissions trap more heat in the atmosphere, average temperatures climb, fueling more frequent and severe heat waves. These extreme heat events strain public health systems, increase energy demand, and dry out soil setting the stage for droughts and wildfires. More developed areas in the County can also suffer from the "heat island effect," where concrete and asphalt absorb and retain heat, making these areas significantly hotter than more rural parts of the County.

At the same time, increased atmospheric moisture couples with heated air masses to supercharge storms. Throughout the southern and eastern United States, hurricanes and now intensify more rapidly, carry stronger winds, and drop heavier rainfall than in previous decades. The same can be said for severe rainstorms and thunderstorms in central Maryland and in Frederick County. Meteorologists have observed a growing number of Category 4 and 5 hurricanes—some of which are stalling over land—unleashing days of destructive rain and wind.[99]



Map 22: The Climate Mitigation Sub-Sector Map

FEMA 100 Year Floodplain

Pluvial Floodplain (2022)

Census Tracts with <30% Average Tree Canopy

The Green Infrastructure Plan acknowledges that these changes to Frederick County's climate aren't just theoretical. They're already happening, and they're accelerating. As the planet warms, the risks from heat and storms will continue to grow, demanding urgent action to reduce emissions and build climate resilience.

The following mapped features have been identified as areas that may be particularly susceptible to the effects of a changing climate and could be prioritized for the implementation of green infrastructure practices to mitigate harmful effects or improve resilience. Those areas of the County where two one more of these layers overlap represent areas that could be particularly susceptible to climate change vulnerabilities, and efforts to set aside land or to increase urban and rural forests could prevent flood-related damage, increase shade and combat the heat island effect, sequester additional carbon, and intercept, infiltrate, and transpirate stormwater.

FEMA 100-Year Floodplain: Protecting floodplains is to reduce flood risks and support resilience. Floodplains absorb and slow excess water during storms and help to prevent downstream flooding and erosion. As storms intensify the frequency of extreme weather events increase, intact floodplains serve as critical buffers for communities and built infrastructure. The Federal Emergency Management Agency (FEMA) floodplain follows the contours of waterways and low-lying riparian lands, like those along the Potomac River, the Monocacy River, Linganore Creek, and Carroll Creek denoting areas subject to recurring inundation, especially during heavy rain or storm surge.

Beyond flood control, healthy floodplains recharge groundwater, filter pollutants, and support biodiversity. When we preserve or restore these areas, we strengthen the land's ability to manage water naturally—reducing the need for costly engineered solutions and enhancing long-term climate adaptation.

Pluvial Floodplain (Frederick County Hazard Mitigations and Climate Action Plan, 2022): In contrast to the FEMA 100-Year Floodplain that follows creeks, streams, and rivers, pluvial floodplains are often found in urban and suburban areas, particularly those with undersized or overwhelmed drainage systems, where rapid precipitation overwhelms infrastructure and poses threats even far away from FEMA floodplain boundaries. Pluvial floodplains play a critical role in emergency management, especially as climate change drives more frequent and severe storm events. If properly designed, these floodplains can absorb and temporarily store stormwater runoff, reducing the speed and volume of water that could otherwise overwhelm urban drainage systems.

Recognizing and mapping pluvial floodplains allows emergency managers and first responders to anticipate flood-prone zones, coordinate evacuation routes, and deploy resources more effectively. As urbanization increases and climate patterns shift, integrating pluvial floodplain protection into hazard mitigation plans becomes essential for safeguarding lives and building climate-resilient communities. Targeting areas identified as high pluvial flood risks with the implementation of green infrastructure practices, like those described earlier in this chapter for stormwater and tree canopy expansion is another way to help build climate-resilient communities.

Census Tracts Under 30% Tree Canopy Cover: Tree canopy plays a critical role in mitigating climate change and reducing urban heat through a combination of shading, evapotranspiration, and carbon sequestration. Trees intercept solar radiation, directly lowering ground or building surface temperatures

Image 27: A FEMA Flood Hazard Map for the Monocacy River near the South Frederick Corridors Planning Area and the Monocacy MARC Station. (Panel 294 of 507)

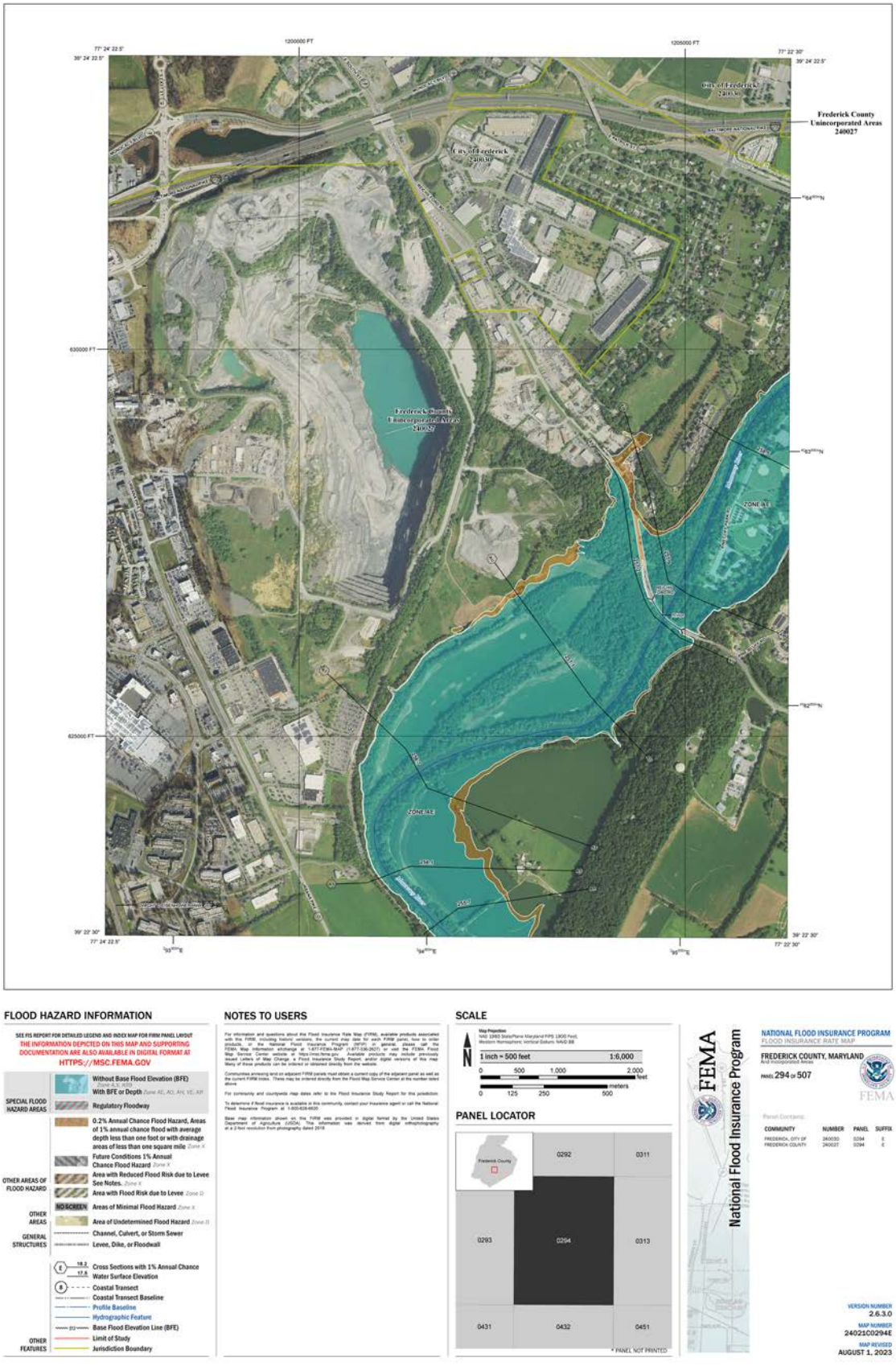


Image Credit: FEMA (https://msc.fema.gov)

and air temperatures, which reduces the urban heat island effect and decreases energy demand for cooling. Through photosynthesis, trees also capture and store atmospheric carbon dioxide, contributing to greenhouse gas mitigation.[100,101] Communities that strategically expand and maintain tree canopy can both adapt to and mitigate climate change impacts and can potentially reduce heat-related illness and mortality, especially in vulnerable neighborhoods.[102]

The 30% canopy cover threshold was selected for this Sub-Sector based on the "3-30-300 Rule," which offers a helpful framework for designing healthier, greener communities. Developed by urban forestry expert Dr. Cecil Konijnendijk, the rule sets three clear goals: every person should be able to see at least 3 trees from their home, workplace, or school; live in a neighborhood with at least 30% tree canopy; and be no more than 300 meters from a public green space. Studies show that 30% canopy coverage is a critical threshold for lowering mortality rates, preventing chronic disease, and enhancing childhood development.[103] The 3-30-300 Rule is also described in more detail in Chapter 4 of the Green Infrastructure Plan—as it specifically relates to the concept of environmental equity.[104] While a higher percentage of tree canopy cover would likely provide more benefits from a heat mitigation standpoint, the 30% threshold is seen as a target that is more readily achieved in the near term. Pursuing a higher target, wherever possible, would be in accordance with ideas and principles set forth in the Green Infrastructure Plan.

Climate Mitigation Sub-Sector Discussion

The intent of this Sub-Sector map is to highlight those areas of the County that could see the most impacts from a changing climate and in which green infrastructure measures may be able to provide some measure of increased resiliency.

The primary mechanism for addressing issues related to flooding in the County is Frederick County's Hazard Mitigation and Climate Adaptation Plan (HMCAP). It actively maps and analyzes two distinct flood-risk zones: the FEMA-regulated floodplain and the pluvial floodplain, which identifies local areas vulnerable to surface runoff or flash flooding during intense short-duration rainfall events. The HMCAP illustrates how these two flood types interact, noting that many neighborhoods face compounded risk when they fall within both jurisdictions or when pluvial flooding channels into FEMA-defined floodplains, increasing danger to homes, roads, and critical facilities.

As development continues, the HMCAP considers how dense suburban corridors and historic downtown pockets—where impervious surfaces and stormwater infrastructure limitations coincide—as zones of most concern for residents. Incorporation of these areas into mapping of this Sub-Sector is intended to highlight the role that green infrastructure measures can play in mitigating one or both types of flooding in communities. Additionally, and particularly regarding naturally occurring floodplains, the Green Infrastructure Network map may highlight locations where these areas can function as recreational or habitat corridors within communities, providing multiple ecosystem services.

In analyzing the extent of census tracts with less than 30% mapped tree cover in the County, the Sub-Sector map also illustrates where additional efforts targeting the establishment of rural or urban tree canopy could help address heat islands in an urban condition while also providing some of the important benefits for storm mitigation provided by trees that were discussed earlier in this chapter. In more rural areas, additional tree canopy can provide many of the important functions highlighted in the discussion of riparian buffers.

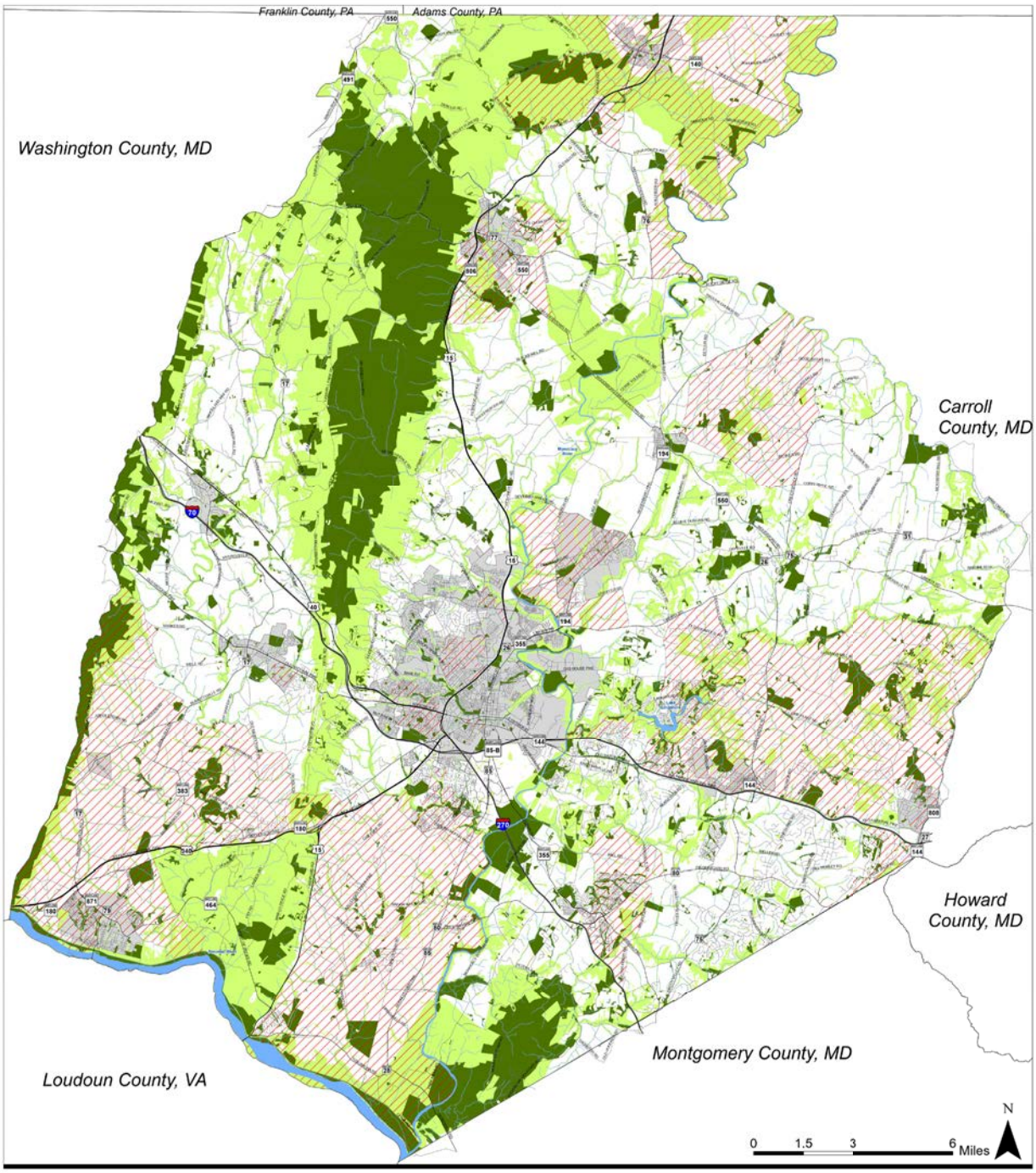
Overall Green Infrastructure Network Map (Green Infrastructure Sector)

The Green Infrastructure Network Map is derived from each of the various Sub-Sectors, and is intended to organize and highlight the most important issues identified by each Sub-Sector. While each Sub-Sector map performs an important function, and aids in the discussion of multi-modal accessibility, access to nature and the outdoors, the location and connectivity of natural habitat, access to recreational opportunities, and those lands within Frederick County where prioritizing green infrastructure could help improve community resilience to climate change, the overall network map is intended to perform three important functions:

1. Highlight those areas that are prime candidates for one or more of the green infrastructure practices highlighted throughout this document. As discussed throughout this Plan so far, there are a wide variety of practices that can be considered green infrastructure, and they can provide an array of benefits—from habitat creation, to air quality improvement, to stormwater management, to helping alleviate stress in the resident population or a myriad of other health impairments. Lands highlighted for inclusion in the Green Infrastructure Network have been selected because they can perform one or more of these important functions and provide beneficial ecosystem services to the County.

2. Track the County's progress toward preserving land and implementing green infrastructure throughout Frederick County. The Green Infrastructure Network Map has been compiled in a manner that highlights those areas that can contribute to achieving one or more goals for the Green Infrastructure Plan. A periodic reassessment of the Green Infrastructure Network and the Green Infrastructure Network Map will be identified as a recommendation later in this plan. During this reassessment, it will be possible to see how successful the public and private sector have been in preserving additional land or in implementing more green infrastructure measures. As the map evolves, it may also aid planners in identifying priority areas for future efforts to increase the size of habitat hubs, eliminate gaps and improve the connectivity of corridors, more equitably allocate green space, or improve resilience in our communities.

3. Illustrate the relationship between the Green Infrastructure Sector (as portrayed by the Green Infrastructure Network) and the Agricultural Infrastructure Sector in Frederick County. In the Livable Frederick Master Plan, the Green Infrastructure Sector and the Agricultural Infrastructure Sector recognize the important role that natural AND working lands play in the maintaining the quality of life in Frederick County. Together, they represent an important thematic counterweight to the Primary and Secondary Growth Sectors. A version of the overall Green Infrastructure Network Map combines both sectors to provide a complete snapshot of both land preservation efforts in Frederick County.



Map 23: The Frederick County Green Infrastructure Network Map

Unprotected Land in Network

Protected Land in Network

Green Equity Area

Composition of the Green Infrastructure Network

The following components from the Sub-Sector maps, as listed in Table 5, were utilized to create the Green Infrastructure Network Map for Frederick County.

Table 6: Green Infrastructure Network Map Data Layers

Sub-Sector Name	Environmental Equity Sub-Sector (See Description of Green Equity Areas)	Habitat Connectivity Sub-Sector	Outdoor Recreation & Education Sub-Sector	Climate Change Sub-Sector
Mapped Layers	Overburdened Census Tracts (Per MD Environment Article, §1–701) Census Tracts with "Low" Park Equity Score (MD DNR Park Equity)	Tier II Watersheds Wetlands (National Wetland Inventory) Targeted Ecological Areas Hubs and Corridors (Maryland Habitat Connectivity Network) Significant County Surface Waters (Catoctin Creek, Little Catoctin Creek, Tuscarora Creek, Glade Creek, Big Hunting Creek, Owens Creek, Ballenger Creek, the Potomac River, and the Monocacy River Significant County Natural Features (Sugarloaf Mountain, Lake Linganore, Lake Marion, Lake Merle, Lake Anita Louise, and the former Lilypons Water Gardens)	Parks (Federal, State, County, Municipal) and Environmental Education Facilities	FEMA 100-Year Floodplain

Sub-Sector Mapping Layers Excluded from the Network

In developing the final Green Infrastructure Network Map, Livable Frederick Staff determined that certain data layers necessary to the various Sub-Sector discussions did not lend themselves to the intended function of the Green Infrastructure Network Map. These data layers will be retained as part of the appropriate Sub-Sector Maps—to provide important background and context—but they will not be depicted on the Green Infrastructure Network Map. The following list identifies the specific layers include a rationale for why those layers that have not been carried forward from Sub-Sector mapping.

- Data from the Multi-Modal Accessibility Sub-Sector, including transitways, bikeways, and trails, was not incorporated into the green infrastructure network for two main reasons. First, although these facilities are long in length, their narrow footprint limits their function as standalone green infrastructure. They can supplement green infrastructure initiatives when integrated with other practices but typically do not provide green infrastructure benefits beyond the facilitation of access. Second, the County's Bikeways and Trails Plan already serves as the primary tool for tracking and implementing bike and pedestrian infrastructure. Incorporating recommendations from the Green Infrastructure Plan into the Bikeways and Trails Plan remains a viable strategy for advancing goals related to multi-modal accessibility.
- Audubon Important Bird Areas (IBAs) were not carried forward from the Habitat Connectivity Sub-Sector due to their broad mapped extent, especially in the northeastern limits of the County. A case can be made for mapping all IBA lands as appropriate for green infrastructure implementation, but their

inclusion could also obscure more targeted green infrastructure opportunities like wetlands, riparian buffers, or habitat hubs and corridors highlighted by the Maryland Habitat Connectivity Network under the current mapping methodology. This exclusion does not diminish the value of bird habitats in Frederick County. The Plan and Livable Frederick support efforts to enhance and expand bird habitat in all areas of Frederick County.

- Much like IBAs, Coldwater watersheds, were excluded because the broad limits of their mapping could obscure targeted opportunities for inclusion. Tier II catchments have been retained due to specific antidegradation requirements associated with those high quality waters. To address specific high-priority waterways for green infrastructure implementation in the County, the Green Infrastructure Advisory Group identified specific waterways that have been provided with enhanced buffers on the Green Infrastructure Network map. Additionally, other layers like the Habitat Connectivity Network identify important buffers for coldwater streams where they exist.
- Pluvial Floodplain modeling focuses on area where stormwater may accumulate during intense storms, and it includes rooftops of large structures within the County. While identifying pluvial flooding hotspots is important for resiliency planning, the green infrastructure implementation possibilities for rooftops are somewhat limited given the broader focus of the plan.[105]
- Lastly, Census tracts with less than 30% tree cover for their overly broad extent and their potential to obscure more targeted green infrastructure opportunities. These tracts remain highlighted as part of the Climate Mitigation Sub-Sector as areas of need for tree canopy expansion, potential heat island mitigation, and opportunities for the County to increase carbon capture.

Inclusion in the Network

This Green Infrastructure Plan outlines strategies to conserve land, to implement green infrastructure on both undeveloped and developed properties, and to incorporate green infrastructure within established communities. By making a strong case for the benefits of green infrastructure, by significantly expanding the definition and mapped extent of land suitable for green infrastructure, and popularizing the available implementation tools, the plan aims to encourage broader and more voluntary adoption of green infrastructure in Frederick County. Any lands identified for inclusion in the Network are identified on Map 23 in a bright, light green color.

Importantly, and as a result of the expansive nature of the mapping of land suitable for green infrastructure implementation in the County, **the inclusion of a property in the Green Infrastructure Network does not impose any new restrictions, covenants, or limitations on any property beyond existing federal, state, County, or municipal regulations or those conditions imposed through voluntary participation in any current or future conservation or preservation programs.** Instead, it signals that applying one or more green infrastructure practices to a property or properties can help advance Frederick County's goals for sustainability, resilience, and equity. As described in Chapter 1 of this Plan, it can also yield significant economic benefits for property owners and health benefits for the larger community.

A flowchart has been developed that reflects a series of questions to be asked for any property mapped as a potential site for green infrastructure implementation on the Green Infrastructure Network Map. Depicted in Figure 16, the flowchart asks a series of questions intended to ascertain both the value of a property as part of the overall network as well as an owner's or stakeholder's intentions for the property. The flowchart clearly indicates the need to comply with all applicable regulations for land development

and to apply applicable standards for sensitive areas that have been described in Chapter 1 of this Green Infrastructure Plan. It also recognizes that the highest and best use of every property highlighted for inclusion in the network may not be permanent conservation or preservation, but these actions should be considered when and where appropriate.

It is important to acknowledge that the flowchart process only terminates at permanent conservation and preservation, but that it is also possible for any land identified for inclusion in the network to circulate through the various steps in the process repeatedly and for the foreseeable future.

By definition, sustainable communities are not permanently preserved in an unchanging state. Community needs change, regulations change, and the conditions in the local and regional climate change. The relevance, and the importance, of the flowchart is in the decision-making process it communicates to users.

When lands within the mapped Green Infrastructure Network are identified for some type of conservation or preservation measure, either in whole or in part due to voluntary participation or regulatory compliance, the map has been prepared so that these lands can be inventoried as "protected." Subsequent updates to the map will allow for tracking of the expansion of land conservation and preservation measures and could also (in time) allow for the identification of areas of high priority to increase the size of hubs or to potentially close gaps.

As part of the initial mapping of the Network, those lands currently subject to some sort of protective conservation or preservation easement have already been mapped as "protected" in Map 23. Future compliance with applicable ordinances or participation in the following list programs can lead lands being mapped as "protected" on the Map in the future:

- Federal Park Land
- State Park Land
- County Park Land
- Municipal Park Land
- Conservation Reserve Enhancement Program (CREP) Easements
- Maryland Environmental Trust (MET), Catoctin Land Trust (CLT), or other Land Trust Easements
- Forest Resource Ordinance (FRO) Banks and Other Easements
- Audubon Ornithological Sanctuaries
- Creek ReLeaf Easements
- Environmental Education Facilities
- HOA/COA Common Areas with Existing Sensitive Areas and "Recorded" Resource Easements[106]

Figure 16: The Green Infrastructure Network Decision Matrix.

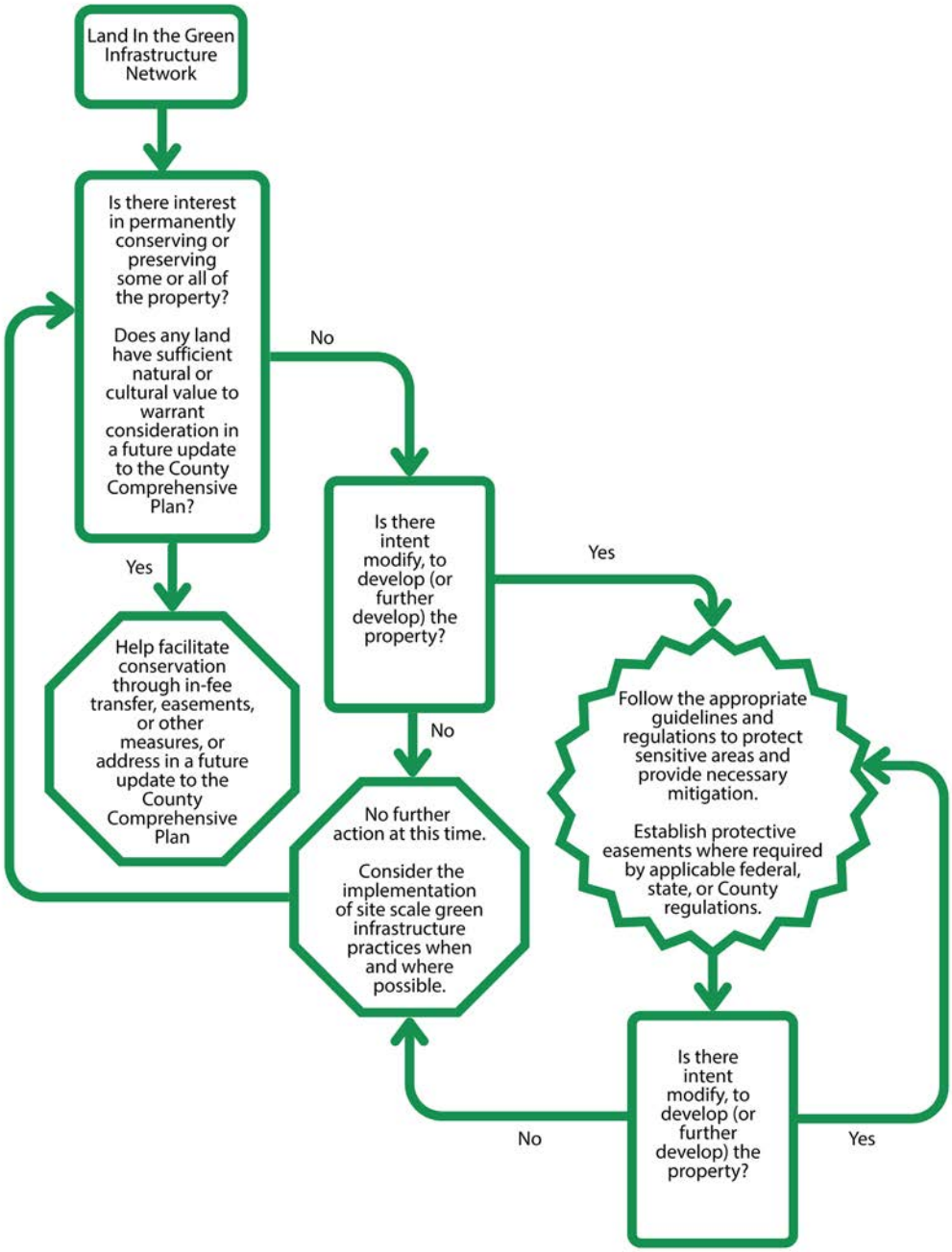


Image Credit: Livable Frederick

Finally, it should be noted that any land—even land outside the mapped Green Infrastructure Network—can be incorporated into the network as protected if acquired or is subject to one or more of the programs included in this list. Such land may become critical in the future as the County and the Green Infrastructure Network grows and changes.

Green Equity Areas[107]

Green Equity Areas (GEAs) have been developed from the Environmental Equity Sub-Sector to aid the Network in delivering benefits to communities in Frederick County that need them most. Through the inclusion of GEAs in Network mapping, it is possible to see where investments in parks, trails, habitat restoration and resiliency efforts, and natural resource corridors can provide benefits to communities that bear excessive environmental burdens or that may lack the same level of access to outdoor recreational facilities present elsewhere within the County. In other words, actively prioritizing green infrastructure strategy with GEAs is one way to address equity and environmental justice directly in Frederick County.

By weaving GEAs into green infrastructure planning, the Network Map can prioritize fairness in how green infrastructure resources are distributed. Communities that have historically lacked safe access to outdoor spaces could be prioritized for new opportunities or facilities. Residents in areas disproportionately affected by heat, flooding, or pollution might receive targeted environmental improvements like tree canopy planting that improve air quality, reduce summer temperatures, and build stormwater resilience. GEAs not only expands the reach of its ecological network, but also ensure that all residents, especially those in underserved areas, in the health, recreation, and climate resilience can realize the benefits that green infrastructure provides.

