Guilford Branch Forest Hub Habitat Assessment and Management Plan

January 2018

Prepared for Howard County, MD

A companion to the Green Infrastructure Corridor Analysis, this document offers habitat management guidance for Guilford Branch Forest Hub. Preparing habitat management plans was listed as a priority project in Howard County's 2012 Green Infrastructure Network Plan. The first section is a Landowner Summary. The second section provides a general orientation to the Network, the concept of habitat value, and the primary stressors and threats to the Network hubs and corridors. It concludes with a brief menu of the most commonly recommended habitat improvement techniques. The final section describes existing conditions and identifies potential habitat enhancements for the Guilford Branch Forest Hub.

HOWARD COUNTY
MARYLAND

Biohabitats

Table of Contents

Figures, Tables, and Photos

List of Appendices

Landowner Summary

This Landowner Summary is intended to give landowners within and adjacent to the Guilford Branch Forest Hub a brief introduction to the Howard County Green Infrastructure Network and the concept of habitat value. A summary is then given of existing conditions within the hub and the primary and secondary actions needed to improve those conditions to enhance the hub's habitat value. A reference section at the end of the summary provides links to sources for information on implementation techniques and potential funding assistance. Landowners who wish to learn more about specific resource conditions or enhancements listed in this summary will find more detailed information in the body of the Habitat Management Plan.

Howard County Green Infrastructure Network

The Network includes two basic building blocks:

- **Hubs - large, natural areas, including forests and wetlands, which provide core habitat for native plants and animals.**
- **Corridors – provide natural connections between hubs, often along rivers and streams, and allow wildlife to move safely and freely between hubs.**

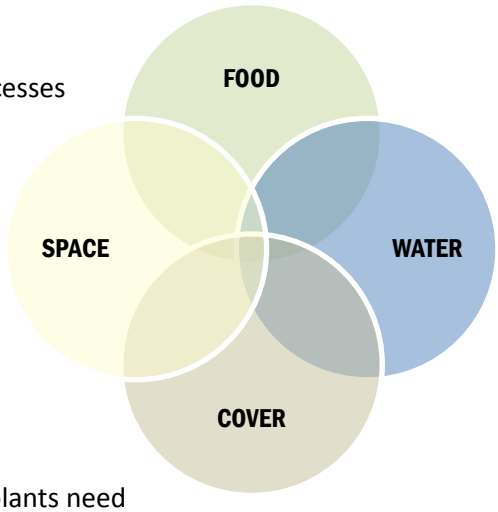
The Network offers multiple benefits for our communities and economy, including habitat for a variety of native plants and animals, opportunities for nature-based recreation, cleaner air and water, reduced storm runoff, and disrupted urban heat islands. The Network includes both public and privately owned land, so a shared sense of stewardship among landowners, no matter how large or small their property, is a critical asset in supporting a healthy Network.

Wildlife in Howard County

Howard County is home to familiar backyard wildlife, such as deer, rabbit, gray squirrel, woodchuck, skunk, raccoon, opossum, fox, and coyotes, that coexist within the patchwork of urban and suburban land uses. The County's more secretive residents, such as long-tailed weasel, river otter, mink, flying squirrel, two species of bat, eleven species of salamanders, and an occasional black bear, have more specific habitat requirements that require blocks of high quality habitat in the woods and along streams and rivers. In addition to the resident wildlife, the Howard County Bird Club has documented over 200 species of migratory birds using the diverse habitats throughout the County for nesting or staging areas along their migration. The most sensitive of the County's wildlife are forest interior dwelling species, which require large blocks of forest (>50 acres) with 10 or more acres of forest interior (more than 300 feet from the forest edge). Overall, the abundance and diversity of wildlife throughout the County also supports various recreational and economically beneficial activities including birdwatching, hunting of deer, waterfowl and upland gamebirds (e.g., American woodcock, mourning dove), and fishing.

A complete list of wildlife species in the County can be derived from the Maryland Biodiversity Project. In order to establish habitat management and connectivity goals, the requirements of forest interior species and the County's 24 amphibians, 30 reptiles and 20 small mammals are a better guide than the needs of highly mobile species such as migratory neotropical birds. Additional lists of threatened and sensitive local wildlife, which can factor into management goals, are available from US Fish and Wildlife Service and the Maryland Department of Natural Resources Wildlife and Heritage Service.

What is Habitat?