The Future of the Network

While this Plan establishes an initial extent for a Green Infrastructure Network for Frederick County, it is not intended to limit the Network's future scope or utility. The Network can be revisited in the future with subsequent updates to the Green Infrastructure Plan as needs or conditions warrant. Additionally, as additional parcels gain permanent protection, new easements are created, or new park facilities are established at the federal, state, County, or municipal levels, the Network Map should be revisited to reflect successes and identify additional opportunities.

The following section of the Plan discusses, or provides reference to, the appropriate section of the Green Infrastructure Plan that may be considered at the different stages highlighted in the flowchart. Mechanisms for conserving, preserving, or creating green infrastructure where it does not currently exist are referred to as the "Green Infrastructure Toolkit."

Green Infrastructure Toolkit

The following tools, including land-use designations, the Adequate Public Facilities Ordinance (APFO), land acquisition, conservation easements, and policies and regulations represent actions that can be taken by property owners and Frederick County government to help protect sensitive areas or resources where they exist or to further the goals of the Green Infrastructure Plan and the Livable Frederick Master Plan.

Land-Use Designations

The Comprehensive Plan Map outlines specific land-use designations that guide the county's zoning strategies to balance development with conservation. These designations clarify where land uses should

be concentrated, how intensely areas may be developed, and which zoning districts apply to each category. Land-use designations are typically applied as part of the updates to the County's Comprehensive Plan. While no updates to land use designations are proposed concurrently with the adoption of the Green Infrastructure Plan, the recommendations included in the plan suggest certain actions that may be considered by the County Executive and Frederick County Council for action as part of a future update to the County Comprehensive Plan. All updates to the County Comprehensive Plan must follow the appropriate, public process for a Comprehensive Plan Amendment.

- **Natural Resource Designation:** County planners use the Natural Resource designation to protect vital ecological assets, such as contiguous and riparian forests and major streams within floodplains. It can also be considered for lands within the Green Infrastructure network. By applying this designation, the county encourages the use of the Resource Conservation (RC) and Agricultural (A) zoning districts. RC allow agricultural activities and restrict residential development to large lots—at least 10 acres—thereby minimizing fragmentation of sensitive landscapes. This designation also promotes potential greenway linkages that enhance habitat connectivity.
- **Public Parkland/Open Space Designation:** This designation supports conservation by reserving public lands for state, local, or federal parks and protected open spaces, especially those safeguarding public water supplies. Zoning under this category often includes RC, Agricultural, and sometimes residential zones for properties that already hold partial protection. By prioritizing these lands for non-intensive uses, planners shield critical watersheds and recreation areas from development pressure.
- **Open Space (Form Designation):** With the adoption of the South Frederick Corridors Plan in April 2024, a new Open Space "form designation" was also added to the list of designations that can be assigned to properties on the Comprehensive Plan map. Form designations are a planning tool used to guide the physical character and design of development under a Form Based Code that will be applied to the South Frederick Corridors Planning Area. Rather than focusing solely on land use (like residential or commercial), form designations emphasize how buildings, streets, and public spaces relate to one another, essentially shaping the look and feel of the built environment. The Open Space form designation is applied to lands intended for few structures and that will be set aside for natural systems or scenic resources. Functionally, the Open Space Form Designation will closely mirror the Natural Resource or Public Parkland/Open Space designations.
- **Agricultural/Rural Designation:** Outside growth areas, this designation preserves farmland, fallow lands, and rural subdivisions. The Agricultural (A) zoning district applies here, allowing farming and limited residential subdivision based on historical land tracts. Development follows a controlled pattern—original tracts from before 1976 may split into only three lots and a remainder—with each lot requiring a minimum of 40,000 square feet. This policy discourages sprawl and helps retain the rural character and function of the landscape.

Land Acquisition

Frederick County aligns its parkland acquisition and development efforts with both State and County Land Preservation, Parks, and Recreation Plans. To remain eligible for Program Open Space (POS) funding, the county updates its plan every five years, with historical updates stretching back to 1983. These plans ensure

that local initiatives reflect state-level conservation priorities, emphasizing equity in access, the health benefits of recreational spaces, and the integration of parks into developed areas.

In the Livable Frederick Master Plan, the county outlines goals to design a diverse park system that blends active and passive use, prioritizes maintenance and modernization, and improves proximity to recreation for all residents. The plan promotes inclusivity across age and ability, expands green infrastructure, and supports varied fitness programs—from casual exercise to competitive sports—across community venues. The county also aims to strengthen recreational infrastructure like trails and park facilities as tools for public health and economic growth.

To realize these goals, Frederick County leverages multiple funding streams. The Capital Improvements Program (CIP) receives financial support from the County's recordation tax and bonds, along with federal aid and limited POS funding. Through annual plans, the Division of Parks & Recreation also coordinates with state departments and local municipalities to allocate POS funds, which have totaled $32.9 million since 1969.[108]

State conservation goals complement this local framework by advocating for land protection through acquisition, easements, and planning tools. Maryland agencies prioritize restoring key habitats, expanding green infrastructure, and safeguarding aquatic systems. They also encourage coordinated watershed management and support forest economies, all of which reinforce Frederick County's local preservation efforts.

Adequate Public Facilities Ordinance (APFO)

The Adequate Public Facilities Ordinance (APFO) in Frederick County, Maryland, ensures that new development aligns with the county's Comprehensive Plan and Capital Improvements Program. Its primary purpose is to guarantee that essential public infrastructure—such as roads, water, sewer, and schools—is available and sufficient at the time new residential, commercial, or industrial development occurs. By doing so, the ordinance promotes orderly growth and prevents overburdening existing public services. Frederick County adopted the APFO to manage growth responsibly and to coordinate development with the timely provision of public facilities. The ordinance requires developers to demonstrate that adequate infrastructure exists or will be provided concurrently with their projects. It also encourages municipalities to adopt corresponding ordinances, fostering regional cooperation when development impacts shared facilities.

In the context of the Green Infrastructure Plan and the Multi-Modal Accessibility Sub-Sector, APFO is relevant in that it requires projects to determine the modal split for bicycle and pedestrian trips by requiring traffic impact analyses (TIA) studies. TIAs account for the percentage of trips made by walking, biking, transit, and driving. Planners and traffic engineers use local and regional data to estimate how many trips will be made by non-automobile modes based on land use, proximity to transit, and existing infrastructure. These modal split assumptions directly influence trip generation and distribution models, which help assess the adequacy of transportation facilities for proposed developments.

To identify and fund necessary bicycle and pedestrian improvements, the APFO Guidelines incorporate mitigation planning and future transportation goals identified in the County Comprehensive Plan and

bike and pedestrian planning efforts. If a development's projected traffic exceeds the capacity of existing infrastructure or if the property is abutted by a mapped, planned bicycle or pedestrian facility, such as a bikeway or tail, the county may require mitigation measures such as new sidewalks, bike lanes, or trail connections be incorporated into plans and posted securities for a project. These improvements are often funded through developer contributions, escrow accounts, or inclusion in the county's Capital Improvement Program. The Bicycle and Pedestrian Advisory Commission also reviews proposed projects and recommends funding priorities to county officials, ensuring that investments align with broader connectivity and safety goals.

Conservation Easements

As discussed in Chapter 2 and later in this chapter in the context of agricultural or working lands, there are a wide range of conservation easements that help preserve farmland, forests, waterways, and ecologically sensitive areas in Frederick County. These easements are voluntary legal agreements between landowners and government agencies or land trusts that restrict certain types of development while allowing continued private ownership. The goal is to protect natural resources in perpetuity while supporting agricultural viability (in the case of working lands) or environmental stewardship.

Other Policies and Regulations

As discussed in Chapter 1 under the topic of the Sensitive Areas Element of comprehensive plans, there are established, regulatory protections for certain "sensitive areas" within Frederick County. Such regulations protect public safety, preserve natural ecosystems, and reduce long-term infrastructure costs. By regulating development on steep slopes or near rivers, streams, and wetlands, the county minimizes the risk of property damage and loss of life during flood events. These setbacks also prevent construction in areas prone to erosion and unstable soils, helping maintain the integrity of roads, utilities, and buildings.

The county's waterway buffer regulations also serve critical environmental functions. Vegetated buffers filter pollutants from stormwater runoff, recharge groundwater, and stabilize streambanks. These areas support aquatic habitats and biodiversity, especially in sensitive watersheds like Linganore. By requiring minimum setbacks from waterbodies as part of the subdivision process—typically 100 to 175 feet depending on slope and floodplain extent—Frederick County ensures that development does not compromise water quality or ecological health. In addition, these requirements align with state and federal floodplain management standards, including FEMA's National Flood Insurance Program. Compliance helps residents access flood insurance and reduces the financial burden of disaster recovery. Through careful enforcement and planning, Frederick County balances growth with resilience, safeguarding both its communities and natural resources.

It is important to note that these policies and regulations are commonly referred to as "permit-triggered regulations" or more formally, as "conditional regulations." The rules only apply when someone initiates a specific action—like submitting a permit application for development, construction, or land use change. These regulations are not enforced universally or continuously—they're activated by the permit process itself, making them a targeted tool for managing growth, protecting natural resources, or ensuring safety without imposing blanket restrictions. Land development proposals on land located within the mapped Green Infrastructure Network would be subject to such regulations for wetlands, streams and waterbodies, forest resources, and steep slopes. Where such conditional regulations result in land being set aside in permanent easements, the Green Infrastructure Network map would be updated accordingly.

Community Action

Community members represent, perhaps, the most effective means of restoring ecological balance by transforming their surroundings into thriving wildlife habitats. Inspired by author Doug Tallamy's vision of a "Homegrown National Park," individuals can start by planting native trees, shrubs, and perennials that support local food webs. These plants provide essential resources—like nectar, seeds, and shelter—for birds, butterflies, and pollinators. Like Tallamy, the Green Infrastructure Plan encourages homeowners to embrace native species such as oak, goldenrod, and milkweed, which sustain hundreds of insect species and, in turn, the birds and mammals that rely on them instead of manicured lawns and plant species that evolved in other, distant ecosystems.[109]

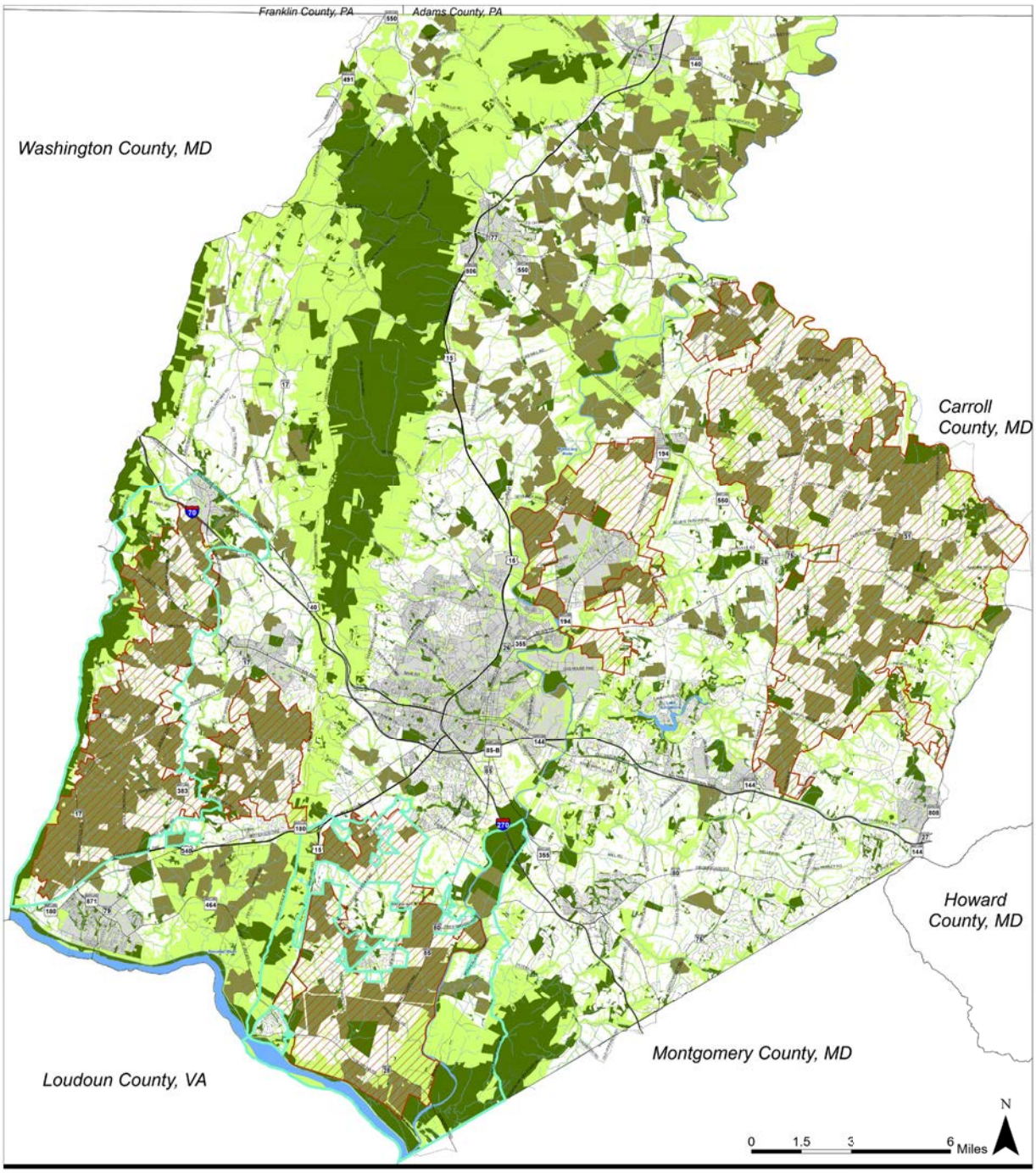
Beyond planting, community members can remove invasive species, reduce pesticide use, and install rain gardens or bioswales to manage stormwater naturally. These green infrastructure elements not only prevent runoff and flooding but also create moist habitats for amphibians and beneficial insects. By connecting with neighbors and encouraging community-wide adoption of native landscaping, individuals can stitch together corridors of habitat that allow wildlife to move freely and safely. As Doug Tallamy emphasizes, conservation starts at home—and every property, no matter the size, can become a vital piece of the ecological puzzle.

Working Lands & Green Infrastructure

In its description of the Agricultural Infrastructure Sector, the Livable Frederick Master Plan states that Frederick County has one of the strongest agricultural economies in Maryland. Much of the County's economic strength derives from several key components of the agricultural economy, each of which remains healthy because Frederick County residents have repeatedly demonstrated a strong commitment to maintaining the practice and culture of farming. Together with the Green Infrastructure Sector, the Agricultural Infrastructure Sectors form an important thematic counterpoint in the LFMP Development Framework to the Primary and Secondary Growth Sectors described in Chapter 1.

In recognition of their shared conservation focus, Map 24 illustrates the proposed relationship between the two Sectors, with the Agricultural Infrastructure Sector being represented by those lands currently enrolled in agricultural preservation programs within the County and the Green Infrastructure Sector being represented by the Green Infrastructure Network as proposed in this Plan.[110]

While the development of an Agricultural Infrastructure Plan, as described in the LFMP, is outside the scope of this planning effort, the Green Infrastructure Plan does recognize that the conservation of working landscapes also plays a vital role in protecting ecological functions and quality of life in Frederick County. Working lands are often solely evaluated by the economic significance of their soil productivity, active agricultural use, and proximity to processing facilities. For working forests, the value hinges on timber type, tree maturity, and logistical access. As far as the Green Infrastructure Plan is concerned, both valuation systems tend to neglect additional ecosystem value provided by working lands. The next three sections of the plan provide a brief overview of the economic, ecological, and infrastructural significance of working lands.



Map 24: The Green Infrastructure Network and Land in Agricultural Preservation

Unprotected Land in Network
Protected Land in Network
Priority Preservation Areas
Rural Legacy Areas
Land in Agricultural Preservation

Image 28: The Peace and Plenty Rural Historic District in Frederick County.

(Image Credit: Livable Frederick)

Economic Significance

Frederick County's Office of Agriculture released an update to the County's Agricultural Strategic Plan in March 2025. The updated Plan reinforces agriculture as a major economic driver in Frederick County, contributing significantly to local output and employment. In 2022, county farms generated $184.4 million in product sales—a 40% increase from 2017—spurring an additional $55.1 million in economic output and $32 million in upstream value-added activity. Crop and livestock sales were nearly evenly split, with grain, soybeans, and other crops leading at $71 million. The dairy sector, despite fewer farms, increased sales by 15% to $51.8 million due to larger herds and improved efficiency. Poultry and egg sales surged 275% to $11.8 million, and beef sales rose 12% to $16.5 million despite a 7% drop in inventory.

Specialty sectors like greenhouse, nursery, and floriculture production grew over 75%, with greenhouse tomato sales more than doubling since the prior version of the Agricultural Strategic Plan. Outdoor fruit and vegetable farming reached $6.2 million, supported by a 36% increase in orchard acreage. Agritourism added further value, with a 19% rise in participating farms, tapping into a regional market of over 23 million people. Value-added agriculture—such as processing and packaging—expanded by 28.6%, pushing Frederick County to the top of the list in Maryland with $13.6 million in sales.

The County's Agricultural Strategic Plan also addresses the importance of connecting local producers with consumers in the County. Such connections not only help the agricultural economy by reducing storage and transport costs, but they also improve the quality of food for residents and develop resilience in the County's food supply system. Integrating green infrastructure practices like riparian buffers, cover cropping, and wetland restoration, can also help the County's agricultural economy and the resilience of the food system by enhancing water quality and ground water availability, reducing runoff, and supporting biodiversity and habitat for important pollinator species.

The Benefits of Community Food Systems:[111]

The Maryland Department of Agriculture released the following list of benefits that can be derived from a robust local food economy during Maryland Buy Local Week, including:

- Local food is better for the environment — it keeps land open, in production, and requires less fuel for transportation and therefore causes less pollution.

- Locally grown food tastes better — when picked within the last day or two, it is crisp, sweet, and loaded with flavor.

- Local produce is better for you — food that travels less time and distance holds more of its nutrients.

- Local food supports local economies — farmers purchase feed and materials from local businesses, thus reinvesting in the community.

- Local food strengthens local farm families — with direct and local sales, farmers can make more money and grow their businesses.

- Local food is safer — consumers like knowing where their food comes from and how it is grown. If there is a food-related issue, it is easier to trace it back to the source when grown locally.

- Local food builds community — farmers' markets provide excellent venues for community gatherings.

- Local food preserves the open character and rural space — with growing development pressures, picturesque barns, lush crop fields, and meadows full of wildflowers will survive only as long as farms are financially viable.

At the same time, properly managed working lands can also provide beneficial habitat functions, such as food for pollinators, healthy, and flood mitigation. The next section of the Plan looks at some of the potential benefits.

Habitat Function

The non-profit organization, Defenders of Wildlife, published a report in 2006 titled, "*Habitat in Agricultural Landscapes: How Much Is Enough?"* The report explores how agricultural lands can support biodiversity when managed with ecological principles. It emphasizes that while agriculture has historically been identified as a contributor to habitat loss and species decline, farmland still harbors a substantial portion of North America's native wildlife. In nearly all cases, agricultural landscapes offer better habitat conditions than urban or suburban areas, especially when they include remnant habitat patches, riparian buffers, and diverse field edges.[112]

Furthermore, the report urges planners and landowners to treat agricultural lands as part of a broader ecological network. It recommends designing farming systems that mimic natural processes and landscape patterns, such as rotational grazing that reflects native hoofed mammal behavior or integrating wetlands and grasslands into crop fields with proper protections to minimize disturbance to them. These practices help maintain viable populations of native species and restore ecological functions like pollination, nutrient cycling, and water filtration. The report also stresses the importance of protecting habitat patches, maintaining large habitat hubs where possible, and restoring connectivity between fragmented areas like those described at the beginning of this chapter in the discussion of hubs and corridors.

Image 29: A Pollinator Buffet on Working Lands of Frederick County.

(Image Credit: Olivia Meshell via Unsplash)

To protect terrestrial species and reduce damage to aquatic ecosystems, agricultural lands must be managed with strong conservation practices. Landowners should minimize soil erosion and chemical runoff by using techniques such as cover crops, no-till methods, windbreaks, and grass waterways. They should avoid intensive tillage on sensitive landscapes like floodplains and steep slopes and increase crop diversity through complex rotations to improve soil health and disrupt pest cycles. Incorporating livestock systems, improving manure management, and enhancing wildlife habitat in pastures with legumes and grasses further boost sustainability.

To mitigate nutrient and sediment loss into waterways, especially in areas potentially impacted by hypoxia[113]—like certain stretches of the Monocacy River during periods of low-flow in summer—agricultural operations should adopt site-specific strategies, including reducing fertilizer use, promoting soil infiltration to retain water, applying nutrients with greater precision, and adopting integrated pest and nutrient management programs. Matching crop choices to local climate, soil, and environmental conditions also supports efficient irrigation and minimizes ecological stress.

On-farm conservation efforts play a vital role in sustaining agricultural productivity while also delivering broad environmental benefits. The American Farmland Trust encourages landowners to assess their natural resources, set conservation goals, and work with trusted partners to implement tailored strategies that protect both farmland and the local habitat. The Trust has developed a comprehensive guide for resources related to on-farm conservation at https://farmlandinfo.org/improve-on-farm-conservation/, and they identify the following partner agencies:

The USDA Farm Service Agency (FSA): The FSA serves as a key entry point for farmers interested in conservation programs. FSA offices, often co-located with USDA Natural Resources Conservation Service (NRCS) centers, help landowners establish a “farm number” and access federal assistance. Staff guide applicants through enrollment procedures and ensure that documentation is complete, streamlining the process for conservation planning and funding.

The USDA Natural Resources Conservation Service (NRCS): NRCS provides hands-on support to farmers through conservation specialists. These professionals meet directly with landowners to develop customized conservation plans that address soil erosion, nutrient management, and habitat restoration. NRCS also administers technical and financial assistance programs, helping farmers implement practices that improve land stewardship and meet environmental goals.

Conservation Districts: Local conservation districts offer localized expertise and resources to support on-farm conservation. Staff can supply detailed maps, evaluate soil conditions, and assist in drafting conservation plans that align with county-level priorities. These districts often serve as a bridge between federal programs and local implementation, ensuring that conservation efforts reflect regional needs and conditions.

The University of Maryland Cooperative Extension should also be included in this discussion. The Cooperative Extension System provides educational and technical support rooted in local agricultural knowledge. Extension agents can test soil samples, advise on crop rotations, and help draft agricultural leases. Their deep understanding of community farming practices makes them valuable allies in designing conservation strategies that are both practical and effective.

The Impact of Working Lands on Infrastructure

Working lands not only fuel local economies, but they also place fewer demands on public and utility services compared to many other types of development. The concept of the "Cost of Community Services" (or COCS) evaluates how much different types of land use cost a municipality in public services compared to the revenues they generate. Agricultural lands consistently come out ahead in these studies because they require minimal infrastructure, generate modest tax revenue, and demand far fewer public services such as electricity, schools, roads, and emergency services. At the same time, these lands also typically have lower population densities and a lower economic return per acre, especially compared to commercial or residential properties, which generate more revenue but also impose significantly higher service costs.

COCS in Frederick County

Cost of Community Services (COCS) studies help communities evaluate the true fiscal impact of different land uses by analyzing revenue-to-expenditure ratios. The American Farmland Trust (AFT) released a summary of the findings of nation-wide COCS studies in 2016. Seven counties in Maryland were identified in the AFT study. Frederick County's 1997 study followed three steps: collecting local financial data, categorizing revenues and costs by land use, and comparing what each category contributes versus consumes. In Figure 3-8, below, the ratio represents the relative cost of community services required by each land use (right of the colon) relative to each dollar generated by that land use (left of the colon). For example, in 1997, each acre of working and open land resulted in a cost of 53 cents for community services per dollar of revenue generated.

Figure: An Excerpt from The AFT Cost of Community Services Study.

REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
Maryland				
Carroll County	1 : 1.15	1 : 0.48	1 : 0.45	Carroll County Dept. of Management & Budget, 1994
Cecil County	1 : 1.17	1 : 0.34	1 : 0.66	American Farmland Trust, 2001
Cecil County	1 : 1.12	1 : 0.28	1 : 0.37	Cecil County Office of Economic Development
Frederick County	1 : 1.14	1 : 0.50	1 : 0.53	American Farmland Trust, 1997
Harford County	1 : 1.11	1 : 0.40	1 : 0.91	American Farmland Trust, 2003
Kent County	1 : 1.05	1 : 0.64	1 : 0.42	American Farmland Trust, 2002
Wicomico County	1 : 1.21	1 : 0.33	1 : 0.96	American Farmland Trust, 2001

These studies expose common misconceptions about lost opportunity costs resulting from agricultural and open land. While residential properties may yield higher gross tax revenues, they also demand far more in public services. In contrast, working lands like farms and forests often generate modest income but cost much less to support, making them comparatively fiscally efficient. It is very important to note that COCS studies offer a snapshot—not a forecast—so it may be necessary to revisit them from time to time. One thing that COCS studies do effectively, however, is encourage communities to rethink the assumption that open lands should automatically transition to more intensive development.[114]

In laying out its growth framework, the Livable Frederick Master Plan argues achieving a balanced land use strategy is vital for long-term fiscal health and community resilience. While agriculture and open space preserve environmental quality and reduce public expenditures, commercial and residential areas drive economic growth and the revenues generated by these uses support the types of vibrant communities where people want to live.

Thoughtful planning—like that in Frederick County's comprehensive approach—ensures that no single land use type dominates, allowing residents to enjoy the benefits of rural character, economic opportunity, and efficient public service delivery all at once. COCS are just one method for illustrating how maintaining a robust Agricultural Infrastructure Sector and Green Infrastructure Sector protects natural systems and saves money while supporting local jobs and the local economy.

Available Conservation Programs

There are a variety of programs available through federal, state, and County government to assist with the implementation of conservation practices on working lands or with the preservation of working lands through the establishment of easements. While agricultural land preservation is not a primary function of the Green Infrastructure Plan, support for agricultural preservation benefits the County as a whole, and a brief summary of available programs is provided in the following pages. The Conservation Reserve Enhancement Program (CREP), as described in Chapter 2, is another such program. More information about CREP is provided in Chapter 2.

More information on many of the following programs can be obtained from the agencies named below.

USDA Farm Service Agency (FSA) Programs

Conservation Reserve Program: The Conservation Reserve Program (CRP) encourages farmers to convert highly erodible cropland and other environmentally sensitive land to vegetative cover including native grasses, trees, filter strips, habitat buffers or riparian buffers. Incentives are provided in the form of annual rental payments and cost-share assistance to establish vegetative cover. The Natural Resources Conservation Service helps evaluate land for eligibility for the program.

United States Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS)

Agricultural Conservation Easement Program: The Agricultural Conservation Easement Program (ACEP) provides technical and financial assistance to help conserve and protect farm and ranch lands, grasslands and wetlands. Under the Wetlands Reserve Easements component, NRCS works directly with landowners to restore, protect, and enhance enrolled wetlands. Enrolled land is not available for production.

Environmental Quality Incentives Program: The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance through contracts to help plan and implement structural and management practices on eligible agricultural land. Contracts address natural resource concerns and opportunities to improve soil, water, plant, animal, air, and related resources and provide technical assistance for landowners from agronomists, biologists, and foresters.

USDA Climate Hubs: USDA Climate Hubs and their partners developed locally-specific tools and resources to help build climate change adaptation capacity across the country. USDA's Climate Hubs are a unique collaboration across the department's agencies. They are led and hosted by the Agricultural Research Service and Forest Service located at ten regional locations, with contributions from many agencies

including the Natural Resources Conservation Service, Farm Service Agency, Animal and Plant Health Inspection Service, and the Risk Management Agency. The Climate Hubs program links USDA research and agencies in their regional delivery of timely and authoritative tools and information to agricultural producers and professionals.

Conservation Stewardship Program: The Conservation Stewardship Program offers technical and financial assistance to help agricultural and forest producers take their conservation efforts to the next level. The program is designed to compensate agricultural and forest producers who agree to increase their level of conservation by adopting additional conservation activities and maintaining their baseline level of conservation.

Frederick County Conservation District

Maryland Agricultural Water Quality Cost-Share Program: The Maryland Agricultural Water Quality Cost-Share Program provides grants that cover up to 100 percent of the cost to install BMPs on farms to control soil erosion, manage nutrients and safeguard water quality in streams, rivers and the Chesapeake Bay. Approximately 40 BMPs are currently eligible for funding.

The Cover Crop Program: The Cover Crop Program provides farmers with grants to plant small grains in their fields in the fall to conserve nutrients, control soil erosion, and protect water quality. The Conservation Reserve Enhancement Program (CREP)—a federal-state partnership program—pays landowners attractive land rental rates to take environmentally sensitive cropland out of production for 10 to 15 years and plant buffers and other conservation practices that protect water quality and provide wildlife habitat.

Manure Management Program: The Manure Management Program helps farmers manage manure resources, comply with nutrient management regulations, and protect water quality in local streams, rivers, and the Chesapeake Bay.

Ecosystem Incentives Program: The Ecosystem Incentives Program provides a menu of conservation incentives that promote clean water, healthy soils, and climate solutions. These include MDA's Conservation Buffer Incentive, Tree Planting Incentives, CREP bonus payments, Cover Crop Plus grants, Tax Incentives for Conservation Equipment, and Low Interest Loans (LILAC) for agricultural conservation projects.

Maryland's Small Farm and Urban Agriculture Program: The Maryland Small Farm and Urban Agriculture Program provides financial assistance to support small-scale agricultural operations located in urban, peri-urban, rural, and suburban areas. It aims to increase community access to healthy foods by helping farmers improve their management of natural resources by adopting Bay-friendly and climate-smart farming practices.

Available Preservation Programs

The following programs are implemented by the Frederick County Office of Agriculture at 118 North Market Street in Frederick, MD, 21701, or (240) 397-4927. The Office of Agriculture's website address is: https://frederickcountymd.gov/8675/Agriculture.

Maryland Agricultural Land Preservation Foundation (MALPF)

Landowners who participate in the MALPF program voluntarily sell their development rights to preserve farmland for agricultural and forestry use. By signing an easement agreement, they agree to permanently

restrict residential, commercial, and industrial development, limit subdivision, prohibit large signage, and follow approved soil and water conservation plans. If the property includes 25 or more acres of forest, owners must also implement a forest stewardship plan. The Foundation retains the right to inspect properties for compliance, though the public does not gain access to the land.

Image 30: Preserved farmland in Frederick County.

(Image Credit: Livable Frederick)

To qualify, applicants must meet criteria related to size, soil productivity, location, and conservation planning. Properties must generally be at least 50 contiguous acres, though adjacent landowners can apply jointly. Eligible land must contain at least 50% high-quality agricultural or woodland soils, or a combination exceeding 60%. Specialized farms may also qualify. Applicants must commit to not alter or subdivide the land during the application process. Counties may impose additional requirements, such as price limits or district enrollment, so landowners should consult the Frederick County Office of Agriculture for guidance.

Since 1980, the program has permanently protected over 23,300 acres in Frederick County. The Maryland Agricultural Land Preservation is implemented through the Frederick County Office of Agriculture. More information on the MALPF program can be found at: https://frederickcountymd.gov/8571/The-Maryland-Agricultural-Land-Preservat.

Rural Legacy

As discussed in Chapter 2, The Rural Legacy Program protects large, contiguous tracts of land rich in natural and cultural resources by funding easement and land acquisitions from willing landowners. Local governments and land trusts collaborate to preserve farms, forests, and natural areas, discouraging sprawl development and offering landowners an alternative to selling to developers. Landowners can sell or donate their development rights while continuing to farm or raise livestock.

Local sponsors identify Rural Legacy Areas and apply annually for funding. The Rural Legacy Advisory Committee reviews these applications and advises the Rural Legacy Board, which then recommends selected areas and funding levels to the Governor and Board of Public Works. The Board of Public Works

designates the areas and approves the grants. There are two designated Rural Legacy Areas in Frederick County, the Mid-Maryland Rural Legacy Area and the Carrollton Rural Legacy Area. Properties. Properties located within the mapped Rural Legacy Areas can apply for preservation through the Land Acquisition and Planning Office of the Maryland Department of Natural Resources. Reviewers evaluate Rural Legacy applications by assessing the significance of agricultural, forestry, natural, and cultural resources at risk from development, along with the economic value of industries like farming, tourism, and recreation. They also consider the application's completeness, the strength of conservation partnerships, available matching funds, and the sponsor's ability to implement the proposed plan and meet program goals.

To date, over 6,700 acres of rural land have been permanently preserved in Frederick County through the Rural Legacy Program. More information on the program can be found at: https://dnr.maryland.gov/land/pages/rurallegacy/home.aspx.

Installment Purchase Program (IPP)

The Installment Purchase Program (IPP) compensates farmers who place land under preservation with tax-free interest payments over 10 to 20 years and a lump-sum principal payment at the end of the installment period. To qualify, landowners must have at least 50 acres (or be adjacent to protected land), possess at least 50% high-quality soils, and retain development rights—though some exceptions apply.

In the summer of 2025, Frederick County's Office of Agriculture and Division of Planning and Permitting launched a new collaboration that allows landowners to combine Installment Purchase Program (IPP) and Forest Resource Ordinance (FRO) easements to preserve farmland and protect natural resources. By merging these easements, the county aims to stretch funding further and increase the amount of preserved farmland and forest. The IPP pays farmers tax-free interest over 10 to 20 years, followed by a lump-sum principal payment, while the optional FRO easement offers an upfront payment using fee-in-lieu funds. The application window for the combined program was open for a limited time, but the collaboration may be reopened if significant demand is identified.

Since 2002, the IPP has preserved over 23,484 acres across 168 properties. Additionally, Frederick County has planted 2,208 acres of new forest and conserved 9,469 acres of existing forest under the FRO Ordinance. More information on the Installment Purchase Plan can be found here: https://frederickcountymd.gov/8570/Installment-Purchase-Program-IPP.

Critical Farms

Frederick County created the Critical Farms Program to preserve agricultural land, support farming as a profession, and facilitate permanent land protection through options to purchase development rights easements. To qualify, applicants must meet property and personal eligibility criteria, including minimum acreage, soil quality, zoning, and proximity to preservation areas. Applicants must be recent or contract purchasers with no prior ownership interest in the property and must actively work in agriculture. County staff evaluate applications using priority criteria and present scores to the Agricultural Preservation Advisory Board, which recommends approvals to the County Executive. The Executive may grant preliminary approval based on rankings and available funds.

Once approved, the county pays for two appraisals to determine easement value, capped at 70% of the land's fair market value. If the county governing body grants final approval, it offers the applicant a five-year option to purchase the easement at 75% of its appraised value. The applicant must then pursue a sale to

the Maryland Agricultural Land Preservation Foundation (MALPF) during that period. If MALPF purchases the easement, the county recovers its investment. If not, the applicant may repay the county or allow the county to exercise the option and finalize the easement purchase. This process ensures long-term protection of farmland while giving farmers financial flexibility and support.

More information on the Critical Farms Program can be found at: https://frederickcountymd.gov/8569/Critical-Farms-Program.

Regenerative Agriculture and Food Forestry

The adoption of certain practices mentioned in the discussion of working lands and green infrastructure, like cover cropping, is also considered representative of the developing field of regenerative agriculture. Regenerative agriculture is a holistic farming approach that focuses on restoring and enhancing the health of ecosystems while also producing usable or marketable agricultural products. The name "regenerative" was adopted because it reflects the ability of many of the practices to reverse environmental degradation in the land and restore soil health and ecosystem function. Unlike certain industrial farming methods that can deplete soil and that rely heavily on chemical inputs, regenerative agriculture aims to improve soil fertility, increase local biodiversity, and strengthen the resilience of the land on which it is implemented.

Popular regenerative agriculture practices often use cover cropping, crop rotation, reduced or no tillage, composting, and rotational grazing to build organic matter in the soil, improve soil-moisture retention, and accelerate nutrient cycling and carbon sequestration. Healthy soils developed from these practices not only produce more nutritious crops but also act as carbon sinks and can help to mitigate climate change. A focus on polyculture, or the growing of multiple crop species together in the same area, is also a common component of regenerative agriculture. Polyculture is the opposite of monocropping, or the growing of a single crop species on a parcel of land. Monocropping tends to invite concentrated pest activity and support pest lifecycles by providing ample food supplies for pest species. Polyculture, on the other hand, provides less of a food source for any single pest species and diversifies habitat structure. A more diverse habitat structure can support a variety of natural predators and reduce the need for the use of pesticides.

As consumer demand for environmentally responsible food grows, regenerative agriculture is gaining attention from policymakers, food companies, and investors alike. Maryland is actively supporting regenerative agriculture through a variety of innovative programs and partnerships aimed at improving soil health, boosting farm profitability, and protecting the Chesapeake Bay. One standout initiative is the Million Acre Challenge, which seeks to transition one million acres of farmland in Maryland to regenerative practices by 2030. Another key effort is the Maryland Grazers Network, developed by Clagett Farm in Prince George's County, Maryland, and led by the Chesapeake Bay Foundation. This mentorship program helps farmers transition to grass-fed livestock systems by offering technical assistance, financial planning, and marketing support. Additionally, the Leaders in Environmentally Engaged Farming (LEEF) program, launched under the Chesapeake Bay Legacy Act, will recognize and incentivize farms that adopt conservation practices and contribute to community food systems.

Food forestry is another agricultural practice gaining momentum in Maryland as a sustainable and community-driven approach to land use. Advocates across the state are transforming public parks, private properties, and even food banks into thriving ecosystems that produce fruits, nuts, herbs, and edible greens. Food forests mimic natural woodland systems by layering canopy trees, shrubs, groundcovers, and

fungi in a way that supports biodiversity and soil health. They are also defined by a polyculture approach, intended to support biodiversity. These projects draw inspiration from indigenous land stewardship practices and require minimal maintenance once established, thanks to the use of hardy native species.

Image 31: The edible fruit of the Pawpaw tree (Asiminia triloba) can be found in the forests of Frederick County in late summer.

(Image Credit: Scott Bauer, USDA, via USDA ARS (Image No. K7575-8))

Private food forestry initiatives are also flourishing in Frederick County. Ecological designer Michael Judd runs Long Creek Homestead, a food forest near the City of Frederick that showcases Maryland's ideal climate for tree crops. Judd and other practitioners emphasize that Maryland's temperate climate and ample rainfall support forest regeneration, making it a prime location for food forestry. Organizations like the REED Center for Ecosystem Reintegration, near Middletown, also host educational events and "forest feasts" to introduce guests to lesser-known native foods like pawpaws, serviceberries, and sochan greens.

Integrating food forestry principles into conservation plantings, like riparian buffers, also offers opportunities to enhance both the environmental and economic benefits of buffers. By incorporating food forestry principles, these buffers can also produce edible crops such as fruits, nuts, and berries, thereby creating additional income streams for landowners supplementing local pantries. The Maryland Department of Natural Resources states that planting species like sugar maple, hazelnut, and black chokeberry within riparian buffers can improve land health and offer new market opportunities.[115] Such an approach not only supports biodiversity and water quality but also aligns with sustainable agricultural practices. The University of Maryland Extension also emphasizes the importance of a well-designed buffer system, which includes a mix of trees, shrubs, and grasses to maximize ecological benefits.[116]

The following plant species include a variety of Maryland Native plants that can be incorporated into food forest plantings. Plants have been categorized by form and mature height to allow for the planting to reflect the vertical structure of a forest. Additional species may be incorporated as desired by the food forest designer.

Native Perennials (Herbaceous Layer)

- Wild Leeks / Ramps (*Allium tricoccum*) – Garlicky-oniony flavor; prized by foragers and wildlife.
- Ostrich Fern (fiddleheads) – Edible fiddleheads in spring, with an asparagus-like flavor.
- Jerusalem Artichoke (*Helianthus tuberosus*) – Nutty, sweet tubers usable raw or cooked.
- Wood Sorrel – Tangy, lemony leaves ideal in salads or as garnish.

Shrubs (Mid-layer)

- Highbush Blueberry (*Vaccinium corymbosum*) – Sweet, antioxidant-rich berries in summer.
- Elderberry (Sambucus canadensis) – Edible flowers (tea, fritters) and berries (syrups, wine).
- Serviceberry (Amelanchier spp.) – Berries like blueberries, great eaten raw or cooked.
- Red Chokeberry (*Aronia arbutifolia/melanocarpa*) – Astringent berries for jams, high in antioxidants.
- Beach Plum (*Prunus maritima*) – Native fruit-bearing that can be consumed directly or used in jellies, jams, and sauces.
- Black Raspberry (*Rubus occidentalis*) – Native fruit-bearing shrub typically found in disturbed areas and forest edges.

Trees (Canopy Layer)[117]

- American Persimmon (*Diospyros virginiana*) – Sweet orange fruits, best after a frost.
- Black Cherry (*Prunus serotina*) – Dark summer fruits for jams or pies, though care must be exercised with stems and pits which can be harmful if consumed in large amounts.
- Pawpaw (*Asimina triloba*) – Custardy fruit of local origin arriving in late summer.
- Hazelnut (*Corylus americana*) – Hazelnuts are often featured in food forest plantings and they can provide flavoring for a variety of foods and beverages.
- Serviceberry (*Amelanchier arborea*) – Small tree or large shrub with berries that can be eaten raw, baked into pies, cakes, and breads, or turned into jams and jellies.
- Sugar Maple (*Acer saccharum*) – Can be tapped to provide sap for syrup production in late winter and early spring, native to central MD.

Chapter Endnotes

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80 <https://dnr.maryland.gov/Invasives/Pages/laws.aspx>.

81 Introduction to invasive plants in Maryland. (n.d.). University of Maryland Extension. <https://extension.umd.edu/resource/introduction-invasive-plants-maryland/>.

82 <https://extension.umd.edu/resource/introduction-invasive-plants-maryland/>.

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84 Grass & Tree Trimming | Frederick County MD - Official website. (n.d.). <https://www.frederickcountymd.gov/1684/Grass-Tree-Trimming>.

85 https://homegrownnationalpark.org/

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88 The appropriate 2025 Maryland State Planning Principles likely include Land, Transportation, Equity, Place, and Ecology.

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91 Cohen, W.J. The legacy of Design with Nature: from practice to education. Socio Ecol. Pract. Res 1, 339–345 (2019). https://doi.org/10.1007/s42532-019-00026-2.

92 Page 37 of the LFMP, "What is Multi-Modal Accessibility?"

93 Including Middletown to Myersville, Thurmont to Woodsboro, Frederick to Urbana District Park, Thurmont to Emmitsburg, and Frederick to New Market and Mount Airy, <(https://frederickcountymd.gov/9094/Plans-and-Documents)>.

94 <https://frederickcountymd.gov/8701/Rustic-Roads-Commission>.

95 The extent of wetlands mapped in National Wetland Inventory data is typically used for planning purposes only. The actual extent of wetlands is determined through field survey and delineation conducted in accordance with the US Army Corps of Engineers 1987 Wetland Delineation Manual and applicable Regional Supplement, as verified by the Maryland Department of the Environment and (if applicable) the US Army Corps of Engineers.

96 Fountain Rock Spring has a mean flow of approximately 1,200 gallons per minute (gal/min), based on four measurements, and is considered the largest spring in Frederick County.

97 Stronghold Watersheds are not mapped as an independent layer due to their inclusion in the Targeted Ecological Areas data layer.

98 Specific recommendations or actions that can be undertaken related to this Sub-Sector include those discussed under the Multi-Modal Accessibility Sub-Sector to further assist in further build-out of the County's multi-modal accessibility network. With regard to the location of County park facilities, the County's Land Preservation, Parks, and Recreation Plan remains the primary tool for inventorying existing and considering future park assets. The Green Infrastructure Plan defers to the LPPRP with regard to facility location, but several recommendations are included for future consideration as they relate to park facilities.

99 Climate change is probably increasing the intensity of tropical cyclones. (2021, March 31). NOAA Climate.gov. <https://www.climate.gov/news-features/understanding-climate/climate-change-probably-increasing-intensity-tropical-cyclones>.

100 Nowak, D. J., & Greenfield, E. J. (2018). U.S. urban forest statistics, values, and projections. Journal of Forestry, 116(2), 164–177.

101 U.S. Environmental Protection Agency. (2022). Using trees and vegetation to reduce heat islands. <https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands>.

102 Vargo, J., Stone, B., Habeeb, D., Liu, P., & Russell, A. (2016). The social and spatial distribution of temperature-related health impacts from climate change for the City of Atlanta, Georgia. Environmental Health Perspectives, 124(6), 770–779.

103 Browning, M., Locke, D., Konijnendijk, C., Labib, S., Rigolon, A., Yeager, R., Bardhan, M., Berland, A., Dadvand, P., Helbich, M., Li, F., Li, H., James, P., Klompmaker, J., Reuben, A., Roman, L., Tsai, W., Patwary, M., O'Neil-Dunne, J., . . . Nieuwenhuijsen, M. (2023). Measuring the 3-30-300 rule to help cities meet nature access thresholds. The Science of the Total Environment, 907, 167739. https://doi.org/10.1016/j.scitotenv.2023.167739

104 To use timely information in this analysis, the tree canopy analysis was developed from 2022 aerial photography collected by Frederick County for determining the total acreage of forest cover in the County. The forest cover data set was edited so that the areas of forest "counted" met the requirements of the Forest Resources Ordinance (FRO) in terms of width and area. Forest cover data was supplemented with Tree Canopy Cover (TCC) data released by the United States Forest Service in 2025 for the year 2023.

105 Installation of a green roof is one practice that can address rooftop flooding, access to nature, and habitat availability.

106 "Recorded" easements are easements that have been deeded to Frederick County to ensure access for inspection and continued management oversight.

107 As noted earlier in this chapter, equity and its relationship to green infrastructure are the central focus of Chapter 4 of the Green Infrastructure Plan.

108 Per the 2022 Frederick County Land Preservation, Parks, and Recreation Plan.

109 Homegrown National Park. (2025, October 2). HNP - Homegrown National Park - Regenerate Biodiversity. <https://homegrownnationalpark.org/>.

110 It should be noted that, in theory and in practice, the Agricultural Infrastructure Sector extends beyond those lands currently participating in preservation programs. Agricultural preservation easements were utilized because they represent the most readily-available, mapped representation of that Sector at this time.

111 <https://mda.maryland.gov/about_mda/Documents/Maryland-Buy-Local-Week-Benefits-of-Buying-Locally.pdf>.

112 Blann, K. (2006). Habitat in Agricultural Landscapes: How Much is Enough? A State-of-the-Science Literature Review. <https://defenders.org/sites/default/files/publications/habitat_in_agricultural_landscapes.pdf>.

113 Hypoxia is a condition where the dissolved oxygen concentrations in water are so low that it is difficult for aquatic organisms to survive.

114 AFT. (2016). <https://farmlandinfo.org/publications/cost-of-community-services-studies/>.

115 <https://dnr.maryland.gov/forests/Pages/programapps/Agroforestry/Riparian-Forest-Buffers.aspx>.

116 <https://extension.umd.edu/sites/extension.umd.edu/files/2021-03/FS725_1.pdf>.

117 Tulip Poplar, Sassafras, Northern Red Oak, Slippery Elm, and Eastern White Pine also offer ecological or edible value.

Chapter 4

Equity in Green Infrastructure and Access to Nature

INTRODUCTION

The Livable Frederick Master Plan's Vision, as referenced in the opening chapter of the Green Infrastructure Plan, provides a desired future for all residents of Frederick County in 2040. The Vision states that every resident, regardless of race, age, gender, or any other identifying characteristic should be provided with the opportunity to lead a fulfilling and healthy life.

Our community enables young and old to lead fulfilling lives. We ensure that all people can be successful, enjoy a high quality of life and are free from poverty.

Good health is fundamental to our quality of life. We value a healthy environment, clear air, water, and green energy, and we are good stewards of environmental and natural resources.

This chapter emphasizes that access to green spaces, whether along streets, in towns and cities, in all types of parks, and even in rural areas, is essential to achieving the County's vision for the future. While the Green Infrastructure Plan plays a key role in addressing these issues, it is not the only tool available.

The County's Land Preservation, Parks and Recreation Plan (LPPRP) and the Bikeways and Trails Plan also address these priorities. As of this Plan's drafting, the LPPRP is beginning the update process. The LPPRP supports park access and facility upgrades by securing Project Open Space (POS) funding from the State of Maryland. The Bikeways and Trails Plan guides the development of the County's multi-modal transportation network through strategic planning and prioritization of bike and pedestrian infrastructure.

Image 32: A tubing program on the Monocacy Scenic River.

(Image Credit: Frederick County Government)

The Green Infrastructure Plan complements these efforts by identifying land near population centers that could deliver green infrastructure benefits—such as recreation, habitat connectivity, or improved climate resilience—if it is preserved in part or in whole, adopted as public parkland, or placed under conservation. It also recommends land management practices to enhance the value of existing green spaces near communities. To fulfill its purpose, the Plan must guide property identification and infrastructure improvements in a way that ensures historically underserved communities are not overlooked. Understanding the implications of equity, and applying an equity lens to decision-making, helps ensure that all residents benefit from green infrastructure investments.

Equality vs. Equity

A discussion of equity as it pertains to green infrastructure must first begin with a definition of the term. The concept of equity is similar to the concept of equality in that both aim to promote fairness, but they approach fairness in fundamentally different ways.

Comparison and Definitions

Equality treats everyone the same, offering identical resources or opportunities regardless of individual circumstances. For example, an organization seeking to promote the health benefits of cycling in a community might wish to provide every resident with a specific model of bicycle. Such an approach ensures everyone receives a bicycle, but it has the potential to ignore the diverse needs of cyclists—resulting from their age, height, weight, gender, or the presence of a physical disability—that can prevent them from benefiting equally from a similar resource. Figure 18, developed by the Robert Wood Johnson Foundation, illustrates the results of an equal distribution of bicycles through such a program.

Figure 17: Equality vs. Equity.

(Image Credit: The Robert Wood Johnson Foundation. https://www.rwjf.org/en/insights/blog/2022/11/we-used-your-insights-to-update-our-graphic-on-equity.html)

Equity, on the other hand, recognizes diversity in the community and adjusts support accordingly to ensure fair outcomes. Instead of distributing resources uniformly, equity customizes interventions to meet specific needs. A bicycle distribution program focused on an equitable distribution of resources would take the age, height, weight, gender, or presence of physical disability into account as part of the distribution program. By actively addressing barriers, equity creates a more level playing field and empowers individuals to succeed based on their unique circumstances.

Specific definitions of equality and equity are as follows:

Equality is the even allocation of resources and opportunities across various groups.

Equity recognizes that each group's circumstances are unique and allocates appropriate resources and opportunities with the intent of achieving equal outcomes.

Environmental Justice

Environmental Justice, or "EJ," is the fair treatment and meaningful involvement of all people, regardless of race, ethnicity, income, or other social factors, in the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice efforts are focused on making sure all residents in a community have equitable access to a healthy, sustainable, and resilient environment in which to live, play, work, learn, grow, worship, and engage in cultural and subsistence practices. Whereas equity is broadly concerned with ensuring equitable outcomes across the board, environmental justice is a vehicle specifically purposed to achieving positive, equitable outcomes derived from nature. The application of environmental justice principles can help guide decision-making about where green infrastructure efforts should be focused.

The Importance of Access to Nature

In recent decades, researchers and healthcare professionals have increasingly recognized the profound impact that access to nature can have on managing and even preventing common health conditions. From chronic diseases like diabetes and heart disease to behavioral and cognitive challenges such as ADHD in children, the natural environment can offer more than just aesthetic value—it has been shown to provide measurable therapeutic benefits. As our lives become more urbanized and screen-dependent, reconnecting with nature may be one of the most accessible and cost-effective health interventions available to us.

Peer-Reviewed Research on the Links Between Nature and Health

An expanding body of peer-reviewed research underscores the vital role that nature plays in supporting health across our lifespans—from early childhood development to healthy aging. While time spent outdoors is not a substitute for professional medical care, it is increasingly recognized as a valuable complement to a holistic, healthy lifestyle. For residents of Frederick County, the physical, emotional, and cognitive benefits of regular exposure to nature are too substantial to overlook, especially when considering how to ensure equitable access to health-promoting environments.

Principles for Implementing Environmental Justice

The Urban Forestry and Environmental Justice Playbook, principally authored by Dr. Lemir Teron of Howard University and funded by the USDA Forest Service, is a community-centered guide designed to support equitable urban forestry planning across U.S. cities. Drawing heavily from a case study in Syracuse, NY, the playbook addresses how decades of environmental injustice—particularly redlining, urban renewal, and the disproportionate siting of environmental hazards—had left marginalized communities with sparse tree canopies and increased vulnerability to climate threats like extreme heat and poor air quality.

The Playbook offers several guiding principles for making sure that planning and implementation efforts that aim to increase access to nature for everyone are effective. The main focus of the Playbook is urban and community forestry efforts, but the principles have the potential for broad application to all types of green infrastructure projects. These principles include:[118]

- Centering environmental justice as essential to programs that improve health outcomes through access to nature and ecosystem services, such as urban and community forestry. Communities must directly address the historical and systemic forces—such as redlining, land dispossession, and urban renewal—that marginalized Black and brown communities in particular and stripped them of access to green space.

- Challenging traditional planning models that assert that untargeted urban greening efforts will reach those most in need. Communities should insist planners intentionally prioritize underserved neighborhoods from the start of any project.

- Elevate public participation by promoting compensated, skills-based training for residents where opportunities exist. Implementing a “train-the-trainer” model ensures that local people gain technical expertise and decision-making power necessary to shape the environmental futures of their own neighborhoods.

- Redefine forestry as a justice tool, connecting healthy urban forests to broaden public health, climate resilience, and economic opportunity. Planting trees in low-canopy, high-risk areas can lower extreme heat, improve air quality, and reduce disaster risk. Green infrastructure measures targeting stormwater and flood control should also receive the same consideration.

- Expose prior patterns of inequitable decision-making[119] as a key contributor to ecological inequality. Racially marginalized populations disproportionately bear the burden of environmental hazards while being cut off from environmental amenities like tree canopy and more.

- Push for democratized environmental decision-making, calling for communities—not just experts—to co-lead efforts like urban forestry planning. This means equipping laypeople with GIS tools and access to environmental data so they can set priorities aligned with local needs.

- Efforts to improve equitable access to nature, through programs like urban forestry, must include non-traditional partners, such as libraries, public health agencies, and local advocacy groups, to reach communities that have been historically excluded from environmental conversations.

- Efforts to improve equitable access to nature should link environmental justice to restorative justice by recognizing the fact that greening neglected communities or neighborhoods isn’t just about trees, it’s about healing decades of harm and empowering communities to thrive ecologically, socially, and economically.

Image 33: A field trip on the Sensory Trail at Catoctin Creek Nature Center

(Image Credit: Frederick County Government)

For individuals at risk of or living with diabetes and heart disease, time spent outdoors can be a transformative element of a physician approved treatment plan. Engaging in physical activity in natural settings—whether it's walking through a park, hiking a trail, or gardening—encourages movement that helps regulate body weight and blood sugar and improves cardiovascular function. Studies have shown that exposure to green spaces is associated with lower blood pressure, reduced inflammation, and improved lipid profiles, all of which are critical in preventing heart disease and managing diabetes.[120] These physiological benefits are compounded by the psychological effects of nature, such as reduced stress and improved mood, which further support heart health and metabolic regulation.

Children with ADHD also show remarkable improvements when they spend time in natural environments. In contrast to some traditional indoor educational settings, nature can provide a dynamic, yet low-stimulation, backdrop that helps reduce attention fatigue and promote calmness. A study published in the *Journal of Attention Disorders* found that children with ADHD who played in green outdoor settings exhibited significantly fewer symptoms than those who played indoors or in built environments.[121] Such studies assert that nature may offer a kind of cognitive reset, enhancing focus and self-regulation without some of the side effects typically associated with medication. Schools that integrate outdoor learning

and environmental education report not only behavioral improvements but also gains in academic performance, suggesting that nature supports both emotional and intellectual development. A study conducted in the early 2000's of children who moved closer to green areas found that those who relocated tended to have the highest levels of improvement in cognitive function following the move, regardless of the level of affluence.[122]

Beyond these specific conditions, the broader health benefits of nature can also be difficult to ignore. Regular exposure to the outdoors can strengthen the immune system, reduce cortisol levels, and foster social connection. Children who play in natural settings tend to be more physically active, less anxious, and more resilient to stress. Even simple interactions—like digging in the soil or observing wildlife—can boost immune health and reduce the risk of autoimmune disorders.

Image 34: Story time at Rose Hill Manor Park

(Image Credit: Frederick County Government)

List of Physical, Cognitive, Social, and Sensory Benefits

The following benefits from exposure to nature have been identified in the following studies. This summary is not exhaustive or intended to represent medical advice but may provide supplemental justification for including outdoor exercise as part of a physician approved treatment plan. Study results include:

- Reduced Blood Pressure and Heart Rate: Spending time in green spaces has been shown to lower blood pressure and heart rate, reducing the risk of cardiovascular disease.[123]
- Improved Immune Function: Exposure to natural environments can enhance immune system activity, partly due to contact with beneficial microbes in soil and plants.[124]
- Lower Risk of Type 2 Diabetes: Regular physical activity in nature helps regulate blood glucose levels and reduce insulin resistance.[125]
- Decreased Mortality Rates: Living near green spaces is associated with lower overall mortality, particularly from heart disease and respiratory conditions.[126]
- Improved Attention and Focus: Nature exposure enhances cognitive function and attention restoration, especially in children with ADHD.[127]
- Enhanced Mood and Emotional Well-being: Both green and blue spaces (e.g., forests and bodies of water) are linked to improved mood and reduced symptoms of depression.[128]
- Improved Academic Performance in Children: Schools that incorporate outdoor learning and green play areas report better academic outcomes and fewer behavioral issues.[129]

Frederick County has taken steps in recent years to aid residents in accessing the benefits listed in this section of the Plan. In late 2024, the Frederick County Division of Family Service's Child Advocacy Center and ThorpeWood announced a partnership to provide free nature-based mental health support for children and caregivers dealing with trauma in Frederick County. Through ecotherapy and outdoor programming, participants in the program will learn vital life skills such as mindfulness, emotional regulation, resilience, and self-esteem. This collaboration is intended to empower families while reinforcing ThorpeWood's mission to promote wellness and environmental stewardship through nature.[130]

FRAMEWORKS FOR EVALUATING EQUITABLE ACCESS TO NATURE AND GREEN SPACE

To evaluate access to nature and green space in Frederick County and as well as current needs for residents, the Green Infrastructure Plan has incorporated several sources of data developed by the Maryland Department of Natural Resources. Maryland has supported recreational access and park development throughout the state since the late 1960's through initiatives like Program Open Space (POS). POS is one mechanism for providing dedicated funding to the state and to local governments to preserve natural resources, expand recreational opportunities, and enhance community livability.

More recently, the state launched new programs to proactively fund green spaces in underserved neighborhoods and communities, and these programs have involved researchers with the University of Maryland and other partners to improve equitable outcomes in the distribution of resources. Data from two of these programs, the Maryland Greenspace Equity Program and the Maryland Park Equity Program, has been incorporated into the equity mapping and equity discussion within the Green Infrastructure Plan. A discussion of both programs and the data developed for Frederick County is included in the following pages.

Maryland Greenspace Equity Program

In 2023, the Maryland General Assembly established the Greenspace Equity Program through legislation to address disparities in access to public green spaces across the state. Administered by the Maryland Department of Natural Resources (DNR), the program provides competitive grants to land trusts, nonprofits, and local governments to acquire, preserve, and improve green spaces in overburdened and underserved communities. These areas are identified based on environmental health risks and socioeconomic indicators such as income levels.

Program Description

The Governor's FY 2025 budget allocated $5 million to launch the program, with additional funding drawn from the state's share of Program Open Space. In its first year, the program received 40 applications requesting over $11 million, ultimately awarding $4.3 million to support 22 projects across 14 counties. These projects include trail restorations, urban farms, community gardens, and greenway expansions—each designed to enhance public health, foster community engagement, and promote environmental stewardship.

The Maryland Greenspace Equity Program uses the state's definitions of "overburdened" and "underserved" communities to identify areas facing disproportionate environmental and public health challenges. Lawmakers designed the program using these criteria—established in 2022 to support environmental justice at the census tract level—to enable agencies to apply standards consistently in permitting, enforcement, and funding decisions. State law defines both terms in the Environment Article, §1-701, which also outlines the specific indicators and thresholds used for identification. A description of both terms and the relevant thresholds and indicators is provided in the following paragraphs.

Overburdened Communities Definition

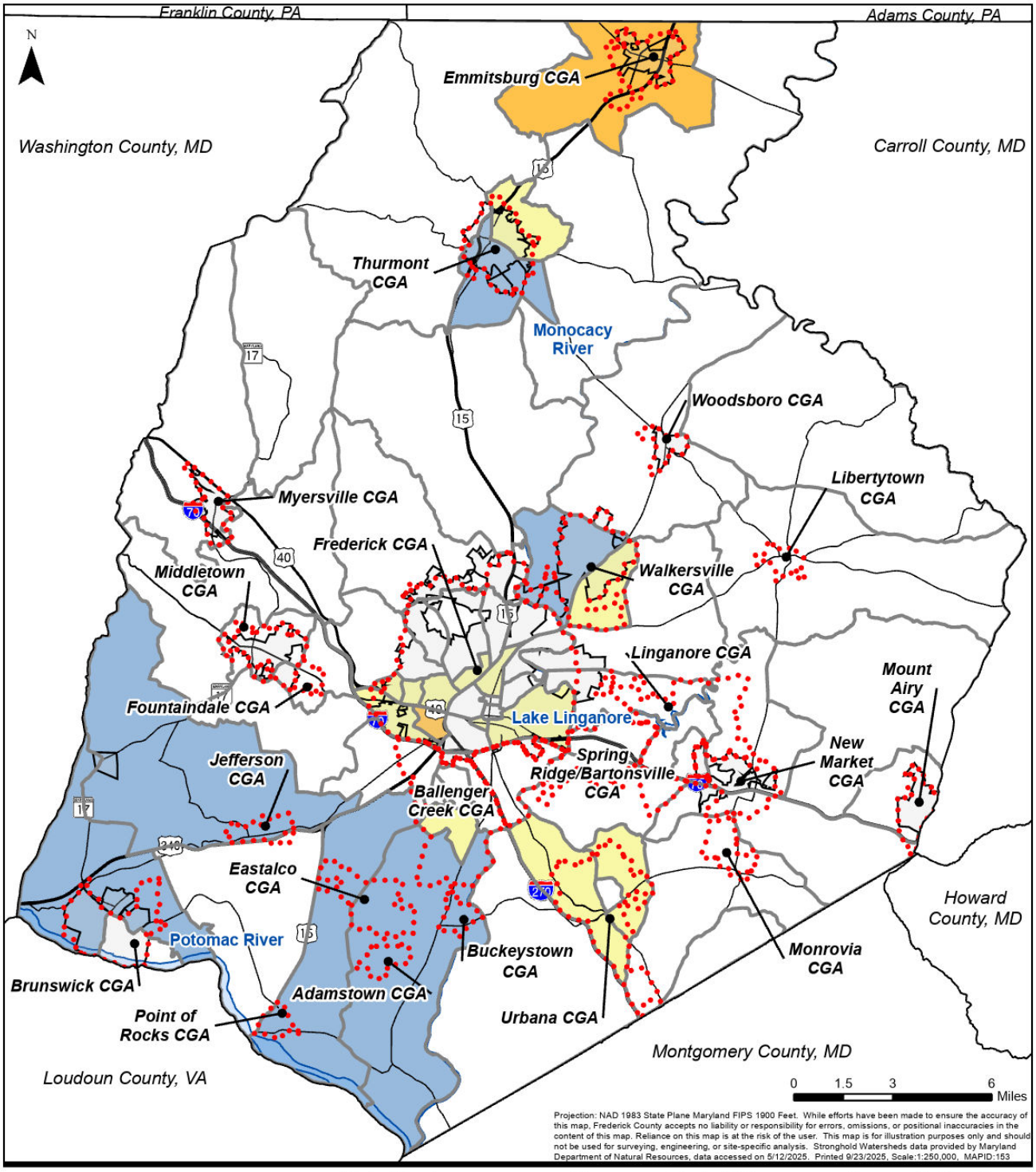
A census tract qualifies as an overburdened community when three or more environmental or health indicators exceed the 75th percentile for all census tracts statewide. By setting a percentile threshold and requiring multiple exceedances, the statute focuses on cumulative burdens rather than a single "hot-spot" metric. State and local agencies and the public can verify these conditions with Maryland's mapping tools and the underlying data the law references.[131]

Criteria for an overburdened community (must have ≥3 criteria above the statewide 75th percentile):

- Particulate Matter (PM)2.5 (a diameter of 2.5 micrometers or less)[132]
- Ozone
- National Air Toxics Assessment (NATA) Diesel PM (Particulate Matter)
- National Air Toxics Assessment (NATA) Cancer Risk
- National Air Toxics Assessment (NATA) Respiratory Hazard Index
- Traffic Proximity
- Lead Paint Indicator
- Superfund National Priorities List (NPL) Site Proximity
- Risk Management Plan (RMP) Facility Proximity
- Hazardous Waste Proximity
- Wastewater Discharge Indicator
- Proximity to a Concentrated Animal Feeding Operation (CAFO)
- Percent of Population Lacking Broadband Coverage
- Asthma Emergency-Room Discharges
- Myocardial Infarction (heart attack) Discharges
- % of Low-Birth-Weight Infants
- Proximity to Emitting Power Plants
- Proximity to a Toxic Release Inventory (TRI) Facility
- Proximity to a Brownfield Site
- Proximity to Mining Operations
- Proximity to a Hazardous-Waste Landfill

Underserved Communities Definition

A census tract counts as an underserved community when it meets any one of three demographic thresholds drawn from the most recent U.S. Census Bureau survey and related to income, race, or limited English proficiency. The concept of underserved communities is meant to ensure that structural barriers to participation in public processes don't exclude certain communities from access to representation and resources. In recent years, state programs have targeted investments, regulatory oversight, and community engagement efforts in underserved communities to advance environmental justice and ensure that vulnerable populations receive equitable protection and support.



Map 25: Maryland Greenspace Equity Mapping

Major Roads

Route Type

- Interstate
- US Highway
- US Alternate
- Business Route
- Maryland

Greenspace Equity (MD DNR)

Qualifying

- Overburdened
- Underserved
- Overburdened and Underserved

- Community Growth Area
- Streams, Rivers, Lakes
- Census Tracts

Specific criteria for an underserved community include (a qualifying tract meets any one of the following criteria):[133]

- At least 25% of Residents Qualify as Low-Income; or
- At least 50% of Residents Identify as Nonwhite; or
- At least 15% of Residents have Limited English Proficiency.

Agencies like the Maryland Department of Natural Resources apply this designation to prioritize investments in green infrastructure, public health, and environmental restoration projects. It should be noted that communities can meet the thresholds for one or both designations. In Frederick County, there are two census tracts that meet both qualifying thresholds, as indicated in Map 25.

Additional Information Regarding Overburdened and Underserved Communities

The Maryland Department of the Environment maintains the Maryland EnviroScreen Tool for the purposes of reviewing permit applications related to air quality control, landfill systems, water pollution, sewage sludge, and hazardous substances and materials. The EnviroScreen Tool was updated in June 2025 to integrate new data, refine methodology, enhance climate resilience assessment capability, and address certain policy changes at the state level. The most recent version of the tool can be viewed online at: https://mde.maryland.gov/Environmental_Justice/Pages/MDEnviroScreen.aspx. The Green Infrastructure Plan currently utilizes mapping prepared by the Maryland Department of Natural Resources developed for the Greenspace Equity and Park Equity Programs. Subsequent updates to that mapping should be considered with future updates to the Green Infrastructure Plan.

Greenspace Equity and the Green Infrastructure Network

As outlined in Chapter 3 of this Plan, the Environmental Equity Sub-Sector uses overburdened census tracts to define its geographic scope. While green infrastructure alone cannot eliminate environmental burdens such as proximity to brownfields or power plants, strategically investing in these areas can help mitigate their impacts. For example, planting forests or expanding the urban tree canopy can improve air quality, while constructing stormwater management systems and protecting streams and wetlands can enhance water quality in underserved communities.

In Frederick County, overburdened census tracts mapped by the Department of Natural Resources illustrate some consistent patterns in public health indicators. Nearly all overburdened tracts in the County uniformly identify with higher than average rates of treatment for asthma symptoms and hospital discharges related to heart conditions. Overburdened census tracts near municipalities also indicate higher reported rates of low birth weight in infants. **It is critically important to note that this data does not identify or imply a specific cause or location for these observed health effects. Rather, it is indicative of general trends that have been observed through objective data collection.** Furthermore, this data has been collected and analyzed because research has shown that some of these conditions can be alleviated through increased access to green space and the outdoors or through green infrastructure interventions.

In more rural parts of the county, overburdened tracts are frequently identified through mapped proximity to concentrated animal feeding operations (CAFOs), which may contribute to localized air and water quality concerns. Additionally, communities near mineral mining and processing sites may be designed because these facilities are listed in the EPA's Toxic Release Inventory or TRI.[134] Proximity to the County's Reichs Ford Road Landfill also contributes to the identification of one overburdened census tract to the south of the City of Frederick. **As with the health indicators discussed in the previous paragraph, it is important to note that this mapping does not imply an immediate threat to public health in proximity to these facilities.** Facilities like CAFOs, mineral processing, and landfills are all required to seek permits and registration that facilitates regulatory monitoring and oversight. Their inclusion in mapping of overburdened communities helps to ensure that no community harbors more than their fair share of these facilities.

It's important to note that the Environmental Equity Sub-Sector includes only those census tracts identified as overburdened unless a tract also meets the criteria for being underserved. This distinction exists because the factors used to define underserved communities are specifically addressed by the second program utilized in development of the Equity in Access Sub-Sector—the Maryland Park Equity Program.

The Greenspace Equity Viewer (Map) can be found online at the following location: https://maryland.maps.arcgis.com/apps/instant/basic/index.html?appid=10314674e5bf4bf692738541a7f702fb. The online map allows visitors to check scores for their census tract and learn more about each of the indicators. **(Note: The Greenspace Equity Viewer was discontinued prior to the publishing of this draft of the Green Infrastructure Plan. Requisite updates to this section of the Green Infrastructure Plan are anticipated as part of 60-Day Review).**

Maryland Park Equity

In 2023, the Maryland Department of Natural Resources (DNR) partnered with the University of Maryland to launch the Park Equity Program to address disparities in access to public parks and green spaces across Maryland. Recognizing that access to nature is a critical factor in public health, community resilience, and environmental justice, the program aims to identify and prioritize communities that lack sufficient access to park infrastructure. The initiative builds on the growing body of research—some of which was noted earlier in this chapter—showing that time spent in nature improves physical and mental health, especially for children and underserved populations.

Program Description

To guide its efforts, the program developed the Maryland Park Equity Mapper, a tool that combines demographic, environmental, and infrastructure data to assess park access at the census block group level. The methodology includes a composite scoring system that weighs factors such as the concentration of children, seniors, low-income residents, population density, proximity to existing park space, and the availability of public transit. These scores are evaluated and mapped to highlight areas with the greatest need for investment.

The Park Equity program awards competitively selected grants to land trusts, nonprofits, and local governments. These funds support the preservation, creation, and enhancement of public green spaces in communities that face significant environmental or access inequities. Starting in fiscal year 2025, the state will fund this program using allocations from the state share of Program Open Space, subject to annual

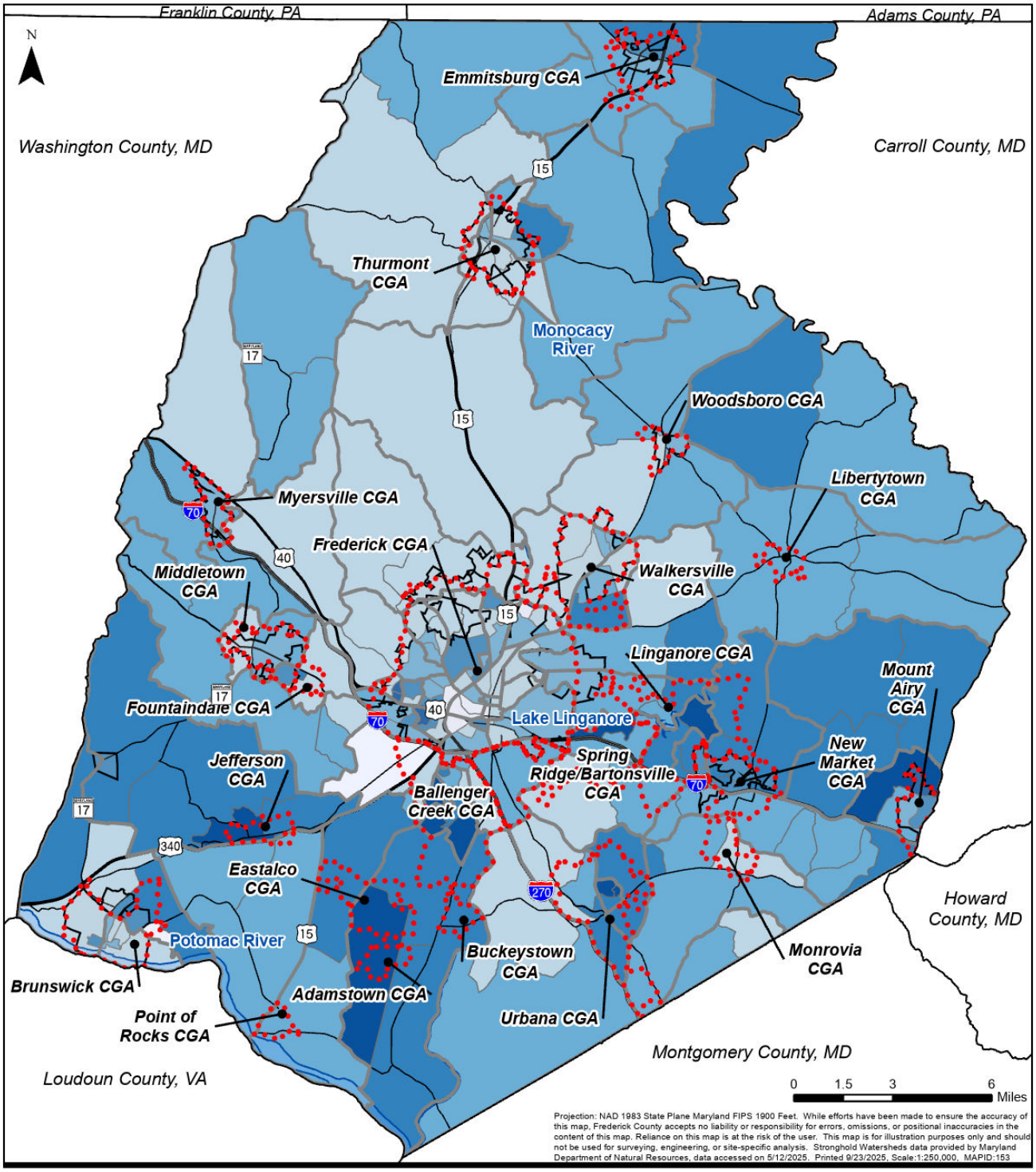
budget commitments. The purpose of the program is to marshal resources to close the green-space gap in communities that have historically suffered from a lack of recreational access.

Program Methodology

The program expressly targets underserved communities with a goal of identifying where the greatest need for park access lies. The Park Equity Model assigns scores to every census block group in the state based on a variety of factors, including:[135]

- Proximity to Public Park Space: Distance to facilities mapped in the latest edition of the Maryland Land Preservation and Recreation Plan. A greater distance to facilities equals a higher score.
- Ratio of Children: Ratio of the number of children aged Seventeen (≤17) and under relative to the total population. A higher ratio equals a higher score.
- Ratio of Seniors: Ratio of the number of adults aged Sixty-Five (65≥) and older relative to the total population. A higher ratio equals a higher score.
- (Population) Density: Number of residents per residential acres (as defined by urban lands in the 2002 Maryland Department of Planning land use/land cover data). Higher density equals a higher score.
- Low Wealth Score: The ratio of households at or below 185% of the county poverty level. A higher ratio equals a higher score.
- Non-White Score: The ratio of non-white to white individuals in that census tract compared to the average ratio of the state. A higher ratio equals a higher score.
- Walkability Score: The Walkability Index Score is based on the US Environmental Protection Agency model which includes the National Walkability Index (relative metric, higher values indicate conditions generally more conducive to pedestrian travel), an employment and household entropy factor, an 8-tier employment entropy (denominator set to the static 8 employment types in the CBG), an analysis of Street intersection density (weighted, auto-oriented intersections eliminated), and the distance from population weighted centroid to nearest transit stop (meters).
- Transit Access Score: The Public Transit Distance Score is based on the Accessibility Index from the United States Environmental Protection Agency. This is an index of the relative accessibility of a block group compared to other block groups in the same metropolitan region, as measured by travel time to the working-age population via transit.
- Linguistic Isolation Score: The Linguistic Isolation score is a measure of the number of households in which every member over the age of 14 speaks a non-English language and none speak English “very well”. A higher ratio equals a higher score.

In building the combined park equity score, the methodology intentionally double-weights two factors: distance to parks and percent non-white population—reflecting research showing these factors strongly correlate with inequitable park access. The remaining seven factors receive equal but lesser weight—each assigned weight 1/7 of the individual contribution.



Map 26: Maryland Park Equity Program Mapping

Major Roads
Route Type
- Interstate
- US Highway
- US Alternate
- Business Route
- Maryland

Park Equity Score (UMD)
Total_UMD
- 0.17 - 0.20 (High)
- 0.21 - 0.25
- 0.26-0.30
- 0.31-0.36
- 0.37 - 0.55 (Low)

- Municipalities
- Community Growth Area
- Census Tracts

Figure 18: The Park Equity Model

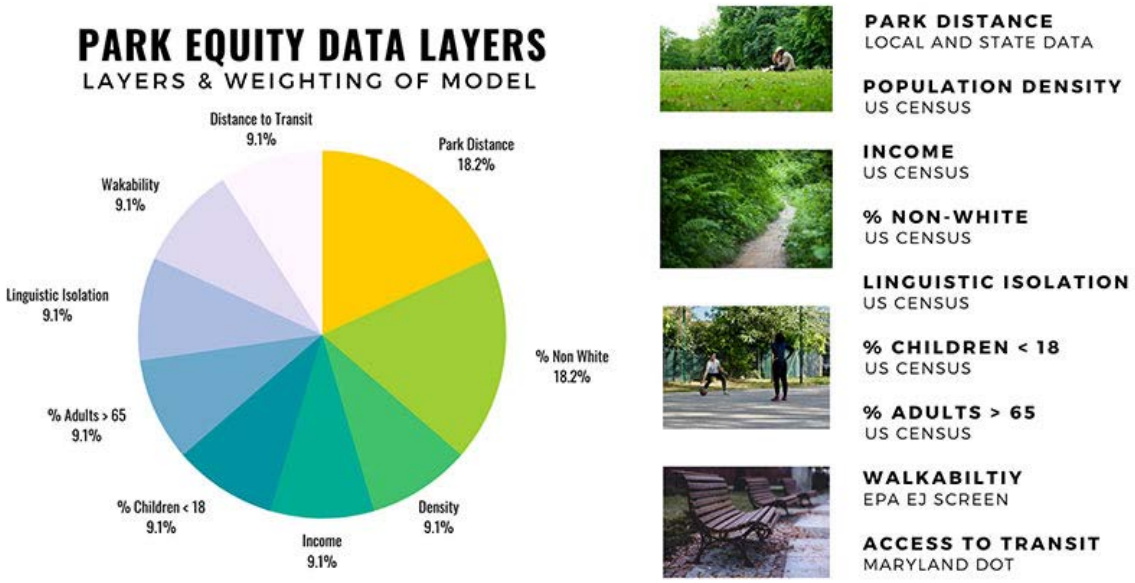


Image Credit: Park Equity Model. (n.d.). Maryland Department of Natural Resources. https://dnr.maryland.gov/Pages/ParkEquity_model.aspx

While the program and mapping include the capability to compare various counties, individual census blocks within a given County are compared with each other and not with blocks located in other counties. Each scoring category within a block is given a weight between 0.0 and 1.0, based on how it compares to other blocks within the same County. Once all categories within a tract are scored, they're totaled and divided to establish a mean score for the block.

Park Equity and the Green Infrastructure Network

Park Equity mapping was also used in the Equity of Access Sub-Sector to identify those areas in the County that could benefit from additional access to park facilities and green space. Map 26 illustrates the current scores for census blocks in Frederick County. The Park Equity Viewer (map) can be found online at https://p1.cgis.umd.edu/mdparkequity/ by anyone seeking more information regarding specific block scores. A brief description of high-scoring areas within Frederick County is provided in the following paragraphs.

The area surrounding the community of Adamstown, for example, scores very highly regarding the number of residents aged 17 and below and 65 and above in Park Equity mapping. In looking closely at the community of Adamstown, Green Hill Park is located centrally near the northern limits, but gaps in pedestrian facilities particularly along Mountville Road and Adamstown Road may contribute to a relatively low walkability score for the community.

The community of Jefferson scores similarly in Park Equity mapping due to a relatively high percentage of both younger and older residents. Unlike Adamstown, however, Jefferson does not possess a community park facility. Both Othello Regional Park and Catoctin Creek Nature Center are located near Jefferson (4.4 miles and 5.7 miles by road, respectively) but are most readily accessed by automobile and this contributes to a relatively low walkability score.

Specific census blocks both within and around the City of Frederick and the Urbana Community Growth Area are also identified as candidate areas for more green space and park access by the Park Equity Program. Park Equity scores for distance to parks, access to transit, and walkability are generally some of the best scores in the entire County in these communities, but they also possess diverse populations with some of the highest percentages of their population being age 17 or younger. The City of Frederick boasts many park facilities, and the community of Urbana is home to both the Urbana Parks and the Urbana District Park. Mapping indicates that park facilities in these communities are clearly meeting a significant existing need, and more investment may be prudent. The implementation of additional green infrastructure measures in these areas, like increases to community tree canopy, could help mitigate some of the negative health impacts associated with life in more densely developed communities, like the urban heat-island effect.

In both the southwestern and northeastern limits of the County, higher than average populations of older residents combine with a general lack of pedestrian facilities and a reliance on automobile transport to result in relatively high scores that, as a result, indicate a general need for more access to recreational facilities. While the incorporation of some types of green infrastructure in and around these communities may not fully resolve access to park facilities and green space, it could certainly provide some ancillary benefits mentioned in both Chapter 3 and Chapter 4 of this Plan.

TREE EQUITY

As noted earlier in this chapter, a healthy tree canopy plays a vital role in enhancing quality of life across urban, suburban, and rural environments. In cities, tree cover helps mitigate the urban heat island effect by lowering temperatures, reducing air pollution, and filtering stormwater runoff—directly benefiting public health and reducing infrastructure stress. Studies show that urban tree canopy can cool ambient air by up to 9°F and reduce residential energy use by 30% during peak summer months.[136,137] Additionally, trees have been shown to improve mental well-being, promote physical activity, and increase social cohesion by making neighborhoods more pleasant and walkable.[138] In suburbs, where car-centric development can create fragmented landscapes, trees provide critical ecological connections, reduce noise pollution, and enhance property values.

In rural settings, a robust tree canopy supports agricultural sustainability, water quality, and biodiversity. Trees act as windbreaks, stabilize soil, and offer shade for livestock. Riparian buffers and reforestation on marginal lands improve watershed health and support habitat connectivity. Across all landscapes, trees sequester carbon and help communities adapt to climate change. The U.S. Forest Service emphasizes that tree canopy is a cost-effective strategy for building climate resilience, reducing disaster risk, and improving environmental equity—especially when planting is guided by the principles of environmental justice discussed earlier in this chapter. Regardless of the geography, a healthy tree canopy isn't just an amenity, it's essential infrastructure for thriving, sustainable communities.

Image 35: Fall color in riparian buffers on the Monocacy Scenic River at Monocacy National Battlefield (U.S. National Park)

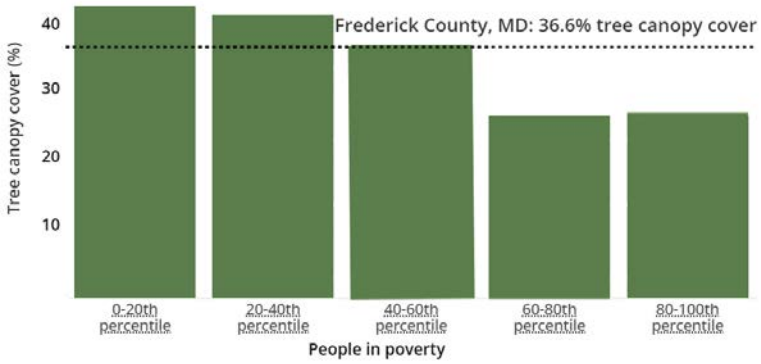
(Image Credit: Alonnie Ropp)

American Forests Assessment (Tree Equity Score)

The non-profit conservation organization, American Forests, has developed the Tree Equity Score mapping system to aid states, counties, and municipalities in assessing existing tree canopy cover and the allocation of existing tree canopy cover based on factors like age, race, income, and health burden. The Tree Equity Score mapper utilizes tree canopy data from the Google Environmental Insights Explorer, data from the 2020 US Census, and data from the US Census Bureau's American Community Survey (2017 – 2021) for mapping and analytical purposes. [139]

For those areas of Frederick County that have been mapped by the organization, American Forests indicates that communities with population concentrations above the 60th percentile for the total number of residents living in poverty, there is a corresponding 26% +/- deficit in tree canopy cover when compared to populations in the 0 to 60th percentile. In other words, areas with increased concentrations of residents living in poverty have fewer trees and receive fewer benefits associated with the presence of trees.

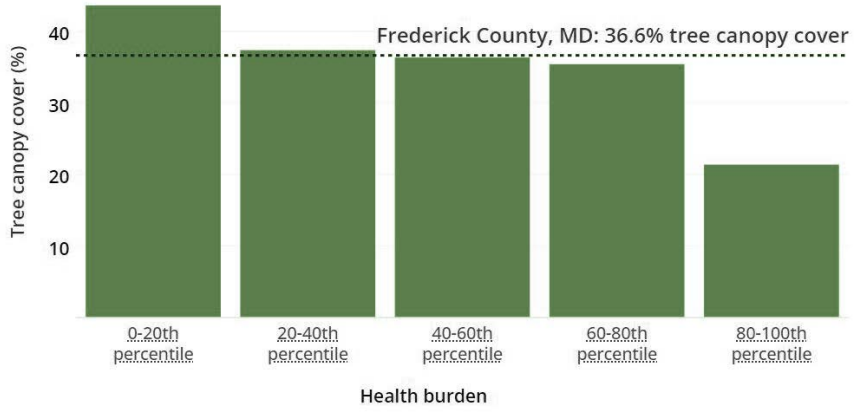
Figure 19: Relationship Between the Percentage of Population in Poverty and Tree Canopy Coverage



Source: American Forests. Tree Equity Score: A Tool for Climate and Health Equity. 2021. https://www.treeequityscore.org/.

Tree canopy coverage can also be correlated to public health. Neighborhoods with the highest indicated levels of health burden (top 20% of surveyed tracts for self-reported prevalence of poor mental health, poor physical health, asthma, and heart disease in an equally weighted index), display a corresponding 42% deficit in tree canopy coverage.

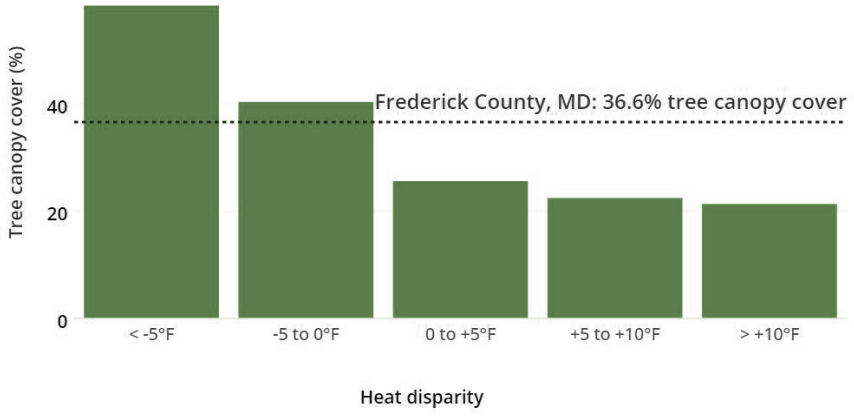
Figure 20: Relationship Between the % of Population Experiencing a Health Burden and Tree Canopy Coverage



Source: Self-reported poor mental or physical health, asthma, or heart disease in an equally weighted index per CDC PLACES data.

The presence or absence of tree canopy coverage also correlates with heat disparities within communities. There is widespread evidence that the presence of trees can mitigate high summer temperatures through both shading and transpiration (the evaporation of water through leaves). These benefits can be particularly important in more developed communities due to the prevalence of paved surfaces and roofs. American Forests reports that cooler neighborhoods (heat disparity of 0 to -5°F) have on average 80% more tree canopy compared to hotter neighborhoods (heat disparity of +5 to +10°F).

Figure 21: Relationship Between Tree Canopy Coverage and Heat Disparity



Heat disparity compares the average block group heat extremity with the urban area average to measure variance in heat severity across an area. Based on Summer 2022 temperatures analyzed at 30-meter resolution for all U.S. urban areas. Data utilized from USGS Earth Explorer – Landsat 8, Collection 2, Level 2 Surface Temperature.

3-30-300 Rule

Addressing inequalities in access to benefits that can be derived from tree canopy requires a new way of thinking about how we manage tree canopy within our communities. As noted earlier in this chapter in the discussion of environmental justice, we must reject the assumption that untargeted greening efforts will naturally benefit those most in need and instead prioritize underserved neighborhoods from the outset. Empowering residents through compensated training, engaging them in participatory planning, and providing access to decision-making tools like geographic information systems (GIS) and online, interactive dashboards that collect community feedback ensures that communities have a role in shaping their own environmental futures. Several of these actions are currently being piloted by Mobilize Frederick in the City of Frederick in the form of the Cooler Neighborhoods project mentioned in Chapter 3 of this Plan under the discussion of tree canopy and green infrastructure.

The 3-30-300 Rule has gained popularity in recent years on a global scale as another means for addressing equity in tree canopy. It was developed by urban forestry expert Dr. Cecil Konijnendijk and has been discussed in publications and presentations around the world. This rule provides a clear, evidence-based framework for integrating green infrastructure into planning decisions. The rule has a specific metric tied to each number included in the name, and they indicate that:

- Three **(3):** Every resident should be able to see at least three trees from their home, school, or workplace. This visual connection to nature supports mental well-being and reduces stress.
- Thirty **(30)**: Neighborhoods should aim for a minimum of 30% tree canopy cover, which contributes to cooling, air quality, biodiversity, and stormwater management.
- Three-Hundred **(300)**: Everyone should live within 300 meters (1,000 +/- feet) of a high-quality public green space, ensuring equitable access to recreational and restorative outdoor environments.

In a January 2024 paper, published in the journal *Elseveier* and titled, *"Measuring the 3-30-300 Rule to Help Cities Meet Nature Access Thresholds,"* the authors evaluate the 3-30-300 rule as a promising framework for promoting equitable access to urban nature. To support implementation of the rule, the authors convened a team of experts who identified categories of data and analytical methods that communities can use to evaluate the three metrics: vegetation indices, street-level imagery analyses, tree inventories, questionnaires, window-view analyses, land cover maps, and green space property maps. For each metric, they identified the most plausible methods for implementing a 3-30-300 Rule program. For example, they recommend using resident surveys and viewshed analyses to assess visual access to trees, high-resolution land use land cover maps to measure canopy, and GIS-based network analyses to determine proximity to green space.

It is important to note that ecological context matters when implementing the 3-30-300 rule. In some regions, such arid environments, achieving 30% canopy cover may be unrealistic. This is likely not a factor in Frederick County. As noted in Chapter 2 of this Plan, the County currently stands at approximately 43% overall canopy cover, with much of that canopy being in forests in more rural areas. The Metropolitan Washington Council of Governments (MWCOG), of which Frederick County is a member jurisdiction, is currently looking at tree canopy on a regional scale. In April 2024 MWCOG's Regional Tree Canopy

Subcommittee (RTCS) released a report titled “Conserving Trees and Forests in Metropolitan Washington,” which proposed a maintained, minimum 50% tree canopy threshold for the greater Washington Region.[140]

Adoption of the 30% in each census tract goal seems achievable, given both the County and regional context. A focus on those areas that currently do not meet the threshold as identified in Sub-Sector mapping, and those highlighted as Green Equity Areas in the Green Infrastructure Network Map in Chapter 3 could be potential areas to start implementing the 3-30-300 Rule.

Image 36: Frederick City Hall and Tree Canopy in the City of Frederick.

(Image Credit: Matthew Binebrink via Wikimedia Commons)

Additionally, and importantly, community trust and engagement are critical. In many U.S. cities, marginalized communities have resisted top-down tree planting due to historic disinvestment, maintenance burdens, and lack of consultation. To be effective and just, 3-30-300 efforts must be flexible, participatory, and responsive to local needs in ways that have been discussed earlier in this chapter.

To reiterate, in Frederick County, the 3-30-300 framework could serve as a highly relevant and realistically achievable metric to address those areas currently below the 30% tree canopy threshold. The county features a mix of urbanizing areas like the City of Frederick and the South Frederick Corridors that present opportunities for the incorporation of additional tree canopy through redevelopment. In the South Frederick Corridors, where infill development and increasing density are pressing needs to help revitalize the area and meet the County’s housing needs, integrating more trees into public rights-of-way, newly created public and shared spaces, and as part of redevelopment projects can help meet the “3” and “30” targets. Both the City of Frederick and the County maintain strong park systems, and both have focused on increasing tree planting efforts in parks in recent years. Such tree planting efforts could also serve as a foundation to build upon for the “3” and “30” goals.

In suburban and rural parts of the county, the 3-30-300 rule could guide future planning, especially as growth pressures increase and the County's housing needs are addressed through new construction and redevelopment. As new projects are proposed, using this rule could help ensure that greenspace access is not an afterthought, but a baseline requirement. Future revisions to both planning documents and the County's Zoning Ordinance should also consider proximity to green space, particularly in areas where higher density zoning results in private, individually owned or maintained open space.

Moreover, as Frederick County emphasizes climate adaptation and resilience in its comprehensive planning, the integration of community surveys, high-resolution canopy mapping, local open space, and green infrastructure investment—as recommended in this Plan—can help the county meet the County's sustainability goals while advancing health and equity. The following Chapter of this Plan will identify additional actions that might be taken in support of the topics discussed in both Chapter 3 and this chapter of the Plan, as well as potential metrics for tracking implementation and success over time.

Chapter Endnotes

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119 Also often identified as "environmental racism," a term defined by Dr. Benjamin F. Chavis, Jr., that reflects the disproportionate exposure of communities of color and/or low-income communities to environmental hazards.

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130 <https://frederickcountymd.gov/DocumentCenter/View/354611/CAC-ThorpeWood-Partnership-122624>.

131 Maryland General Assembly, Md. Code, Environment, §1-701(a)(7).

132 A single human hair is 50 to 70 micrometers in diameter.

133 Maryland General Assembly, Md. Code, Environment, §1-701(a)(8).

134 The EPA's Toxics Release Inventory (TRI) Program requires certain industrial facilities to report the quantities of specific toxic chemicals they release into the air, water, and land. This data helps the public, researchers, and policymakers track pollution sources, assess environmental health risks, and support informed decision-making at the local and national levels. More information on the TRI can be found at: https://www.epa.gov/toxics-release-inventory-tri-program.

135 <https://dnr.maryland.gov/Pages/ParkEquity_model.aspx>.

136 U.S. Environmental Protection Agency. "Using Trees and Vegetation to Reduce Heat Islands." 2023. https://www.epa.gov/heatislands

137 Nowak, David J., et al. "Tree and forest effects on air quality and human health in the United States." Environmental Pollution, vol. 193, 2014, pp. 119–129.

138 Kuo, Frances E. "How might contact with nature promote human health? Promising mechanisms and a possible central pathway." Frontiers in Psychology, Vol. 6, 2015, article 1093.

139 American Forests. Tree Equity Score: A Tool for Climate and Health Equity. 2021. <https://www.treeequityscore.org/>.

140 The report was developed in response to tree canopy losses between the years 2013 and 2018 that were discussed in Chapter 2 of this report and that brought about Frederick County's reinstatement of its "no net loss" policy in the Forest Resources Ordinance (FRO). MWCOG estimated the regional canopy at 49.6% in 2023 in the report, down from 50.6% in 2014. <https://www.mwcog.org/documents/2024/04/10/conserving-trees-and-forests-in-metropolitan-washington-climate--energy-tree-canopy/>.

Chapter 5

Recommendations & Implementation

EXECUTIVE SUMMARY

Chapter 5 of the Green Infrastructure Plan presents a framework for preserving green infrastructure where it exists in Frederick County and, also, for expanding its implementation. Establishing the Green Infrastructure Network, as mapped in the Plan, highlights those areas in the County where actions can achieve the most positive effects for both the ecosystem and residents. The Action Framework is intended to assist green infrastructure implementation through changes to the County's Comprehensive Plan, policies, and regulations, and by fostering new and expanded partnerships in the County.

Table 7 outlines the goals, initiatives, and supporting initiatives from the Green Infrastructure Plan's Action Framework. More information about each of the proposed actions follows in this chapter.

COMPREHENSIVE PLAN MAP & COMPREHENSIVE REZONING RECOMMENDATIONS

The Green Infrastructure Plan proposes no concurrent changes to the Comprehensive Plan Map and no concurrent changes to the zoning. However, certain components of the Action Framework described in this chapter propose future actions regarding the Comprehensive Plan and zoning regulations that may be undertaken in support of the Initiatives outlined in this Plan and the Goals in the Livable Frederick Master Plan.

GREEN INFRASTRUCTURE PLAN ACTION FRAMEWORK

The Green Infrastructure Plan continues the Action Framework of the Livable Frederick Master Plan. Goals in the Action Framework articulate a broad purpose, initiatives offer more specific direction for achieving each goal, while supporting initiatives provide the most specific level of detail for implementation. Initiatives and supporting initiatives can also be cross-cutting and interconnected in the ways they support goals.

An Implementation Matrix was established as part of the Livable Frederick Master Plan (LFMP), organizing all proposed actions and policies—goals, initiatives, and supporting initiatives—into a clear, accessible chart that helps stakeholders identify policies to implement or actions that can be taken in support of the LFMP's Vision and to track progress. The Implementation Matrix emphasizes collaboration across agencies, organizations, and stakeholders—assigning leadership roles where appropriate and encouraging partnerships with non-governmental partners. The Implementation Matrix was also designed as both a checklist and a strategic guide that supports periodic evaluations to ensure accountability.

Table 7: Green Infrastructure Plan Action Framework

Goal	Initiative Name	Supporting Initiative (Summary)
Natural Resources & Green Infrastructure	The Future of Green Infrastructure	Evaluate or update the Green Infrastructure Network on a recurring five-year basis.
	Multi-Modal Connectivity	Support municipalities becoming Appalachian Trail Communities.
		Partner with municipalities and other counties to pursue grants related to regional trails and multi-modal connectivity.
		Prioritize bikeway and trail connections between communities and nearby public parks.
	Environmental Equity	Add Green Equity Areas to the list of priority retention and reforestation areas under the Forest Resources Ordinance (FRO).
		Incorporate the principles of the 3-30-300 Rule in planning efforts and land use regulations.
		Support policies to establish a minimum 30% tree canopy cover (or more) at the census tract, community growth area, and/or municipal level.
		Revisit green space requirements in high-density residential and mixed-use zoning districts to improve access to green space.
	Habitat Connectivity	Increase the minimum width of stream buffers to 100 feet.
		Explore the adoption of Low- and No-Mow practices at all County facilities.
		Expand the adoption of Integrated Pest Management (IPM) practices across County government.
		Pursue designation as a “Bee County” under the Bee City USA Network.
		Work with federal, state, and local partners to install a wildlife overpass where Interstate 70 crosses South Mountain.
		Develop a wildlife monitoring and wildlife crossing installation program to improve motorist and wildlife safety.
		Promote participation in the Maryland Forest Legacy Program.
		Advocate for the adoption of Integrated Vegetation Management (IVM) standards for all utility transmission corridors.
	Recreation & Environmental Education	Develop a new “linear” park type as part of the LPPRP.
		Develop a new “urban” park type as part of the LPPRP.
	Climate Mitigation & Community Resiliency	Revisit the Natural Resources Land Use Designation mapping in the County to better align it with current FEMA floodplain limits.
		Critically reassess land use designations as part of future corridor and small areas plans to protect sensitive areas and green infrastructure.
		Consider green infrastructure and sensitive areas as part of Express Approval requests and annexations.
		Set priorities for the use of land conservation funds near communities.

The Livable Frederick Master Plan 5-Year Dashboard

The Maryland Department of Planning requires a mid-cycle (5-year) report for local government comprehensive plans. The Livable Frederick Master Plan was adopted on September 3, 2019, and the County's mid-cycle report was submitted on June 20, 2025, containing data for the period between 2020 and 2024. An online dashboard was published concurrent with the issuance of the report, and it allows users to check in the status of various goals, initiatives, and supporting initiatives from the LFMP. The Dashboard represents a collaborative effort between County Staff, municipalities, and other public and private sector partners in Frederick County to implement the LFMP. The Dashboard can be viewed online here: https://livable-frederick-fcgmd.hub.arcgis.com/.

The following section highlights those goals, initiatives, and supporting initiatives from the LFMP related to the Green Infrastructure Plan. Additional goals in the LFMP related to the Vision for Our Environment remain part of the County's Comprehensive Plan, and they are just as important to achieving the Vision for Our Environment as are new initiatives and supporting initiatives identified in this chapter.

LIVABLE FREDERICK MASTER PLAN GOALS, INITIATIVES, AND SUPPORTING INITIATIVES

The following goals, initiatives, and supporting initiatives were identified in the Livable Frederick Master Plan and relate to the Green Infrastructure Plan and/or topics addressed by this plan. The Green Infrastructure Plan directly addresses several of these initiatives, particularly the initiative related to its development. Some of the supporting initiatives under the Green Infrastructure Plan, Tree Canopy & Forest Coverage, and Outreach for Ecology Initiatives have also been further refined or expanded as part of new supporting initiatives later in this section.

Goal: Natural Resources and Green Infrastructure

The natural environment and its habitat provision and ecosystem services are critical to our quality of life, and so they should be the primary consideration in all land planning and governmental decision-making processes.

Initiative: Green Infrastructure Plan

Develop and implement a functional green infrastructure plan to protect, connect, and enhance the county's natural assets and support their role in ensuring future resilience in the county.

Supporting Initiatives:

1. Establish a regular cycle of review of environmental protection and conservation ordinances and processes with the aim of ensuring protections for clean air, land, and water.
2. Critically examine the land use designations and zoning applied to green infrastructure and other sensitive environmental resources within Community Growth Areas.

3. Incorporate natural resource protection and restoration in addition to active recreational elements in the development of all county parkland.

4. Enhance the protection measures for significant natural resources and highly sensitive environmental features through regulatory, voluntary, and incentive based programs.

5. Improve the site plan review process to identify, confirm, and protect natural resources.

6. Control and mitigate invasive and exotic species (flora and fauna) to help maintain the diversity and health of forestlands, native plants, animal populations, waterways, and habitats.

Initiative: Tree Canopy & Forest Coverage

Increase tree canopy coverage and riparian forest acreage in Frederick County.

Supporting Initiatives:

1. Analyze and identify a numerical goal to achieve – primarily through the voluntary efforts of Frederick County landowners - an increase in the 2040 forest coverage in Frederick County to enhance forest corridors and hubs.

2. Develop goals to increase and enhance the performance of riparian forests and vegetation along Frederick County's waterways for years 2025 and 2040 through voluntary and incentive-based programs.

3. Examine our Community Growth Areas for the presence of significant natural resources and develop enhanced measures to minimize their degradation and loss.

4. Enhance the Forest Resource Ordinance for development occurring in growth areas to protect significant and connected forestlands.

5. Expand and fully utilize voluntary and incentive-based programs, including the county's Creek ReLeaf program, to increase tree canopy and riparian forest acreage in the county.

Initiative: Outreach for Ecology

Increase the public's general knowledge about ecology and environmental sustainability.

Supporting Initiatives:

1. Expand public outreach for the county's Stormwater Program (MS4 Permit) and communicate ways to reduce nutrient and sediment loads in areas dominated by non-point source pollution.

2. Develop and implement an effective public outreach program with the Board of Education, libraries, and other educational institutions.

3. Work with the Division of Parks and Recreation to include educational elements in county parks.

GREEN INFRASTRUCTURE PLAN INITIATIVES

As noted earlier in this chapter, the Green Infrastructure Plan does not introduce any new goals to the Livable Frederick Master Plan Action Framework, but it does propose several new initiatives that directly support the existing Goal of "Natural Resources and Green Infrastructure." These initiatives aim to strengthen the county's commitment to preserving ecological assets, enhancing connectivity between natural areas, and promoting sustainable land use practices, all while aligning with the broader Vision outlined in the Livable Frederick Master Plan. The new initiatives have been, for the most part, organized around the five core principles and Sub-Sectors identified in the Green infrastructure Plan.

New initiatives and supporting initiatives are as follows:

Initiative: The Future of Green Infrastructure

Adopt the following policy to ensure future relevancy and functionality of the Green Infrastructure Plan.

Supporting Initiatives:

1. Prepare a report evaluating the implementation of, and/or update, the Green Infrastructure Plan on a recurring basis of five (5) years to address evolving conditions and needs related to green infrastructure in the County.

Initiative: Multi-Modal Connectivity

Continue to improve multi-modal accessibility within and between communities.

Supporting Initiatives:

1. Support incorporated municipalities in Frederick County in pursuing designation as "Appalachian Trail Communities" as a means of accessing grant funding and promoting the local outdoor economy.
2. Actively seek opportunities to partner with both incorporated municipalities and neighboring counties on grant applications related to multi-modal connectivity as a means of improving multi-modal connectivity throughout the region, particularly as they apply to the Appalachian Trail and the Chesapeake and Ohio Canal Towpath.
3. Prioritize implementation for bikeway and trail segments between residential areas and existing County parks in the Bikeways and Trails Plan, particularly in Green Equity Areas.

Initiative: Environmental Equity

Implement the following actions through legislation and future planning to improve resilience, better protect sensitive areas where they exist in developed communities, and to improve the quality and functionality of green space.

Supporting Initiatives:

1. Add Green Equity Areas to the list of priority retention and reforestation areas under the Forest Resources Ordinance (FRO) to increase tree canopy and the provision of ecosystem services in these areas.

2. Incorporate the principles of the 3-30-300 Rule into planning and land use regulations to promote environmental equity and environmental justice in future planning efforts.

3. Support policies for urban and rural forestry programs to prioritize a minimum of 30% tree canopy cover at the census tract, community growth area, and/or municipal levels to increase overall tree canopy coverage in communities in an equitable manner.

4. Revisit and/or adopt green-space requirements in high-density residential and mixed-use zoning districts to ensure all residents have access to quality outdoor environments and green space within approximately 1/4 mile of their residence.

Initiative: Habitat Connectivity

Improve the functionality of habitat corridors and hubs in the County and also within established communities.

Supporting Initiatives:

1. Increase the minimum width of a Stream Buffer as it is defined in 1-21.5 – Definitions of Chapter 1-21: Forest Resources in the Frederick County Code of Ordinances to bring the minimum width of a stream buffer width into agreement with the minimum width for a waterbody buffer (100 feet) to further protect local waterways and enhance riparian buffers and corridors.[141]

2. Continue to explore the adoption of Low- and No-Mow landscape management practices for Low Traffic Turf Areas (LTTAs) on all County facilities to improve air quality, stormwater infiltration, and increase grassland habitat throughout the County (Adapted from the Climate Response and Resilience Report, 2021).

3. Encourage all Divisions and Offices in Frederick County Government to adopt Integrated Pest Management (IPM) policies to reduce the exposure of employees and community members to toxic substances and to make the County more pollinator-friendly.

4. Pursue designation as a "Bee County" under the Bee City USA Network to leverage educational resources and potential publicity to promote the benefits of increasing pollinator habitat in the County.

5. Begin a dialogue with the Maryland Department of Transportation's State Highway Administration, local legislators and lawmakers, the Federal Highway Administration, and any other applicable parties to explore a future wildlife overpass near the Annapolis Rock & Black Rock Cliff Trailhead at Interstate 70 and Baltimore National Pike (US 40), west of Myersville, MD to enhance a regionally significant wildlife corridor in the face of a changing climate.

6. Develop a wildlife crossing monitoring and installation program for County roads to reduce "deer-vehicle collisions" (DVCs) and other traffic incidents involving wildlife with the goal of making County roads safer for motorists and wildlife in Frederick County and to harness potential costs savings for both Frederick County road maintenance operations and for residents.[142]

7. Promote participation in the State of Maryland's Forest Legacy Program to owners of qualifying, significantly forested lands that could be subject to permanent clearing or loss.

8. Advocate for the application of Integrated Vegetation Management for utility transmission corridors in Frederick County and for owners and managers of such corridors to pursue independent accreditation with the Right-of-Way Stewardship Council or a similar organization promoting the management of transmission corridors for wildlife habitat.

Initiative: Recreation & Environmental Education

Implement the following actions through an update to the Land Preservation, Parks, and Recreation Plan to accommodate both the growing need for parks and new roles that parks might fulfill in the future.

Supporting Initiatives:

1. Develop a new park type and new standards for the development and management of "linear parks" as part of updates to the County Land Preservation, Parks, and Recreation Plan, like the Ballenger Creek Linear Trail, to improve multi-modal accessibility, access to parks from multiple properties and neighborhoods, and to function as potential habitat corridors within and between communities.

2. Develop a new park type and new standards for the development and management of "urban parks" as part of updates to the County Land Preservation, Parks, and Recreation Plan, to ensure that parks and open space, like those that will be established under the South Frederick Corridors Plan, are appropriately funded, sited, programmed, and maintained.

Initiative: Climate Mitigation & Community Resiliency

Implement the following actions through legislation and future planning efforts to improve resilience, better protect sensitive areas where they exist, and to leverage ecosystem services provided by green space in developed communities.

Supporting Initiatives:

1. Revisit the extent of Natural Resources Land Use designation mapping in the context of current Federal Emergency Management Agency (FEMA) 100-Year Floodplain mapping to improve resilience in the County.

2. Small Area and Corridor Plans are an opportunity for more detailed planning analysis for designated growth areas than County-wide plans. Frederick County Planning should adopt a policy to critically reassess land use designations and zoning with a focus on green infrastructure, sensitive environmental resources, and opportunities to improve community resiliency as part of these targeted planning efforts in the future.

3. Consult the Green Infrastructure Network Map when reviewing and evaluating requests for municipal annexations and Express Approval in accordance with the Code of Maryland, Local Government, §4-416 and note the presence of green infrastructure in staff reports and correspondence to ensure protection of sensitive areas during regulatory transition and future development.

4. Adopt a policy that prioritizes the use of public funds for land conservation within, or directly adjacent to, municipalities and community growth areas to protect environmentally sensitive areas, historic resources, or to establish park land.

METHODS AND METRICS FOR TRACKING GREEN INFRASTRUCTURE IMPLEMENTATION

Objective evaluation is a critical component for determining the relative success of collaborative decision-making processes. Implementation tracking plays a vital role in community and green infrastructure planning. It ensures that plans move beyond vision and policy and into measurable action. By actively monitoring progress, planners can identify whether projects are meeting their intended goals—such as improving habitat connectivity, increasing tree canopy, or improving community access to green spaces. Creating a feedback loop allows for needed adjustments and helps avoid misaligned outcomes.

Implementation tracking also fosters transparency and accountability. Stakeholders, including residents, local officials, and funding partners, can see tangible progress and understand how their input shapes the built environment. Tracking builds trust and encourages continued engagement, which is essential for long-term success and stewardship of green infrastructure. Moreover, tracking implementation helps planners evaluate the effectiveness of different strategies. By comparing outcomes across projects, they can refine best practices and allocate resources more efficiently. This plan suggests a five-year rolling evaluation and/or update cycle because it coincides with the current release schedule for Land Use/Land Cover (LULC) data from the Chesapeake Conservancy and its partners. This data represents an objective, peer reviewed, analysis of land use and land cover trends in Frederick County and the Chesapeake Bay Watershed. Data sets like the LULC will be integral to some of the implementation tracking mechanisms identified below.

The following implementation tracking mechanisms and metrics are proposed as part of the Green Infrastructure Plan:

Green Infrastructure Network Map Updates as Implementation Tracking (% Protected)

The Frederick County Green Infrastructure Network Map indicates that approximately __% of the land mapped as green infrastructure in this Plan is protected by through public ownership or easement. Subsequent evaluations of the network or updates to the Green Infrastructure Plan should reassess the percentage of land identified as potential green infrastructure and revisit the percentage accordingly. Notably, such evaluations should also attempt to highlight potential gaps between areas of protected land in the network that could be closed through one or more of the avenues outlined in the Plan.

Net Increase/Decrease in Tree Cover (Acres)

Maintaining healthy and abundant tree and forest canopy plays a critical role in supporting environmental quality, public health, and community resilience. As noted throughout this Plan, trees actively filter air pollutants, reduce stormwater runoff, and moderate urban heat, making neighborhoods cooler and more livable. A robust canopy also protects local waterways by stabilizing soil and filtering rain before it reaches streams and rivers. In rural and suburban areas, trees preserve scenic character and provide essential habitat for wildlife. As development continues, preserving and expanding the tree canopy ensures that Frederick County retains its natural beauty while enhancing climate resilience and quality of life for residents.

The 2025 release of the Chesapeake Bay Program's Land Use & Land Cover indicates the County's forest canopy coverage currently stands at 43% of the County's total land area based on 2021 data. Monitoring this percentage over time and taking actions to increase it will have multiple benefits for Frederick County.

Net increase/decrease in Wetlands (Acres)

Wetlands face significant risks from climate change, including altered precipitation patterns, rising temperatures, and sea level rise, which can disrupt their structure, function, and biodiversity. These changes also threaten wetlands' ability to store carbon, manage water quality, and support diverse habitats. Despite their potential vulnerability, wetlands play a crucial role in both mitigating and adapting to climate change. They act as carbon sinks, help regulate floods, filter pollutants, and recharge groundwater. Their natural resilience, shaped by cycles of wet and dry phases, may allow many wetlands to continue providing essential ecosystem services even as climate conditions shift.

The 2025 release of the Chesapeake Bay Program's Land Use & Land Cover data identified approximately 202.3 acres of wetlands of various types of wetlands in Frederick County based on 2021 data.[143]

Net Increase in Publicly-Owned Park Land (Acres)

Frederick County actively tracks the amount of available park land as part of the Land Preservation, Parks and Recreation Plan. Frederick County actively maintains and expands its parkland to support a high quality of life, protect natural resources, and meet the needs of a growing population. Parks provide essential spaces for recreation, community gatherings, and outdoor education, while also preserving green space that helps manage stormwater, improve air quality, and support biodiversity. As development increases, growing the amount of parkland ensures that all residents have access to nature and recreational opportunities, reinforcing the county's commitment to health, sustainability, and livability.

Percentage of Residents Reporting Ready Access to Parks or Green Space

The Frederick County Land Preservation, Parks, and Recreation Plan (LPPRP) surveys County residents to ascertain demographic and park usage data use in preparation of the LPPRP. The results of these surveys can also include information about travel times and travel modes that residents use to reach County park facilities. The results of these surveys can be utilized to identify trends in both travel time and predominant modes of access. Reductions in reported travel times and increases in the percentage of trips being made without the use of a personal car should be tracked as potential indicators of improved multi-modal accessibility.

Installation of Wildlife Crossings

Habitat connectivity is essential for wildlife migration, genetic diversity, and ecosystem resilience, enabling animals to access food, water, and shelter while adapting to environmental changes. Fragmented habitats—often caused by roadways—threaten species survival and increase wildlife-vehicle collisions. The 2025 Wildlife Connectivity and Crossings Act established the Maryland Connectivity Coalition to coordinate efforts among state agencies, prioritize projects, and integrate wildlife considerations into land use planning. Establishing a program to implement wildlife crossing construction in the County will improve habitat connectivity and motorist safety. The number of crossings installed each year would serve as an effective metric to track progress. More information on wildlife crossings is provided in the Appendices of the Green Infrastructure Plan.

Area of Land Placed under Low- or No-Mow Management

Reducing the amount of land subjected to active and repeated mowing not only reduces labor, maintenance, and fuel costs incurred by Frederick County, but it also increases the amount of pollinator-friendly land in the County. Actively tracking the area of Low Traffic Turf Areas (LTTAs) that is transitioned to low- or no-mow management would facilitate cost savings calculations and provide a myriad of other benefits outlined in Chapter 3 of the Green Infrastructure Plan.

Development of Working Partnerships

Developing strong working partnerships with Frederick County's incorporated municipalities, its neighboring counties, and state agencies is essential to wholistically and successfully implementing green infrastructure. These collaborations enable the County to align land use planning, environmental protection, and infrastructure investment across jurisdictional boundaries. By coordinating efforts, partners can reduce habitat fragmentation, enhance stormwater management, and expand access to green spaces in a way that benefits the entire region. Such partnerships help leverage local and technical expertise, raise the profile of requests for state and federal funding, and improve the function of regulatory support, making it possible to implement large-scale, interconnected networks of natural areas and corridors. Actively pursuing and maintaining such partnerships represents a metric of success that should be tracked.

Chapter Endnotes

141 As is the case with other jurisdictions in Maryland that have adopted wider stream buffers, an administrative process that allows for modification of buffer width to accommodate structures or other improvements that exist at the time legislation such legislation is approved should be considered.

142 The monitoring program could include standing up a citizen science web application for reporting wildlife collisions via mobile devices to begin identifying frequent crossing or collision hotspots.

143 Including forested and unforested "riverine" wetlands (associated with rivers and streams) and "terrene" wetlands (surrounded by drier, upland habitat).

Green Infrastructure Plan Appendices

The following appendices provide supplementary information that supports and expands upon the main content of Green Infrastructure Plan. Each section has been provided to offer additional insights, data, or analysis relevant to the topics discussed in the Plan, ensuring transparency and enhancing the reader's understanding. These materials include technical derivations, extended data tables, graphical representations, and background explanations that were referenced but not fully elaborated in the main body of the Green Infrastructure Plan. Together, they serve as additional resources for reference and further exploration.

The first section, focused on Ten Principles of Green Infrastructure is intended to provide a background on the philosophy of green infrastructure as it is addressed in this plan, and the broad assumptions that underlie the process. Certain programs that Frederick County has in place that are representative of these principles are also highlighted where appropriate.

10 PRINCIPLES OF GREEN INFRASTRUCTURE

In the 2006 book, *Green Infrastructure: Linking Landscape and Communities*, authors Mark Benedict and Ed McMahon identify ten principles for green infrastructure networks, derived from the fields of conservation biology and land-use planning, that ensure that green infrastructure can be implemented in a way that benefits both people and nature.

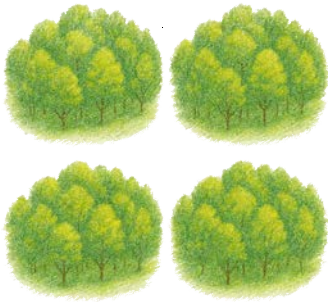
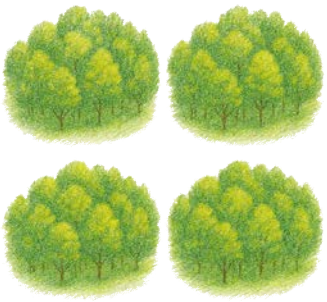
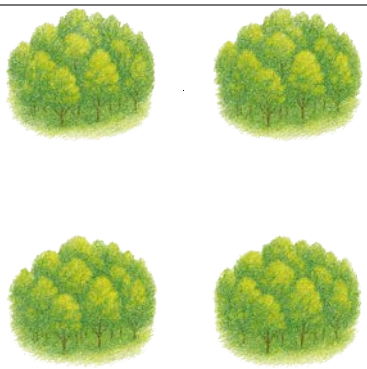
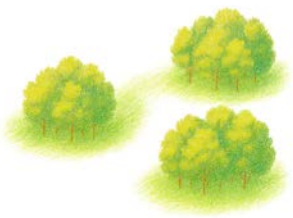
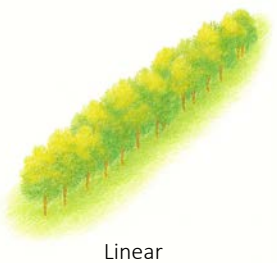
Connectivity

Benedict and McMahon note that many preservation programs in the United States have traditionally focused on identifying and protecting specifically defined sites with significant natural and cultural resources by setting them aside and subjecting them to specific management practices designed to preserve or maintain what makes them unique. They also note that the field of conservation biology, by contrast, has demonstrated that linkages to surrounding natural systems are critical for such places to function properly and for the plants and animals residing there to survive. In describing green infrastructure network design guidance later in their book, the authors identify several design concepts for creating habitat networks that can improve the overall quality of habitat and increase connectivity.

These design concepts are illustrated in Figure 23. They illustrate the fact that, generally, large areas of habitat are preferable to small areas, single (or contiguous) blocks of habitat are preferable to separate blocks of habitat, aggregated blocks (or blocks in proximity) are preferable to blocks separated by larger distances, and habitat blocks with some sort of physical connection are preferable to blocks that lack any sort of connection. Additionally, and as will be explained later in this chapter, wider, rounder habitats are preferable to longer, linear habitats when the area of those habitats is equal.

The guidelines illustrated in Figure 23[144, 145] are not specific to any particular site in Frederick County or any particular policy or program but should be generally considered as part of any planning or implementation effort focused on enhancing green infrastructure and habitat connectivity.

Figure 22: Illustrated Guidelines for Habitat Form and Connectivity

Design Principle	Better	Worse
(a) Size		
	Bigger	Smaller
(b) Number		
	Single	Several
(c) Proximity		
	Aggregated	Widely Separated
(c) Connectivity		
	Connected	Isolated
(c) Shape		
	Circular	Linear

Context

Given the importance of connectivity between any habitat and the surrounding landscape, Benedict and McMahon also note that, "the managers of public parks, wildlife refuges, and other conservation lands within a region need to consider what is happening outside their borders, in terms of both how land use changes may impact their resources and how to link up with other conservation areas and natural resource initiatives to meet common goals at a landscape scale."

The need to consider context in conservation planning was identified as early as the 1970's, in work completed by United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO recognized that people, animals, air, and water all moved readily across culturally defined boundaries. The need to consider context was also borne out in research conducted in and around the western U. S. National Parks in the 1980's that identified that certain species of large mammals found in the national parks (bear, bison, elk, etc.) had range requirements much greater than the size of any specific park. Management and planning for these species could not be addressed at the scale of any single park.

At their core, consideration of context in green infrastructure planning should recognize the fact that human transformation of the landscape has grown to a point where context must be explicitly considered in planning efforts. Sites should be considered in the context of neighborhoods. Neighborhoods should be considered in the context of regions. Equally importantly, green infrastructure planning must also consider the social context in which decisions are being made to avoid the risk of biased or opportunistic decision making that could be based on information from only one perspective. Land use decisions are primarily local, but they should be made with as much knowledge of regional implications as is possible. [146]

Grounded in Science and Land-Use Planning

Integrating both scientific knowledge and land-use planning principles into green infrastructure planning ensures that critical ecological functions—such as water filtration, habitat connectivity, and climate resilience—are recognized, prioritized, and effectively translated into spatial strategies, zoning regulations, and policy frameworks to guide land use and community development. Benedict and McMahon note that successful green infrastructure planning builds on the foundations of many disciplines and engages a wide variety of experts in many fields. Drawing knowledge and inspiration from the broadest possible base of stakeholders helps provide the appropriate balance and integration of ecological, cultural, social, and practical considerations. Additionally, it is acknowledged that, without a firm grounding in ecology and science, plans risk being ineffective or ecologically harmful; and without planning theory and an understanding of the social and political frameworks in which decisions are being made, even the best science may remain abstract and disconnected.

The incorporation of work by the Maryland Department of Natural Resources, in the form of the Maryland Habitat Connectivity Network (illustrated in Map 1 in Chapter 1), and the inclusion of many different scientific studies in the development of this Plan represent ways that Green Infrastructure Plan seeks to incorporate the latest in remote sensing and GIS-based analysis into land use planning efforts. Employing this information in furtherance of the principles, goals, and initiatives contained in the Livable Frederick Master Plan or in the continued application or improvement of state and County regulations is done in recognition of the importance of land use planning.

A Framework for Conservation and Development

As noted in the discussion of the Three E's (or P's) in Chapter 1, sustainability is achieved when the needs of the present are met without compromising the ability of future generations to meet their own needs. Furthermore, social equity and economic prosperity are just as critical to achieving sustainability as protecting the natural environment. Maryland's 8 Planning Principles, as adopted in 2025, highlight the importance of transportation networks, adequate housing, and the cultural and historical values of communities as being central to the state's vision for a sustainable future. Inherent in these definitions of sustainability is a recognition that economic prosperity makes more things possible, and a solid understanding of what makes a place helps determine how those things get (or should get) done.

Benedict and McMahon also note that green infrastructure can and should function as the framework for conservation and development because it helps communities determine where growth should go and, equally important, where it should not. Once such decisions are made, communities can make better use of existing infrastructure and target the installation of new infrastructure to shape more compact, walkable, bikeable, transit-supported communities that are better able to maintain a sense of place.

Planned and Protected Before Development

This principle recognizes that it is far more impractical and expensive to restore habitat where it previously existed than to invest time and funds to preserve habitat before it can be impacted by development. A central focus of green infrastructure planning is the integration of development into the environment in a way that minimizes the loss of existing ecosystem functions. In documentation accompanying its 2017 report regarding ecosystems services (that was discussed in Chapter 1), the Maryland Department of Natural Resources identified a cost of approximately $27,6000 dollars per acre to restore wetland habitat in the state between the years 2010 and 2017 with funding from the Chesapeake and Coastal Bays Trust Fund.[147] The cost to restore forest habitat can also be significant on a per-acre basis. The Frederick County Division of Energy and Environment notes that preparing a site, a planting plan, and installing an acre of young, native trees can range between $19,100 to $36,600 an acre in 2025. The cost depends significantly on the level of site preparation required, including the removal of dead or potentially competing vegetation, and size of the stock to be installed (seedlings vs. containerized trees).

As noted in the discussion of sensitive areas and their protections in Chapter 1, certain protections are currently afforded to streams and their buffers, the 100-year floodplain, habitats of threatened or endangered species, steep slopes, and other lands intended for resource protection that would preclude their development or loss. Sensitive areas and planning to protect sensitive areas, as it is currently implemented in Frederick County, are good examples of the implementation of this principle.

Funded Up Front

Benedict and McMahon note that gray infrastructure[148] in the United States is a perfect example of how infrastructure projects are publicly financed, included as primary budget items, and the costs are borne across a large pool of users so that systems function according to plan. Furthermore, they note that green infrastructure is a critical public investment that should be funded in a similar manner.

Some forward funding of green infrastructure work has been under-way in Frederick County for years. The Division of Energy and Environment (DEE) regularly identifies and prioritizes green infrastructure

Image 37: A completed stream restoration on Beaver Creek near Wolfsville, MD.

(Image Credit: Frederick County Division of Energy and Environment)

improvements in the form of Frederick County's Stormwater Capital Improvement Projects. These projects aim to protect local waterways, reduce pollution, and comply with state and federal environmental regulations, particularly as they pertain to the County's Municipal Separate Storm Sewer System (MS-4) permit under the Clean Water Act.

DEE's Department of Stormwater identifies and prioritizes projects through watershed assessments and feasibility studies, focusing on areas with the greatest need and where projects implementation could provide the most potential impact. Once selected, projects—such as stream restorations, reforestation, and stormwater pond upgrades—are incorporated into the County's Capital Improvement Program (CIP) and undergo a public review and design processes to ensure community input and regulatory compliance.[149]

Some of this forward funded money is recaptured by DEE in the form of grants. Advancing projects as part of the CIP Program facilitates the preparation of design documents that can then be provided to granting agencies to demonstrate both the importance and viability of a project. As part of a 2025 update to the Frederick County Climate and Energy Action Plan (CEAP), the Frederick County Division of Energy and Environment (DEE) announced it has secured approximately $1.9 million dollars in grant funding in recent years for programs that support and implement green infrastructure improvements in Frederick County.

Image 38: A post-construction photo of the Point of Rocks stream restoration.

(Image Credit: Frederick County Division of Energy and Environment)

These programs include the Creek ReLeaf program discussed in Chapter 1 and a recently completed, significant stream restoration project in Point of Rocks. The Point of Rocks restoration project removed an aged, hazardous dam embankment, reestablished a former stream channel, created multiple pocket wetlands to improve water quality and wildlife habitat, improved safe stormwater conveyance, and allowed for the installation of a new pedestrian bridge between homes in vicinity and the nearby MARC station. The Point of Rocks Restoration project is an excellent example of how green infrastructure implementation can be leveraged for multiple environmental and social benefits.

Benefit Nature and People

This plan has already touched on several ways in which green infrastructure planning can provide benefits to both nature and to people. The United States Environmental Protection Agency (EPA) has published online resources illustrating how communities can utilize green infrastructure to mitigate flooding risk, prepare for drought, reduce the urban heat island effect, protect coasts, lower building energy demands, and spend less money to control stormwater volumes—particularly in developed communities.[150]

Many of the desirable outcomes listed in the preceding paragraph benefit the natural environment within and immediately surrounding our communities while also benefiting residents' quality of life and community health. Improving vegetative cover in neighborhoods through the planting of additional tree canopy or the installation of green roofs to mitigate heat islands can have ancillary effects like supporting

insect populations and the rest of the local food web (provided appropriate plant species are selected). Such measures also improve water quality and, by extension, local aquatic habitats.

Benedict and McMahon also state that green infrastructure planning can be utilized to identify high-hazard areas that may be subject to disasters like floods or fires, and to direct growth away from these areas—thus facilitating fewer negative outcomes for both the environment and people.

Respect Landowner and Stakeholder Needs

Green infrastructure planning should consider the needs and values of landowners and other stakeholders. Privately owned lands—especially working farms and forests—can play a vital role in a connected and effective green space system. Furthermore, successful green infrastructure initiatives are more likely to result when the perspectives and concerns of various stakeholders in the public, private, and nonprofit sectors are incorporated into planning and design of green infrastructure.

Published research has been conducted into various mechanisms for facilitating preservation and conservation on privately owned land that attempts to mitigate the need for strict, "top-down," government action. Certain mechanisms, like public-private partnerships, collaborative conservation planning/consensus decision-making, and dispute resolution are emerging as effective tools to help stakeholders meet face to face to work through conflicts or to develop new strategies to address ecological issues. Such efforts, when initiated by community members, are referred to as "bottom-up" measures.[151]

Critics of collaborative or bottom-up decision-making that involves multiple stakeholders have argued that it can dilute accountability, underrepresent key voices, or compromise scientific credibility. Dominant actors, and specifically those with greater access, resources, or influence, should be cognizant of how they steer discussions in such processes, being careful to support public participation and considerations of equity. In addition, any consensus-seeking efforts should consider their potential to suppress controversial or scientifically optimal solutions in favor of broadly acceptable but less effective compromises. One potential solution to avoid making repeated, less-than-optimal decisions is periodic, objective evaluation of the results to determine when and how collaboration yields truly effective and inclusive outcomes. By including the Green Infrastructure Plan as functional element of the County Comprehensive plan, the intent is to ensure that development and approval of the plan is both inclusive and transparent and reflects the rights of both public and private landholders.

Image 39: Sugarloaf Mountain is just one example of private land conservation in Frederick County.

(Image Credit: Idawriter via Panaramio)

Connect Within and Beyond a Community

As noted in the discussion of the principles of "connectivity" and "context," many of the important social and ecological needs that can be addressed through green infrastructure planning carry beyond political or other types of jurisdictional boundaries. For this reason, green infrastructure requires making ecological and social/political connections both within and beyond communities.

Benedict and McMahon state that the desired outcome for all green infrastructure initiatives, "is a green space network that functions as an ecological whole." Effective planning should consider not only the area of planning focus, but areas upstream and downstream as well and how the planning area is influenced by these areas or how it exerts influence on them.

Make A Long-Term Commitment

Green infrastructure plans should be considered living documents that require periodic updating and modification to stay pertinent and relevant. Additionally, funding efforts centered on maintaining and enhancing green infrastructure networks over the long term are critical to their success.

Frederick County's green infrastructure planning efforts will be supported in the long term by the framework of the Livable Frederick Master Plan. As noted in the introduction to the LFMP, comprehensive plans can address two specific aspects of community planning: policy and capacity. Policy represents the values and ideas behind concrete actions and guides decision-makers in the day-to-day operation of a business, government, or other organizations. Capacity deals with the finite ability of natural and artificial systems to absorb growth and the subsequent need to manage the supply and demand of roads, community facilities, watersheds, and wastewater treatment facilities.

Both aspects are vitally important, but plans that focus on policy, like the LFMP, rather than capacity assessments are best-suited to implementing a community's aspirations. Policy-focused plans also allow communities to take a step back, gain some perspective, and re-evaluate the aspirations and intentions that drive the future shape of their communities. As noted in the description of the Action Framework on Page 19 of the LFMP, it has been adopted as the Strategic Framework for making decisions about the County's Future, including as part of the annual budget adoption process.

Adoption of the Green Infrastructure Plan as a Functional Element of the LFMP is a significant step toward making a long term commitment to green infrastructure planning in Frederick County.

KEY HABITATS OF FREDERICK COUNTY

The following descriptions have been adapted from the 2015 Maryland State Wildlife Action Plan (SWAP) to provide an overview of the varied types of habitats that exist in Frederick County because of its unique geographical location and geological, hydrological, and climatological context.[152]

More information on any of the key habitat types can be found in Chapter 4 of the 2015 Maryland State Wildlife Action Plan, including generalized maps for the locations of each key habitat as well as more information regarding plant and animal species that rely on these habitats. The 2015 Maryland State Wildlife Action Plan can be found online at: https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_home.aspx.

Hemlock-Northern Hardwood Forest

The Hemlock–Northern Hardwood Forest is a cool, moist forest habitat found on low mountain slopes and valleys in Maryland, especially at higher elevations on the Appalachian Plateau and in pockets along north-facing slopes of the Ridge and Valley[153] and Blue Ridge regions. Historically shaped by logging and fire, these forests now feature a mix of northern hardwoods like sugar maple, American beech, and yellow birch, often interspersed with eastern hemlock. The understory includes striped maple, witch-hazel, and dense thickets of mountain-laurel and great laurel, while the herb layer may be dominated by ferns and woodland wildflowers. Although old-growth stands are rare—only 413 acres remain on state lands in Maryland—these forests support rare plants like northern oak fern and Canada yew and are considered ecologically significant.

Cove Forest

The Cove Forest key wildlife habitat consists of diverse, moist forests found on sheltered mountain slopes, such as coves, ravines, and concave lower slopes, where shade and protection from wind create rich, mesic conditions. These forests are divided into Rich Cove Forests, which grow on fertile, calcium-rich soils and support some of Maryland's highest plant diversity, and Acidic Cove Forests**,** which occur on sandstone or quartzite and support less diverse vegetation due to poor, acidic soils.

Rich Cove Forests are dominated by species like sugar maple, basswood, and white ash, and host a lush herbaceous layer with plants such as Jack-in-the-pulpit, wild ginger, and trilliums. In contrast, Acidic Cove Forests feature eastern hemlock, white pine, and mountain-laurel, with a sparser understory of ferns and acid-tolerant herbs. These forests are rare—only about 500 acres of old growth remain on state lands—and face threats from logging, invasive species like garlic mustard, and pests such as the hemlock woolly adelgid.

Montaine Piedmont Oak Forest

The Montane-Piedmont Oak-Pine Forest is a dry forest habitat found on low mountain slopes, ridge crests, and rolling hills below 2,500 feet in elevation across Maryland's mountains and Piedmont region. These forests grow on acidic substrates like shale, sandstone, and metamorphic rock, and are typically dominated by a mix of oaks—such as chestnut, white, scarlet, and black oak—along with black gum and white pine. Some stands are dominated by chestnut oak, while others feature abundant white or Virginia pine, especially in areas with past disturbance. The shrub layer includes mountain-laurel, wild azalea, and maple-leaf viburnum, with low-growing heaths like blueberry and huckleberry. The sparse herb layer may include grasses and sedges like poverty-oat grass and Pennsylvania sedge. This habitat is widespread, including in Frederick County, in places like South Mountain State Park.

Oak-Hickory Forest

The Oak-Hickory Forest is Maryland's most widespread forest type, historically covering vast areas of the Piedmont and mountainous regions like the Ridge and Valley, Blue Ridge, and Appalachian Plateau. These forests thrive in upland areas with intermediate soil moisture and fertility, typically on acidic soils, though rare, more diverse communities occur on basic substrates like metabasalt and amphibolite. Dominated by oaks such as white, red, scarlet, and black oak, and supported by various hickories, these forests once featured American chestnut before its decline due to blight.

Today, many stands are early to mid-successional, often including tulip-poplar, sugar maple, and pines. The shrub layer includes blueberry, deerberry, and flowering dogwood—though the latter has declined due to disease. Herbaceous diversity is highest on basic soils but is often reduced by deer browsing and invasive species like garlic mustard and Japanese stiltgrass. These forests can be explored in the Monocacy Natural Resource Management Area.

Basic Mesic Forest

The Basic Mesic Forest is a rich, moist forest habitat found in Maryland's Coastal Plain, Piedmont, and low mountain regions, where it develops over bedrock high in calcium and/or silicate that produces basic, nutrient-rich soils high in calcium and magnesium. These forests typically occur on north- and east-facing slopes, ravines, and well-drained floodplain terraces. While the underlying geology varies—from shell deposits in the Coastal Plain to amphibolite and limestone in the Piedmont and mountains—these forests share a common suite of species. Dominant trees include tulip-poplar, American beech, black walnut, chinkapin oak, and white ash, with sugar maple more common in mountain areas.

The lush understory features ferns and forbs like may-apple, black cohosh, and twinleaf. Though like Cove Forests, Basic Mesic Forests are distinguished by species restricted to lower elevations. Due to limited data, their full distribution in Maryland is not well mapped, but they are known to occur in Frederick County. Notable rare plants in this habitat in Maryland include tall larkspur, Virginia heartleaf, and Goldie's fern.

Mesic Mixed Hardwood Forest

The Mesic Mixed Hardwood Forest is a widespread, but increasingly fragmented, forest habitat found across Maryland's Coastal Plain and Piedmont regions. It forms on acidic, nutrient-poor soils in moist settings such as ravines, lower slopes, and flatwoods. These forests feature a mixed canopy of tulip-poplar, American beech, white and red oaks, and hickories, with understory species like flowering dogwood, pawpaw, and hop-hornbeam. Coastal Plain stands may also include loblolly pine and American holly, which are absent in the Piedmont. While the infertile soils limit herbaceous diversity, ferns like Christmas and New York fern are often abundant, along with wildflowers such as pink lady's-slipper and Indian cucumber-root.

Acidic Glade & Barren

The Acidic Glade and Barren key wildlife habitat consists of glades and rocky woodlands that form over acidic substrates in Maryland's Piedmont and mountain regions. These habitats typically occur on exposed rock outcrops and boulder-covered slopes composed of schist, granite, or quartzite. Notably, rare Sandstone Glades—especially those on Pottsville or Oriskany sandstone—are found at elevations ranging from 800 to 2,800 feet. These environments are harsh, with shallow soils, rapid runoff, and high sun exposure, making them extremely drought-prone.

Vegetation is sparse and patchy, with stunted trees like chestnut oak, bear oak, pitch pine, and black gum, along with shrubs such as mountain-laurel, huckleberry, and lowbush blueberry. Herbaceous plants, including little bluestem, broomsedge, and wintergreen, grow in open patches, often alongside reindeer lichens. These unique habitats can be visited in Frederick County in places like Cunningham Falls State Park and South Mountain State Park.

Basic Glade & Barren

The Basic Glade and Barren habitat is comprised of glades and woodlands that form over limestone and silicate rocks rich in magnesium and iron (also known as mafic)—such as greenstone, amphibolite, diabase, and gabbro—in Maryland's western Piedmont and mountain regions. These habitats typically occur on small outcrops and steep talus slopes with thin, dry, and highly fertile soils that range from moderately acidic to basic. Due to drought stress and shallow soils, vegetation forms a patchy mosaic of stunted woodlands and open grassy glades. Common trees include chinkapin oak, white ash, eastern red cedar, and hackberry, while glades support grasses and wildflowers like side-oats grama, bottlebrush grass, and hoary puccoon.

Similar communities over mafic bedrock feature species like chestnut oak, Virginia pine, and little bluestem. These rare, small-patch habitats are vulnerable to invasive species and are considered ecologically significant. They can be visited in Frederick County at sites like the C&O Canal National Historical Park. Notable rare plants include mountain parsley, snow trillium, and Appalachian sandwort.

Cliff & Rock Outcrop

The Cliff and Rock Outcrop habitat includes steep to vertical expanses of exposed bedrock or soil, ranging from small outcrops to towering cliffs over 50 meters high. Found primarily in the Appalachian Plateau and Ridge and Valley regions—with notable examples in the Piedmont—these habitats form on formations like Pottsville sandstone, Tuscarora and Oriskany formations, and Weverton Quartzite.

These rugged landscapes feature deep fissures, sparse soil, and extreme conditions such as wind, ice, and drought, which limit vegetation to hardy species. The most exposed areas support only lichens and mosses, while less exposed zones host shrubs like mountain-laurel and rhododendron, and stunted trees such as chestnut oak, pitch pine, and eastern hemlock. These habitats often transition into boulder-field forests and are influenced by surrounding forest types like Hemlock-Northern Hardwood and Montane-Piedmont Oak-Pine Forests. In central and western Maryland, cliffs also line rivers like the Potomac and Youghiogheny, with dramatic examples near Harpers Ferry and Point of Rocks.

Montane-Piedmont Floodplain

The Montane-Piedmont Floodplain key wildlife habitat includes a diverse array of floodplain ecosystems along streams and rivers in Maryland's Piedmont and mountain regions. These habitats vary widely depending on geology, soil, and flooding patterns, and often feature bottomland forests dominated by sycamore, silver maple, black walnut, river birch, and boxelder. Along larger rivers, distinct landforms like gravel bars, levees, and oxbows support young, flood-scoured woodlands and dense stands of sycamore and green ash.

Seasonally flooded backswamps and sloughs host red maple, sweetgum, and hydrophytic oaks like pin and swamp white oak, often forming complex hummock-and-hollow terrain. In narrower, higher-gradient stream valleys, mesophytic[154] species such as tulip-poplar, sugar maple, and American beech are common, while higher elevations support eastern hemlock and great laurel. Found in Frederick County, these floodplain habitats are ecologically rich and support rare plants like Virginia mallow, and Southern blue monkshood.

Montane Piedmont Acidic Seepage Swamp

The Montane-Piedmont Acidic Seepage Swamp is a unique wetland habitat found in the Piedmont and mountain regions of Maryland, where groundwater seeps to the surface along impermeable rock or clay layers, creating saturated conditions year-round. These swamps typically form in headwaters, ravine bottoms, and toe-slopes, with acidic soils derived from sandstone, quartzite, or granitic bedrock. Structurally, they are forested wetlands with closed- to semi-open canopies dominated by red maple, tulip-poplar, black gum, yellow birch, and, at higher elevations, red spruce, and eastern hemlock. Shrub layers include winterberry, swamp azalea, highbush blueberry, and mountain-laurel, while the forest floor features sphagnum moss, skunk cabbage, cinnamon fern, and a variety of sedges and wildflowers. These habitats are ecologically rich and support rare plants like nannyberry and Clinton lily, and they can be visited at sites such as Sugarloaf Mountain.

Montane Piedmont Basic Seepage Swamp

The Montane-Piedmont Basic Seepage Swamp is a saturated forested wetland habitat found in the Piedmont and mountain regions of Maryland, where groundwater emerges at the base of slopes in headwaters, ravines, and stream bottoms. These swamps form over base-rich substrates such as metabasalt (greenstone), calcareous shale, and limestone, and are characterized by boulders and gravelly alluvium, braided seeps, and muck-filled depressions. The soils range from strongly acidic to nearly neutral but are consistently rich in calcium and magnesium.

These conditions support a distinctive plant community, including rare species like glade spurge, queen-of-the-prairie, and swamp lousewort. Found in Frederick County, this habitat is part of the rare Montane-Piedmont Basic Seepage Swamp natural community and can be explored in places like Catoctin Mountain Park.

Piedmont Seepage Wetland

The Piedmont Seepage Wetland is a groundwater-fed wetland habitat found in low stream valleys and "toe" slopes of rolling hills throughout Maryland's Piedmont region. These wetlands remain saturated for much of the growing season due to a high water table and are composed of mineral soils with mucky, organic surface layers. Vegetation varies from open, graminoid-dominated meadows with species like tussock sedge, wood reedgrass, and rice cutgrass, to shrub swamps featuring alder, buttonbush, and southern arrow-wood. Herbaceous plants such as jewelweed, skunk cabbage, and Joe-Pye weed are common, while invasive species like purple loosestrife and Japanese stiltgrass pose ongoing threats. Though trees are not dominant, red maple often encroaches in the absence of disturbance.

Piedmont Upland Depression Swamp

The Piedmont Upland Depression Swamp is a seasonally flooded forested wetland found in Frederick County, where shallow bedrock or clay hardpans impede drainage, causing standing water in early spring followed by gradual drying. These wetlands experience variable hydroperiods depending on rainfall and drought cycles. The canopy ranges from open to closed and is typically dominated by oaks such as willow, pin, swamp chestnut, and swamp white oak, along with red maple, green ash, and black gum. The understory often includes dense growths of greenbrier, while the herbaceous layer is sparse, featuring sedges, rushes, and patches of Sphagnum moss. These isolated wetlands are vulnerable to disturbance from logging, drainage, and development, and many of their finer-scale plant communities are considered rare in Maryland. These habitats can be visited at sites like the C&O Canal National Historical Park.

Vernal Pools

The Vernal Pool key wildlife habitat consists of small, seasonal, non-tidal forested wetlands that form in shallow basins with no permanent outlet. These pools fill with water in fall and winter due to rising water tables and typically reach peak depth in spring before drying out by mid- to late summer. Their seasonal drying prevents fish from becoming established, making them critical breeding grounds for amphibians and invertebrates that rely on fish-free environments. Vernal Pools occur statewide, though they are most common on the Lower Coastal Plain and less frequent west of the Fall Line (which is generally located along MD I-95). They are typically found in forest depressions, floodplain backwaters, old sinkholes, or spring-fed basins. Vegetation varies but often includes a semi-open to closed canopy, sparse herbaceous

growth, and dense leaf litter and woody debris in the basin. Some pools may have a shrub layer, especially on the Coastal Plain. These habitats are ecologically important yet vulnerable to degradation from land use changes.

Springs

Spring key wildlife habitat consists of small, concentrated groundwater discharge points—typically less than one square meter in size—that emerge where hydrostatic pressure forces water to the surface, often through fractures in rock. These features are uncommon and mostly found west of Maryland's Fall Line (which is generally located along MD I-95). Springs are ecologically significant, providing critical habitat for rare aquatic snails, subterranean invertebrates, salamanders, crayfish, and other species. They also help maintain the health of nearby streams and wetlands, supporting species like brook trout and rare dragonflies. Maryland hosts several types of springs, including contact, scree, fault, and the more common fracture springs, which emerge along ravines or swales. Unlike seeps, which are diffuse and support distinct plant communities, springs are sharply defined aquatic and geological features.

Coldwater Stream

The Coldwater Stream key wildlife habitat includes approximately 2,750 miles of Maryland's freshwater streams, primarily located in the Appalachian Plateau and Ridge and Valley regions, with additional stretches in the Piedmont. These streams are defined by cool temperatures (daily mean < 20°C or 68°F), high dissolved oxygen, and fast-flowing, riffle-dominated channels shaded by forested riparian zones. They support a unique aquatic ecosystem with low biodiversity but high conservation value, including Maryland's only native trout, the brook trout, as well as stoneflies, mayflies, and a rich diversity of aquatic and semi-aquatic salamanders.

Coldwater Streams rely on natural features like fallen logs and leaf litter for habitat structure and food web support, and beaver activity enhances habitat complexity and water quality. However, these habitats have declined due to agriculture and urban development, with only 7% considered "high quality waters" under Maryland's anti-degradation regulations as of 2015. They are found in Frederick County, and they can be explored in places like Catoctin Mountain Park (Little Hunting Creek) or in the form of Bennett Creek.

Limestone Stream

Limestone Stream habitats are primarily located in the Ridge and Valley physiographic province, and they are shaped by the region's geology, which fosters strong groundwater-surface water connections through abundant fractures and springs. This connectivity stabilizes pH and temperature, creating a unique aquatic environment. These streams support distinct biological communities, including watercress, waterweed, and crustaceans like scuds and sow bugs, and host fish such as checkered sculpin and pearl dace. Submerged logs and leaf litter form the foundation of the food web, while beaver activity enhances habitat diversity and water quality. However, agricultural practices and suburban development have degraded many of these streams, with 25% no longer supporting their characteristic species. This habitat can be located within (or near) Frederick County in the vicinity of South Mountain State Park.

Highland Stream

Highland Stream key habitats in Maryland are found throughout the Appalachian Plateau, Ridge and Valley, and Blue Ridge regions, featuring steep gradients and rocky substrates of gravel, cobble, and boulders. These streams, often located in the rain shadow of the Appalachians, experience reduced summer flows due to low rainfall. Logs, leaf litter, and streamside trees shape stream channels and provide essential organic matter for the food web. Beaver activity enhances habitat diversity and improves water quality by reducing sediment and nutrient loads. Native fish species include mottled and Potomac sculpins, silverjaw minnow, striped shiner, and fantail darter, while stoneflies and mayflies dominate the benthic macroinvertebrate community. Of the approximately 320 miles of Highland Streams in Maryland, nearly half are severely degraded, with only a small percentage classified as high quality.

Piedmont Stream

Piedmont Streams, stretching from the Catoctin Mountains to Maryland's Fall Line (generally located along MD I-95), are among the state's most biologically productive waterways. Their physical and chemical characteristics vary with the region's diverse topography and geology, with low-gradient, sandy streams in the east and high-gradient, rocky streams in the west. Submerged logs, streamside trees, and leaf litter shape stream channels and support aquatic life by forming the base of the food web. Beaver activity enhances habitat diversity and improves water quality.

These streams support a wide range of fish species, including American eel, tessellated darter, and Blue Ridge sculpin, and are home to amphibians like the eastern hellbender and dragonflies such as the zebra clubtail. Despite their ecological richness, urbanization has degraded many Piedmont Streams, with 42% considered degraded and only 12% in good condition as of 2015. Of the 1,800 miles of Piedmont Streams, just 54 miles were designated as "high quality waters" at that time. Many of the tributaries to the Monocacy River in the eastern half of Frederick County are indicative of the Piedmont Stream habitat.

Highland River

Large Highland Rivers in Maryland, found primarily in the Youghiogheny and Potomac River basins, feature a mix of riffle, run, and pool habitats with substrates ranging from boulders to sand and silt. These rivers rely on energy sources like leaf litter, large woody debris, and aquatic plant production. They support a wide variety of fish, including game species like smallmouth bass, walleye, and stocked trout, as well as nongame species such as redbreast sunfish and Potomac sculpin. However, habitat degradation from industrial discharges, sewage effluent, and damming for water supply and power generation has negatively impacted these systems, especially by reducing habitat for sensitive fish and mussel species. Maryland contains about 180 miles of Highland River habitat, with Catoctin Creek exhibiting this type of habitat as it nears the Potomac River in Frederick County.

Piedmont River

Piedmont Rivers in Maryland, located between upland headwaters and the tidal Chesapeake Bay, serve as ecologically rich transitional habitats. These rivers feature riffle/run and pool sequences with substrates ranging from boulders to silt, supporting a mix of upland and lowland aquatic species. Their chemical and hydrologic stability fosters high biodiversity, including fish like American eel, smallmouth bass, and migratory species such as striped bass and shad. Logs, leaf litter, and aquatic plants contribute to the food

web, while floodplains provide refuge during high flows. However, urbanization has degraded many of these rivers through pollution from combined sewer overflows and habitat fragmentation caused by dams.

There are approximately 270 miles of Piedmont River habitat in Maryland. The Monocacy River, designated a State Scenic River in 1974, flows for 58 of those miles through the heart of Frederick County—from the Pennsylvania border to the Potomac River. The "scenic river" designation recognizes the Monocacy's ecological, cultural, and historical importance and guides conservation efforts through local and state collaboration. As part of Maryland's Scenic and Wild Rivers System, the Monocacy River benefits from policies aimed at protecting its water quality, natural habitats, and recreational value.

Cave and Karst

Caves in Maryland are natural underground formations that support rare and specialized animal communities within fragile ecosystems. Over 100 caves have been documented, primarily in the Ridge and Valley and Appalachian Plateau regions, with Washington County hosting the most. Maryland's caves fall into two categories: non-solutional caves, formed by mechanical processes like fractures in bedrock, and solutional caves, which are larger and formed by the dissolution of limestone by acidic groundwater. These solutional caves often feature complex passageways, speleothems like stalactites and stalagmites, and sometimes subterranean streams or springs.

Managed Successional Forest

Managed Successional Forests in Maryland are early-stage forests dominated by shrubs and small trees, typically resulting from human activities like logging, land use changes, or other disturbances. These habitats occur statewide in three main settings: recently logged forests, non-forested lands undergoing natural succession (such as old fields or reclaimed mines), and forest edges. Habitat quality and duration depend on factors like soil type, deer browsing, invasive species, and forest management practices. While forest edges can support some early successional species, they often lack the size and structure needed for species of greatest conservation need. Historically, natural disturbances such as fire, storms, and herbivory by animals like beavers and elk maintained these habitats.

Managed Grassland

Managed Grasslands in Maryland are human-created upland habitats dominated by grasses and herbaceous plants, with limited shrub and tree cover. These habitats vary in height, structure, and species composition, with native-dominated grasslands offering higher conservation value. Wildlife habitat quality improves with larger patch sizes and favorable landscape features. Historically, Maryland supported extensive natural grasslands, maintained by fire, grazing, and soil conditions, but most have disappeared due to development, agriculture, and fire suppression.

Today, managed grasslands persist in four main settings: active pastures and hayfields, fallow fields and grass plantings, airfields, and reclaimed strip mines. These areas support species of conservation concern such as bobolink and eastern meadowlark. The largest remaining native grassland is the Serpentine Barren at Soldiers Delight Natural Environment Area in Baltimore County referenced in Chapter 3 of this plan. Managed grasslands now occur statewide, often as temporary habitats that may revert to forest without continued management.

Roadside and Utility Rights-of-Way (ROW)

Roadside and Utility Rights-of-Way in Maryland are narrow, linear habitats maintained along roads, pipelines, and powerlines, consisting of managed grasslands and early successional shrublands. These areas support a mix of native and non-native vegetation and can mimic natural disturbance regimes depending on site conditions and management practices. While their narrow shape limits their suitability for area-sensitive vertebrates, they provide valuable habitat for invertebrates, serve as movement corridors for birds and other wildlife, and help connect larger patches of grassland or successional forest. In fragmented landscapes, this connectivity can be crucial for species survival. These habitats occur statewide and support rare plant species such as Walter's paspalum, red milkweed, and tuberous grass-pink.

Artificial Impoundment and Artificial Wetland

The 2015 SWAP states that Maryland has no natural lakes due to its location south of glaciated regions and the absence of lake-forming geological processes. Instead, the state contains numerous man-made ponds, lakes, and wetlands, often created by water diversion and impoundment of natural streams or marshes. Some small natural freshwater habitats still exist, such as beaver impoundments, vernal pools, and river oxbows, which support species of conservation need. In cases where natural habitats have been lost, artificial impoundments can serve as critical refuges, though many, like stormwater ponds, offer limited ecological value. Habitat loss, drainage, and historical declines in beaver populations have significantly reduced the extent and quality of Maryland's natural open water areas.

WETLANDS OF SPECIAL STATE CONCERN

Wetlands of Special State Concern (WSSC) hold significant ecological value in Maryland due to their potential for supporting rare, threatened, or endangered species and their unique habitat features. The Code of Maryland Regulations (COMAR) Title 26, Subtitle 23, Chapter 06 formally designates these wetlands and provides them with heightened regulatory protection. The Maryland Department of the Environment (MDE) identifies these areas using data from the U.S. Fish and Wildlife Service's National Wetlands Inventory, supplemented by field inspections. These wetlands are not only ecologically sensitive, but they also serve the same critical functions as other wetlands in Frederick County, including water filtration, flood mitigation, and biodiversity support.

The following Non-Tidal WSSCs have been identified in Frederick County:

1. Bennett Tributary Swamp -- Buckeystown
2. Brunswick Riverside -- Harpers Ferry
3. Buzzard Branch -- Myersville
4. Buzzard Branch Bog -- Myersville
5. Buzzard Branch Bottom -- Myersville
6. Catoctin Creek Mouth -- Point of Rocks
7. Catoctin Station -- Point of Rocks
8. East Buzzard Branch -- Catoctin Furnace
9. Eyeler Valley -- Blue Ridge Summit
10. Fishing Creek -- Catoctin Furnace
11. Foxville Swamp -- Blue Ridge Summit
12. Hunting Creek Hollow -- Blue Ridge Summit
13. Le Gore Bridge -- Woodsboro
14. Little Catoctin Creek Glade -- Myersville
15. Little Fishing Creek Pond -- Catoctin Furnace
16. Lock 28 Floodplain -- Point of Rocks
17. Lock 29 Floodplain -- Point of Rocks
18. Owens Creek Swamp -- Blue Ridge Summit
19. Ridenour Swamp -- Smithsburg
20. South Salamander Rock Fire Ponds -- Catoctin Furnace
21. Spruce Run -- Myersville
22. Steep Creek Swamp -- Catoctin Furnace
23. Turkey Creek -- Blue Ridge Summit
24. Upper Hunting Creek Swamp -- Blue Ridge Summit
25. Wigville Swamp – Myersville

The designation of a wetland as a WSSC carries a mandatory 100-foot protective buffer around the wetland where development is restricted. This buffer helps shield the wetland from encroachment, pollution, and other disturbances. Additionally, deeds for properties containing WSSC must reflect the presence of these wetlands and their buffers, ensuring long-term recognition and awareness.

SPECIES OF CONSERVATION NEED IN FREDERICK COUNTY

The 2015 Maryland State Wildlife Action Plan (SWAP) identifies plant and animal Species of Greatest Conservation Need (SGCN) are known or likely to occur in Frederick County, particularly due to its location in the Piedmont and Ridge and Valley regions, which support a mix of forest, wetland, and stream habitats.

SGCNs are defined as plants and animals, both aquatic and terrestrial, that are at risk or are declining in Maryland. This includes not only species that are already listed as threatened or endangered, but also many others whose populations are of concern due to habitat loss, environmental changes, or other stressors. The designation of a species as SGCN helps prioritize conservation actions and funding. The goal is to prevent these species from becoming endangered by maintaining or restoring their populations and habitats. This proactive approach supports biodiversity, ecosystem health, and long-term environmental resilience across the state.

A non-exhaustive list of SGCN species likely endemic or regionally significant to Frederick County include the following:[155]

Mammals

- Allegheny woodrat (Neotoma magister)
- Eastern small-footed myotis (Myotis leibii)
- Indiana bat (Myotis sodalis)
- Northern long-eared bat (Myotis septentrionalis)
- Tricolored bat (Perimyotis subflavus)

Birds

- Wood thrush (Hylocichla mustelina)
- Cerulean warbler (Setophaga cerulea)
- Golden-winged warbler (Vermivora chrysoptera)
- Ovenbird (Seiurus aurocapilla)
- Bald eagle (Haliaeetus leucocephalus)

Reptiles and Amphibians

- Bog turtle (Glyptemys muhlenbergii)
- Eastern box turtle (Terrapene carolina carolina)
- Jefferson salamander (Ambystoma jeffersonianum)

Fish

- Rosyside dace (Clinostomus funduloides)
- Brook trout (Salvelinus fontinalis)

Invertebrates

- Edwards' Hairstreak (*Satyrium edwardsii*)
- Indian Skipper (*Hesperia sassacus*)
- Tiger Spiketail (*Zoraena erronea*)

Forest and Upland Plant Species

- Goldenseal (Hydrastis canadensis)
- Large whorled pogonia (*Isotria verticillata*)

Wetland and Riparian Species

- Nodding trillium (Trillium *cernuum*)

Prairie and Meadow Species

- Purple milkweed (Asclepias purpurascens)

Many of these species are prioritized for conservation due to habitat loss, fragmentation, pollution, and climate change. Their presence in Frederick County underscores the importance of protecting forests, wetlands, and headwater streams through local planning and habitat conservation and restoration efforts.

RARE, THREATENED, AND ENDANGERED SPECIES OF FREDERICK COUNTY

The following tables include lists of rare, threatened, and endangered species in Frederick County developed by the Maryland Natural Heritage Program and published by the Maryland Department of Natural Resources in 2021.

Additional information on rare, threatened, and endangered species in Frederick County and elsewhere in the State of Maryland can be found on the Wildlife and Heritage Service website at: https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/rte/rteanimals.aspx.

Table 8: Rare, Threatened, and Endangered Animal Species[156]

Scientific Name	Common Name	Animal Type	State Rank	State Status	Federal Status
Aeshna tuberculifera	Black-tipped Darner	Insect	S2		
Alasmidonta undulata	Triangle Floater	Mollusk	S1, S2	T	
Alasmidonta varicosa	Brook Floater	Mollusk	S1	E	
Bartramia longicauda	Upland Sandpiper	Bird	S1B	E	
Caecidotea vandeli	Vandel's Cave Isopod	Crustacean	S1	E	
Cicindela patruela	Northern Barrens Tiger Beetle	Insect	S1	E	
Cordulegaster bilineata	Brown Spiketail	Insect	S3		
Cordulegaster erronea	Tiger Spiketail	Insect	S3		
Cottus sp. 7	Checkered Sculpin	Fish	S2		
Elliptio lanceolata	Yellow Lance	Mollusk	S1	T	LT
Elliptio producta	Atlantic Spike	Mollusk	S2, S3	I	
Erythrodiplax minuscula	Little Blue Dragonlet	Insect	S1		
Euphydryas phaeton	Baltimore Checkerspot	Insect	S2		
Gallinula galeata	Common Gallinule	Bird	S2, S3B	I	
Haliaeetus leucocephalus	Bald Eagle	Bird	S3, S4		
Hylogomphus abbreviatus	Spine-crowned Clubtail	Insect	S1		
Hylogomphus viridifrons	Green-faced Clubtail	Insect	S1		
Ixobrychus exilis	Least Bittern	Bird	S2, S3B	I	
Ladona julia	Chalk-fronted Skimmer	Insect	S3		
Lampsilis cariosa	Yellow Lampmussel	Mollusk	SU		
Lanius ludovicianus	Loggerhead Shrike	Bird	S1B	E	
Lanthus vernalis	Southern Pygmy Clubtail	Insect	S2		
Lasmigona subviridis	Green Floater	Mollusk	S1	E	
Libellula flavida	Yellow-sided Skimmer	Insect	S2, S3		
Mustela nivalis	Least Weasel	Mammal	S2, S3	I	

Scientific Name	Common Name	Animal Type	State Rank	State Status	Federal Status
Nannothemis bella	Elfin Skimmer	Insect	S1	E	
Neotoma magister	Allegheny Woodrat	Mammal	S1	E	
Ophiogomphus sp. 1	Chesapeake Snaketail	Insect	S1		
Phanogomphus quadricolor	Rapids Clubtail	Insect	S2	I	
Podilymbus podiceps	Pied-billed Grebe	Bird	S2, S3B		
Porzana carolina	Sora	Bird	S2B		
Satyrium edwardsii	Edwards' Hairstreak	Insect	S1	E	
Setophaga fusca	Blackburnian Warbler	Bird	S3B		
Sorex fumeus	Smoky Shrew	Mammal	S2, S3	I	
Sorex hoyi winnemana	Southern Pygmy Shrew	Mammal	S2		
Spiza americana	Dickcissel	Bird	S3B		
Strophitus undulatus	Creeper	Mollusk	S2, S3	I	
Stygobromus pizzinii	Pizzini's Cave Amphipod	Crustacean	S1		
Stygobromus sp. 14	Roundtop Amphipod	Crustacean	S1		
Stygobromus tenuis potomacus	Potomac Amphipod	Crustacean	S3		
Thryomanes bewickii	Bewick's Wren	Bird	SXB	X	

Table 9: Rare, Threatened, and Endangered Plant Species

Scientific Name	Common Name	State Rank	State Status	Federal Status
Adlumia fungosa	Climbing Fumitory	S2	T	
Agalinis auriculata	Earleaf False Foxglove	S1	E	
Agastache scrophulariifolia	Purple Giant-hyssop	S1, S2	T	
Agrimonia microcarpa [?]	Small-fruited Agrimony	S1?		
Amelanchier spicata	Running Serviceberry	S2		
Amianthium muscitoxicum	Fly-poison	S2		
Anaphalis margaritacea	Pearly Everlasting	S3		
Arabis patens	Spreading Rockcress	S3		
Aralia racemosa	American Spikenard	S2, S4		
Asclepias purpurascens	Purple Milkweed	S2		
Asclepias rubra [h?]	Red Milkweed	S1	E	
Asclepias verticillata	Whorled Milkweed	S3		
Asplenium pinnatifidum	Lobed Spleenwort	S1	E	
Astragalus canadensis	Canadian Milkvetch	S1	E	

Scientific Name	Common Name	State Rank	State Status	Federal Status
Aureolaria flava [h]	Smooth Yellow False Foxglove	S3		
Aureolaria levigata [h]	Downy Yellow False Foxglove	S3		
Bartonia paniculata [h]	Twining Screwstem	S3		
Blephilia ciliate	Downy Woodmint	S3, S4		
Borodinia dentata	Short's Rockcress	S3		
Botrychium simplex [?]	Least Grapefern	SH	X	
Calopogon tuberosus [h]	Tuberous Grass-pink	S1	E	
Calystegia spithamaea ssp. spithamaea	Low Bindweed	S2		
Capnoides sempervirens	Pale Corydalis	S3		
Cardamine douglassii	Purple Cress	S3		
Carex albursina	White Bear Sedge	S3		
Carex argyrantha [h]	Hay Sedge	S3		
Carex conoidea	Field Sedge	S1	E	
Carex davisii	Davis' Sedge	S1	E	
Carex emoryi	Emory's Sedge	S3		
Carex pellita	Wooly Sedge	S2?		
Carex shortiana	Short's Sedge	S3, S4		
Carex sparganioides	Bur-reed Sedge	S3		
Castilleja coccinea [h]	Scarlet Indian-paintbrush	S1	E	
Cirsium muticum	Swamp Thistle	S3		
Chelone obliqua [h?]	Red Turtlehead	S2	T	
Chimaphila umbellata	Common Wintergreen	S3		
Clematis viorna	Vase-vine Leatherflower	S3		
Commelina erecta	Erect Dayflower	S3		
Coptis trifolia	Goldthread	S1	E	
Corallorhiza wisteriana [h]	Spring Coralroot	S1	E	
Cornus rugosa [h]	Roundleaf Dogwood	S1	E	
Corylus cornuta	Beaked Hazelnut	S3		
Cyperus lancastriensis	Many-flowered Umbrella-sedge	S2, S3		
Cyperus refractus	Reflexed Flatsedge	S2?		
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-slipper	S3		
Cystopteris tennesseensis [h]	Tennessee Bladderfern	S1		

Scientific Name	Common Name	State Rank	State Status	Federal Status
Dactylorhiza viridis	Long-bract Green Orchis	S1	E	
Delphinium tricorne	Dwarf Larkspur	S3		
Dichanthelium bicknellii [h]	Bicknell's Witchgrass	SU	X	
Diphasiastrum tristachyum [?]	Deep-root Clubmoss	S3		
Dirca palustris	Eastern Leatherwood	S2	T	
Doellingeria infirma	Cornel-leaf Aster	S3		
Drosera rotundifolia	Roundleaf Sundew	S3		
Dryopteris celsa	Log Fern	S3		
Epilobium leptophyllum	Linear-leaf Willowherb	S2, S3		
Equisetum sylvaticum	Woodland Horsetail	S1	E	
Erigenia bulbosa	Harbinger-of-spring	S3		
Erythronium albidum	White Trout Lily	S2	T	
Euphorbia purpurea	Glade Spurge	S1	E	
Eurybia radula	Rough Wood Aster	S1	E	
Eutrochium maculatum [?]	Spotted Joe-pye Weed	SU	X	
Filipendula rubra	Queen-of-the-prairie	S1	E	
Fraxinus nigra	Black Ash	S3		
Galium latifolium	Purple Bedstraw	S3		
Gentiana andrewsii	Fringe-top Bottle Gentian	S2	T	
Geranium robertianum	Herb-Robert	S1		
Geum laciniatum	Rough Avens	S3		
Glyceria acutiflora	Sharp-scaled Mannagrass	S1	E	
Gymnocarpium dryopteris	Northern Oak Fern	S1	E	
Helianthus hirsutus [h]	Stiff-hair Sunflower	S1		
Heracleum maximum	Cow-parsnip	S3		
Hibiscus laevis	Halberd-leaf Rosemallow	S3		
Hybanthus concolor	Green Violet	S3		
Hydrastis canadensis	Golden-seal	S2	T	
Iris virginica	Virginia Blueflag	S3		
Isoëtes engelmannii	Engelmann's Quillwort	S3		
Juglans cinerea	Butternut	S2, S3		
Krigia dandelion [h]	Potato Dwarf-dandelion	S2, S3		
Lespedeza frutescens	Violet Lespedeza	S3		
Ligusticum canadense [h]	American Lovage	SH	X	

Scientific Name	Common Name	State Rank	State Status	Federal Status
Liparis liliifolia	Large Twayblade	S3		
Liparis loeselii	Loesel's Twayblade	S1, S2		
Lycopodiella inundata	Bog Clubmoss	S2		
Lythrum alatum	Winged Loosestrife	S1	E	
Maianthemum stellatum	Starflower Solomon's-plume	S2	E	
Malaxis unifolia	Green Adder's-mouth Orchid	S2		
Malus angustifolia	Southern Crabapple	S3		
Matelea obliqua	Climbing Milkweed	S1, S2	E	
Micranthes micranthidifolia [h]	Lettuceleaf Saxifrage	S3		
Monarda clinopodia	Basil Beebalm	S3, S4		
Mononeuria glabra	Appalachian Sandwort	S1		
Myosotis macrosperma	Large-seed Forget-me-not	S3, S4		
Myosotis verna	Spring Forget-me-not	S3		
Napaea dioica	Glade Mallow	S1	E	
Nymphoides cordata	Little Floatingheart	S1	E	
Orthilia secunda [h]	One-side Wintergreen	SH	X	
Packera paupercula	Balsam Ragwort	S3		
Panax quinquefolius	American Ginseng	S2, S3		
Patis racemosa	Black-fruit Mountain-ricegrass	S2S3		
Pellaea glabella	Smooth Cliffbrake	S1	E	
Penstemon laevigatus [h]	Smooth Beardtongue	SU		
Phacelia purshii	Miami-mist	S3		
Phyllanthus caroliniensis	Carolina Leaf-flower	S3		
Platanthera ciliaris	Yellow Fringed Orchid	S2	T	
Platanthera cristata	Crested Yellow Orchid	S3		
Platanthera flava	Pale Green Orchid	S2, S3		
Platanthera grandiflora	Large Purple Fringed Orchid	S2	T	
Platanthera peramoena	Purple Fringeless Orchid	S1, S2	T	
Platanthera psycodes	Small Purple Fringed Orchid	S1	PE	
Platanthera shriveri	Shriver's Frilly Orchid	S1		
Pycnanthemum pycnanthemoides [h?]	Southern Mountainmint	SH	X	
Pycnanthemum torreyi	Torrey's Mountainmint	S1	E	
Pycnanthemum verticillatum	Whorled Mountainmint	S2	T	

Scientific Name	Common Name	State Rank	State Status	Federal Status
Quercus macrocarpa [h]	Bur Oak	S1, S2		
Quercus shumardii	Shumard Oak	S2	T	
Ranunculus septentrionalis	Carolina Buttercup	S1?		
Ranunculus flabellaris	Yellow Water Crowfoot	S1	E	
Ribes cynosbati	Prickly Gooseberry	S3		
Ribes americanum	Wild Black Currant	S1	X	
Ribes glandulosum	Skunk Currant	S3		
Ripariosida hermaphrodita [h]	Virginia Mallow	S1	E	
Rubus pubescens	Dwarf Raspberry	S1?		
Rudbeckia fulgida	Orange Coneflower	S3		
Rudbeckia triloba	Brown-eyed Susan	S3		
Ruellia strepens	Limestone Wild Petunia	S2, S3		
Rumex altissimus [h]	Tall Dock	S1	E	
Sagittaria rigida [h]	Sessile-fruit Arrowhead	S1	E	
Salix exigua [h]	Narrowleaf Willow	S1	E	
Sanguisorba canadensis	Canada Burnet	S2	T	
Sanicula trifoliata	Large-fruited Sanicle	S3		
Sarracenia purpurea	Northern Pitcherplant	S2	T	
Sceptridium oneidense [?]	Blunt-lobe Grapefern	S1	E	
Schoenoplectus subterminalis	Water Bulrush	S1	E	
Scrophularia lanceolata	Hare Figwort	S3		
Scutellaria incana	Hoary Skullcap	S3		
Scutellaria leonardii [h]	Shale Barren Skullcap	S2	T	
Scutellaria nervosa	Veined Skullcap	S1, S2	T	
Scutellaria ovata	Heartleaf Skullcap	S3		
Scutellaria saxatilis	Rock Skullcap	S1	E	
Scutellaria serrata	Showy Skullcap	S3		
Senecio suaveolens	Sweet-scented Indian-plantain	S1	E	
Senna marilandica	Maryland Wild Senna	S3		
Silene nivea	Snowy Campion	S1	E	
Silphium asteriscus var. trifoliatum	Threeleaf Rosinweed	S3		
Smilax ecirrata [h]	Upright Greenbrier	S1, S3		
Solidago arguta var. arguta [?]	Late Goldenrod	S1?		

Scientific Name	Common Name	State Rank	State Status	Federal Status
Solidago hispida	Hairy Goldenrod	S3		
Solidago patula	Sharp-leaved Goldenrod	S3		
Solidago rigida [h]	Prairie Goldenrod	S1	E	
Sparganium eurycarpum	Giant Bur-reed	S3		
Spiranthes ochroleuca	Yellow Nodding Ladies'-tresses	S1	E	
Stachys hyssopifolia [h]	Hyssopleaf Hedge-nettle	S1		
Stenanthium gramineum	Eastern Featherbells	S1	T	
Symphyotrichum shortii	Short's Aster	S3, S4		
Thaspium trifoliatum	Purple Meadow Parsnip	S1	E	
Trichophorum planifolium [h]	Bashful Bulrush	S2, S3		
Trichostema brachiatum	Glade Bluecurls	S3		
Trillium cernuum	Northern Nodding Trillium	S3		
Triosteum angustifolium	Yellowleaf Tinker's-weed	S1	E	
Valeriana pauciflora	Valerian	S1	E	
Valerianella umbilicata [?]	Navel-shaped Corn-salad	SH	X	
Veratrum hybridum	Broadleaf Bunchflower	S1	E	
Veratrum virginicum	Virginia Bunchflower	S3		
Vernonia gigantea [h]	Giant Ironweed	SU		
Veronica scutellata	Marsh Speedwell	S1	E	
Zanthoxylum americanum [h]	Northern Prickly-ash	S1, S2	E	
Zizia aurea	Golden Alexanders	S3		

Key to State Ranking (S) Criteria[157]

SX: Presumed Extirpated — Species or ecological community believed to be extirpated from the jurisdiction (i.e., global, or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

SH: Historical (Possibly Extirpated) — Known only from historical records, but still some hope of rediscovery. There is evidence that the species may no longer be present in the jurisdiction (i.e., global, or state/province), but not enough to state this with certainty.

S1: Critically Imperiled/Highly State Rare — At very high risk of extinction or extirpation due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors. Typically occurring in fewer than five populations.

S2: Vulnerable/Watchlist — At moderate risk of extinction or extirpation due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors. Typically occurring in 21-80 populations. [A non-standard rank of S3.1 is used infrequently to identify species that are of higher conservation concern because of the global significance of Maryland populations.

Although not currently imperiled, Maryland occurrences may be critical to the long-term security of the species.]

S4: Apparently Secure — At fairly low risk of extinction or extirpation due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.

S5: Demonstrably Secure — At very low risk of extinction or extirpation due to a very extensive range, abundant populations or occurrences, or little to no concern from declines or threats.

SU: Status Uncertain — A numerical rank cannot be established with confidence for reasons including lack of historical records, low survey effort, cryptic nature of the species, or concerns that the species may not be native to the state. Uncertainty spans a range of more than 3 ranks, as defined above.

SNR: Not ranked — Conservation status has not yet been fully assessed

Ranking Qualifiers (Global and State)

?: Questionable Rank — Indicating uncertainty that may span 2-3 numeric ranks, as defined under State Ranking Criteria.

B: Breeding — Conservation status refers to Maryland's breeding population of a migratory animal.

M: Migrant — Migrant animal that occurs regularly during migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the state.

N: Nonbreeding — Conservation status refers to Maryland's non-breeding population of a migratory animal.

Q: Questionable Entity — Indicates that the taxon has questionable, controversial, or uncertain taxonomic standing (e.g., treated by some taxonomic authors as a full species, whereas others treat it as a subspecies or variety or not at all).

T: Taxon — Indicates the rank of a subspecies or variety (i.e., an infraspecific taxon).

State Status Legal Definitions and Qualifiers

X: Endangered Extirpated — A species that was once a viable component of the flora or fauna of Maryland, but for which no naturally occurring populations are known to exist in the State.

E: Endangered — A species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.

T: Threatened — A species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

I: In Need of Conservation — An animal species whose population is limited or declining in the State such that it may become threatened in the foreseeable future if current trends or conditions persist. [This category does not apply to plants.]

***:** Range Restriction: This species is listed in a limited geographic area only; not statewide.

Federal Legal Status Definitions

LE: Listed Endangered — Species listed as endangered; in danger of extinction throughout all or a significant portion of its range.

LT: Listed Threatened — Species listed as threatened; likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

PE: Proposed Endangered — Species proposed to be listed as endangered.

PT: Proposed Threatened — Species proposed to be listed as threatened.

C: Candidate — Candidate species for listing for which the Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list it as endangered or threatened.

WILDLIFE CROSSINGS

As noted in Chapter 1 of the Green Infrastructure Plan, habitat connectivity plays a critical role in supporting wildlife migration and sustaining healthy, resilient populations of plants and animals. When animals move freely across landscapes, they access essential resources like food, water, shelter, and they are provided with an opportunity to find potential mates and maintain genetic diversity throughout their populations. Migration corridors allow species to adapt to seasonal changes, escape natural disasters, and shift their ranges in response to climate change. Without these connections, isolated populations face higher risks of inbreeding, disease, and local extinction due to limited genetic diversity and restricted access to vital resources. Even for species that don't migrate, habitat fragmentation is a serious issue.

Defining the Need for Wildlife Crossings

Roadways are a common source of habitat fragmentation, creating barriers that disrupt natural movement. Wildlife crossings, greenways, and protected corridors restore connectivity by linking fragmented landscapes and allowing animals to travel safely across human-dominated areas. These interventions benefit not only species frequently involved in vehicle collisions—like rabbits, deer, raccoons, possums, turtles, and squirrels—but also support broader ecosystem functions such as pollination, seed dispersal, and predator-prey interactions. Each year, drivers in the United States experience roughly 1.5 million deer-related vehicle collisions, according to the National Highway Traffic Safety Administration (NHTSA). While most of these incidents do not result in serious injury, the Insurance Institute for Highway Safety (IIHS) reports that nearly 1,900 people died in animal-related crashes between 2013 and 2022—including 11 in Maryland and 37 in Virginia. Even non-fatal crashes carry a financial burden. In 2023, the average insurance claim for an animal strike in Maryland reached $5,957, with similar costs in neighboring states.[158]

To address this growing safety and financial concern, Maryland enacted legislation in 2024 that introduced a $10 annual wildlife-vehicle collision mitigation fee for every insured vehicle. This fee is projected to generate $50.9 million annually starting in FY2025, funding wildlife crossings and other mitigation strategies. The state also secured a $387,424 federal grant to map wildlife crash "hot spots" and incorporate wildlife-passage designs into transportation planning as part of the Wildlife Crossings Pilot Program.

On May 13, 2025, Governor Wes Moore also signed House Bill 731—the Wildlife Connectivity and Crossings Act—into law, marking a major step forward in Maryland's commitment to wildlife protection and road safety. The bill established the Maryland Connectivity Coalition (MCC), a multi-agency group tasked with advancing habitat connectivity and reducing wildlife-vehicle collisions. The law also requires local jurisdictions to consider wildlife movement and habitat connectivity when developing or amending land use plans. Under the new law, the Maryland Department of Natural Resources (DNR), State Highway Administration (SHA), and Maryland Department of Planning (MDP) must coordinate to identify, prioritize, and implement wildlife crossing projects. The MCC will also develop performance metrics, share data, and recommend funding strategies, while the Maryland State Highway Administration (MDSHA) retains final authority over project design and placement. The legislation also created a Wildlife Connectivity Fund to support future projects and leverage federal resources, including the Wildlife Crossings Pilot Program Grant.[159]

Wildlife Crossing Resources

The FHWA Wildlife Crossing Structure Handbook outlines key principles for designing effective wildlife crossings that reduce wildlife-vehicle collisions and restore habitat connectivity. These principles emphasize tailoring structures to the target species, landscape context, and roadway characteristics. Designers must consider species-specific behaviors—such as whether animals prefer open or enclosed spaces—and ensure that crossings are appropriately sized, located in high-use areas, and integrated with fencing to guide animals toward them.

The handbook categorizes wildlife crossings into several types, each suited to different species and settings:[160]

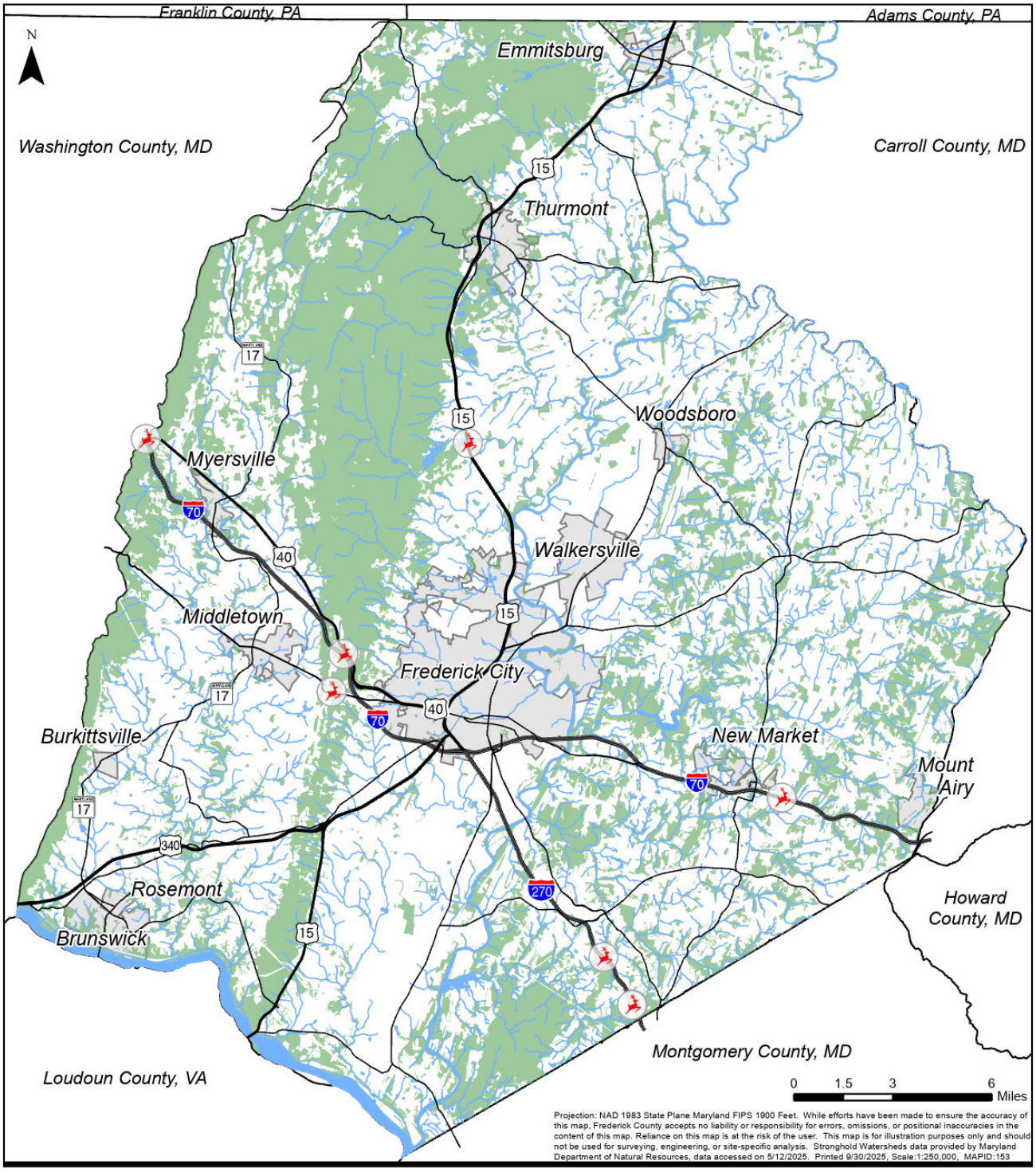
- Landscape bridges and wildlife overpasses provide broad, vegetated crossings ideal for large mammals like deer and black bears.
- Large mammal underpasses and multi-use underpasses serve both wildlife and recreational users, offering flexibility in suburban or rural areas.
- Small-to-medium mammal underpasses, modified culverts, and amphibian/reptile tunnels are designed for smaller species and often include moisture-retaining features or natural substrates.
- Fencing is a critical component, especially for large mammals, to prevent animals from accessing the roadway and to funnel them toward safe crossing points.

Strategic placement near known wildlife corridors—such as along the Catoctin Mountain and South Mountain ridgelines, where roadways cross Monocacy River and Potomac River tributaries, and Appalachian Trail intersections with roadways—would maximize effectiveness of crossings in Frederick County. In locations where recreational assets, like trails, intersect or closely follow wildlife corridors, the possibility may also exist to incorporate bike and pedestrian accommodations in constructed crossings to improve the safety of motorists, bicyclists, and pedestrians.

The Green Infrastructure Plan Advisory Group noted several important locations where frequent wildlife and vehicle collisions have been observed. The following Map, A-1, includes several locations that could be targeted with early implementation efforts aimed at improving safety and piloting the establishment of County wildlife crossing installation program. Highlighted locations include a mix of potential at-grade or culverted crossing locations where signage, fencing, or the installation of larger culverts (including culverts with mammal or “critter” shelves) could help improve habitat connectivity and motorist safety.

For more information on the design and installation of wildlife crossings, a copy of the Federal Highway Administration’s Crossing Design Manual is available for download here: https://www.fhwa.dot.gov/clas/ctip/wildlife_crossing_structures/.

The Maryland Department of Transportation, State Highway Administration, has also developed online resources for wildlife crossings focused on box turtles and the use of drainage structures as wildlife passages. The documents are available for download here: https://roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=334.



Map 27: Wildlife Crossing Hotspots noted by the Green Infrastructure Advisory Group

Advisory Group Wildlife Crossings
Forest
Municipalities
County Boundary
Municipalities

Major Roads
Route Type
Interstate
US Highway
US Alternate
Business Route
Maryland

Rivers and Lakes
Streams

THE APPALACHIAN TRAIL

The Appalachian Trail (AT) is more than just a footpath stretching over 2,190 miles from Georgia to Maine—it's a living thread of American history and culture. Conceived by forester Benton MacKaye in 1921, the trail was envisioned to promote conservation and recreation at a regional scale. With the support of volunteers, local trail clubs, and federal agencies, construction of the trail began in the 1920s and culminated in its official completion in 1937. Over time, the trail has evolved into a protected corridor managed by the National Park Service, the U.S. Forest Service, and the Appalachian Trail Conservancy. Its development represents one of the most successful grassroots conservation efforts in American history.

The Appalachian Trail in Frederick County

The Trail offers a rich blend of natural beauty, historical significance, and outdoor adventure as it meanders along the South Mountain ridgeline and between Frederick and Washington Counties, forming a 41-mile stretch that traverses the state of Maryland. Known for its moderate terrain and scenic overlooks, the trail is ideal for both seasoned hikers and beginners seeking a rewarding experience without the extreme elevation changes found in other states along the Trail.

Several notable sites along the trail in (or near) Frederick County make it a standout destination. Annapolis Rock and Black Rock Cliff (the trail head and parking lot are in Frederick County) are two of the most popular scenic overlooks, offering sweeping views of the Cumberland Valley and surrounding forests. These spots are accessible via a moderate hike from Greenbrier State Park and are especially popular during the fall foliage season. Washington Monument State Park, home to the first monument dedicated to George Washington, provides both historical context and panoramic vistas of the region. Further south, Gathland State Park commemorates Civil War correspondent George Alfred Townsend and features the War Correspondents Memorial Arch. Another highlight is Weverton Cliffs, located near Knoxville and the City of Brunswick, which rewards hikers with dramatic views of the Potomac River and Harpers Ferry.

The Appalachian Trail represents a significant natural, cultural, and recreational resource for Frederick County, and it is also one that might be leveraged to additional benefit based on outreach conducted for the Green Infrastructure Plan. In its 2021 Comprehensive Trail Plan, Catoctin Mountain Park actively sought to enhance regional trail connectivity by exploring opportunities to link its trail system with the Appalachian National Scenic Trail. The plan emphasized the importance of creating a more integrated trail network that would allow visitors to experience the broader Blue Ridge landscape while promoting sustainable recreation. One of the key components of this vision involved strengthening the connection between the Catoctin National Recreation Trail—which begins in Catoctin Mountain Park—and the Appalachian Trail, located just a few miles to the west.[161] Such a connection would bring a continuous footpath from the Appalachian Trail to within less than 2 miles of the City of Frederick (via the Catoctin National Recreation Trail) and to just outside the Town of Thurmont (via the Gateway Trail).

Washington County, Maryland, is also seeking to leverage the Appalachian Trail as part of planning and redevelopment efforts. Fort Ritchie, in northern Washington County, is undergoing redevelopment that blends historic preservation with modern revitalization. After years of vacancy following the closure federal operations at the Fort in 1998 under the Base Realignment and Closure (BRAC) Act, the former military base is now the focus of a multi-phase redevelopment. The project aims to restore the site's historic stone buildings while introducing new housing, retail, and community amenities. The Maryland Department of

Housing and Community Development awarded the project a $15 million Catalytic Revitalization Tax Credit in 2023, supporting the adaptive reuse of the site into a mixed-use community.

Washington County Government has been looking at ways to connect the Fort Ritchie development to the Appalachian Trail through the construction of new trails connecting to both High Rock and the village of Pen Mar to create another destination along the trail. Establishing a connection to from Catoctin Mountain Park to the Appalachian Trail (which passes to the west of Catoctin Mountain Park entirely in Washington County) will require coordination between multiple jurisdictions and agencies, including Frederick County, Washington County, the National Park Service, the Maryland Department of Transportation's State Highway Administration, and (potentially) private and public landholders between Catoctin Mountain Park and the Appalachian Trail. Livable Frederick staff discussed connections between Fort Ritchie and Catoctin Mountain Park and the Appalachian Trail in with Washington County Staff late Spring 2025. While both connections are still in the early stages of analysis and planning, they represent an opportunity for future collaboration between jurisdictions for grant requests, like those offered by the U.S. Department of Transportation Federal Highway Administration (USDOT FHWA) under the Eastern Federal Lands Access Program (FLAP). FLAP funding is provided each year on a state-by-state basis to help facilitate safe and adequate transportation to and through federal lands for visitors, recreationists, and resource users with no requirement for matching funds.[162]

Such future partnerships form the basis of an identified initiative in this plan and represent one of the ways in which the proximity of the Appalachian National Scenic Trail could be leveraged by Frederick County.

Appalachian Trail Communities

The Appalachian Trail Community™ program, launched by the Appalachian Trail Conservancy (ATC), builds on the legacy of the Appalachian Trail by formally recognizing towns and cities that commit to supporting the Trail and its users. By participating in the program, towns demonstrate their dedication to protecting the trail corridor and enhancing the experience for hikers. This partnership fosters a sense of shared responsibility and pride, linking local identity with the broader mission of the AT. Communities designated as Appalachian Trail Communities can realize economic benefits, such as increased tourism, which supports local businesses such as outfitters, restaurants, and lodging providers. The Appalachian Traill Communities program also encourages educational initiatives, focused on local history and culture, as well as events that celebrate heritage and strengthen community bonds through volunteerism and collaboration with trail organizations.

On June 3, 2023, the City of Brunswick and the Town of Boonsboro proudly became the first official Appalachian Trail Communities in Maryland, marking a significant milestone in their long-standing support for the trail and its users. The Appalachian Trail Conservancy hosted designation ceremonies in both towns to celebrate their commitment to conservation, outdoor recreation, and community engagement. Brunswick held its ceremony at the Brunswick Family Campground, while Boonsboro celebrated at Washington Monument State Park, a historic site along the trail. Local officials, residents, and trail advocates gathered to recognize the towns' efforts in promoting sustainable tourism, supporting hikers, and preserving the natural and cultural resources of the Appalachian Trail.[163]

Opportunities exist for other communities in Frederick County to leverage the proximity of the trail to enhance recreational connectivity and recognize local cultural history. The Appalachian Trail Conservancy's Community Impact Grants program, launched in 2020, empowers local, regional, and statewide organizations to strengthen outdoor recreation economies and promote environmental stewardship. The Conservancy's 2021 round of grant funds were directed toward communities in Virgina and West Virginia. By funding projects that enhance education, land conservation, and community resilience, the program supports initiatives such as trail centers, youth adventure clubs, cultural heritage tourism, and environmental education. These grants prioritize underserved communities and aim to foster equitable access to natural spaces, while cultivating the next generation of conservation leaders.

INTEGRATED VEGETATION MANAGEMENT / TRANSMISSION CORRIDORS AND UTILITY RIGHTS-OF-WAY AS HABITAT

The Livable Frederick Master Plan also considers goals related to the built environment and the relationship between the energy, utilities, and climate resilience in outlining the Vision for Our Environment. Distribution infrastructure for energy, and its impacts on the landscape of Frederick County are also vitally important issues when considering habitat connectivity. As this Green Infrastructure Plan is being developed and drafted, the impacts of the Maryland Piedmont Reliability Project (MPRP) remain undetermined as critical environmental surveys remain ongoing. If permitted, the final alignment of the MPRP, and the habitat impacts that could be associated with it, represent significant concern for the residents of Frederick County.

In recognition of the significant negative impacts that utility transmission can have for communities and ecosystems, Integrated Vegetation Management (IVM) has evolved over the past several decades as a best-practice approach for managing vegetation along utility rights-of-way (ROW). Originally developed to address the challenges of maintaining safe and reliable utility infrastructure, IVM now serves as a comprehensive, environmentally responsible strategy that balances operational needs with ecological stewardship. Rather than relying solely on mechanical clearing or widespread herbicide use, IVM integrates a variety of techniques—including biological, chemical, cultural, mechanical, and manual methods—to promote stable, low-growing plant communities that resist the encroachment of tall, incompatible vegetation.

The IVM process begins with a detailed site assessment to understand the ecological context, followed by the selection of appropriate control methods tailored to the specific conditions and goals of the site. These methods may include selective herbicide application, mowing, prescribed burns, or the introduction of native plant species. Regular evaluation and adaptive maintenance ensure that the vegetation remains compatible with the utility's operational requirements while minimizing environmental impact. Over time, successful IVM programs reduce maintenance costs, improve worker safety, and enhance habitat quality for pollinators, birds, and other wildlife.[164]

The Right-of-Way Stewardship Council (ROWSC) plays a central role in promoting excellence in IVM practices across North America. Established in 2013 as a program of the nonprofit Dovetail Partners, ROWSC offers the only accreditation program specifically designed for utility ROW vegetation management. Through this program, utilities can demonstrate their commitment to environmental stewardship, regulatory compliance, and community engagement. Accreditation is based on rigorous standards and best management practices that emphasize safety, reliability, ecological integrity, and cost-effectiveness.[165]

The ROWSC brings together a diverse group of stakeholders—including utility companies, environmental NGOs, academic researchers, and government representatives—to guide its standards and ensure broad accountability. Accredited utilities benefit from third-party recognition, improved stakeholder relations, and a framework for continuous improvement. The ROWSC has developed a list of ten (10) principles that must be adhered to by accredited utilities, and they include:[166]

1. 10 Core Principles of ROWSC IVM Standards

1. Compliance with Laws and Best Management Practices (BMPs): Ensure all vegetation management activities comply with applicable laws, regulations, and industry BMPs.

2. Tenure and Use Rights and Responsibilities: Respect land ownership and usage rights while managing vegetation responsibly.

3. Community Relations: Engage with local communities and stakeholders to build trust and transparency in IVM practices.

4. Management Planning: Develop and maintain comprehensive vegetation management plans that guide decision-making and implementation.

5. Understanding Pest and Ecosystem Dynamics: Base management decisions on ecological knowledge, including pest behavior and ecosystem interactions.

6. Establishing Tolerance Levels: Define acceptable thresholds for vegetation types and densities to guide treatment decisions.

7. Integrated Treatment Techniques: Use a combination of methods—chemical, biological, mechanical, manual, and cultural—to manage vegetation effectively and sustainably.

8. Economic and Ecological Considerations: Evaluate both the financial and environmental impacts of vegetation management treatments.

9. Site-Specific Implementation: Tailor vegetation management strategies to the unique conditions of each site.

10. Monitoring and Adaptive Management: Continuously monitor outcomes and adjust practices based on performance and environmental feedback.

The ROWSC also provides research and references related to IVM implementation and cost effectiveness. While FirstEnergy Corporation, of which Potomac Edison is a subsidiary operating in Frederick County, has been an accredited utility of the ROWSC since 2021, not all regional infrastructure operators are accredited. In order to ensure that new transmission corridors, where they can't be avoided as a result of judicious use of existing infrastructure, and proper planning and implementation, are as minimally impactful to the landscape of Frederick County, County government should work with the State of Maryland to ensure that all operating transmission and distribution utilities seek, achieve, and adhere to IVM standards like those set forth by the ROWSC.

The suitability of utility rights-of-way for use as trail corridors should also be considered. These corridors are already typically cleared and graded to accommodate infrastructure and future maintenance, making them ideal for trail development with minimal environmental disruption and reduced construction costs. Trails within existing rights-of-way can significantly cut construction expenses while creating valuable recreational and transportation routes. In densely populated or land-constrained areas, utility corridors may also offer critical opportunities for connectivity between neighborhoods, parks, and other community facilities. Moreover, partnering with utility companies fosters collaborative projects that benefit both infrastructure providers and the public, turning single-use spaces into multi-functional community assets.

Chapter Endnotes

144 Adapted from Noss, R. F., & Cooperrider, A. (n.d.). 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity and Benedict, M. A., McMahon, E. T. (2006). Green infrastructure: Linking Landscapes and Communities.

145 Adapted from Microsoft. (2025). Response to "create an image of a small patch of trees from a high vantage point in the style of a colored pencil sketch on a white background." Copilot (GPT-4). Retrieved August 11, 2025, from https://copilot.microsoft.com/.

146 Trombulak, S. C., & Baldwin, R. (2014). Landscape-scale Conservation Planning. Springer.

147 <https://dnr.maryland.gov/ccs/documents/mdreturnonenvironmentfactsheet.pdf>.

148 As defined in the glossary of this Plan, gray infrastructure represents systems engineered and constructed by humans like roads, drinking water systems, wastewater systems, and dry utilities (electric, gas, data, etc.).

149 The CIP is a multi-year working document that outlines the County's planned capital projects, such as major infrastructure, facilities, or equipment upgrades, over a period of five years, and it is typically revisited each year as part of the County's annual budgeting process.

150 <https://www.epa.gov/green-infrastructure/green-infrastructure-and-extreme-weather>.

151 Jansujwicz, J. S. and Calhoun, A. J. K., in Trombulak, S. C., & Baldwin, R. (2014). Landscape-scale Conservation Planning. Springer.

152 Certain species endemic to these key habitats have been noted in these descriptions, but not all species listed have been verified as occurring in Frederick County.

153 The Ridge and Valley physiographic region is generally recognized as starting on the western side of South Mountain and extending westward toward Garrett County where the Appalachian Plateau begins.

154 Mesophytic species are species that tolerate moderate moisture conditions. Xeriphytic species prefer dry conditions, while hydrophytic species prefer moist conditions.

155 Species of Greatest Conservation Need from SWAP cross-referenced with iNaturalist for sites in Frederick County <https://www.inaturalist.org/> or noted in other sources.

156 The Tricolored bat (Perimyotis subflavus) was added to the list of Rare, Threatened, and Endangered Animal Species in 2022 with a State Rank of S1. Federal Status for this species has not been finalized as of the publishing of the Green Infrastructure Plan.

157 <https://dnr.maryland.gov/wildlife/Documents/MDDNR-Rank-and-Status-Code-Definitions.pdf>.

158 D. Gibson. (2024, October 3). Fear the deer! Tis the season for increased Vehicle-Deer crashes in Frederick County. WFMD-AM. <https://www.wfmd.com/2024/10/03/fear-the-deer-tis-the-season-for-increased-vehicle-deer-crashes-in-frederick-count>.

159 The Maryland State Highway Administration received a federal grant of $387,424 in 2024 to develop a comprehensive plan designed to reduce wildlife-vehicle collisions in the state. Funds will be used to map wildlife-vehicle collision hotspots and high-risk areas, incorporate wildlife passage designs in highway infrastructure projects, improve incident recording practices, and educate the public.

160 <https://www.fhwa.dot.gov/clas/ctip/wildlife_crossing_structures/>.

161 U.S. National Park Service, U.S. Department of the Interior. (2022). Catoctin Mountain Park Comprehensive Trail System Plan and Environmental Assessment. U.S. National Park Service.

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163 Merrill, A., & Merrill, A. (2024, April 20). Five new A.T. communities to be designated this month. Appalachian Trail Conservancy. <https://appalachiantrail.org/news/five-new-a-t-communities-to-be-designated-this-month/>.

164 U.S. Environmental Protection Agency. (2008). Fact Sheet Integrated Vegetation Management. <https://www.epa.gov/sites/default/files/2016-03/documents/ivm_fact_sheet.pdf>.

165 PlusCode. (n.d.). Right-of-Way Stewardship Council.<https://rowstewardship.org/>.

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