Habitat is simply the area where a plant or animal makes its home and accesses the resources necessary to live. Each species has different habitat requirements, which can be defined in terms of the four resources that must coexist for plants and wildlife to live and thrive in a specific location: food, water, cover, and space. The greater the amount and variety of each of these resources, the more valuable the habitat is for a wider range of species. Accordingly, the habitat value of a property can be improved by the following:

- Food: Provide a variety of food sources
    - Food provides the sustenance and nutrition animals and plants need to survive and reproduce. For plants, it may be a certain set of nutrients and the availability of sunlight. For animals, it may be a selection of native plants, insects, or other smaller animals. Good habitat provides a variety of abundant food sources to accommodate a wide range of species year-round. Property owners and managers are most likely to increase food sources for wildlife by planting or protecting the native plants that provide food in the form of foliage, nuts, fruits, seeds, nectar and pollen.
- Water: Provide and protect clean sources of water
    - Water is a basic element for survival shared by all species, both as a source of hydration and as a home for all or a portion of a species' life cycle. Plants and animals need a variety of clean water sources, which can be available in the form of soil moisture, groundwater, vernal (or seasonal) pools, ponds, wetlands and streams.
- Cover: Provide a variety of cover
    - Wildlife need places to hide, rest, raise their young and take shelter from the weather. Depending on the species, cover can be found in rock or brush piles, downed logs, thickets, shrubs or trees. Forests, streams, wetlands, ponds and meadows with more structural diversity (vegetation in layers at differing heights) provide better cover.
- Space: Provide safe and appropriate space
    - Plants and animals need safe and appropriate space that can accommodate their entire life-cycle, and space needs can vary by species and by life-stages within a species. By providing large, connected habitat areas, the Network is better able to accommodate the space needs of a variety of native species. Property owners within the Network can ensure their land continues to provide good quality habitat by protecting and enhancing the woods, meadows, wetlands and streams on their property.

Existing Conditions in Guilford Branch Forest Hub

The Guilford Branch Forest Hub is located within a suburban area in southeast Howard County and is bordered by Interstate 95 (I-95) and the CSX railroad track near Oakland Mills Road. The hub is a forest patch of approximately 150 acres that is important to wildlife because it serves as a gateway from the developed suburban environment of Columbia into the Green Infrastructure Network, and it is adjacent to a protected crossing under I-95.

The hub contains a mix of young and mature deciduous/coniferous forest, small wetlands, Guilford Branch, a small intermittent tributary to Guilford Branch, and drainage ditches or ephemeral channels. The hub also contains forest interior habitat, which is generally defined as forest found 300' from the forest edge. Forest interior habitat is cooler, moister and more isolated habitat, and certain species such as songbirds, require this type of habitat for nesting and raising their young. The hub has low, rolling hills and the area near I-95 has an old, abandoned mining site. A high, chain-link fence separates the eastern third of the hub from the remainder, and a second fence separates the hub from I-95.

As a headwater area, the hub also influences the downstream water quality in two Network corridors. Guilford Branch originates in the northern portion of the hub and flows south through the Guilford Little Patuxent Corridor, connecting the Guilford Branch Forest Hub to the Little Patuxent Savage Corridor at the Anne Arundel County border. An ephemeral channel that originates in the southeast corner of the hub also connects to the Network, running south under I-95 then becoming a perennial stream as it runs through the Chase Quarry within the Guilford Dorsey Corridor that connects the Guilford Branch Forest Hub to the Dorsey Wetland Hub.

The forest and wetlands in the hub generally provide good habitat for the resident wildlife. There are a variety of food and water sources, including oak and hickory trees that provide acorns and nuts. Abundant downed wood, standing dead wood that host insects and grubs, and forests with layers of vegetation provide cover and nesting habitat. The dispersed wetlands and deep shade make the hub excellent habitat for amphibians (frogs, toads, newts, salamanders). Based on an informal, visual assessment, the instream habitat is supportive of an aquatic community of aquatic insects and other invertebrates, with limited value to fish due to its small size and position higher up in the watershed.

Although the hub is in reasonably good condition, it suffers from water management impairments (storm drain outfalls and ditches), a lack of connectivity within the hub and to the Network due to fencing and the interstate, and an overabundance of deer. The water management impairments include old drainage ditches that efficiently drain water from the landscape, depriving it of needed water and diminishing the hub's ability to sustain wetlands. By draining the water directly to the streams rather than allowing it to more slowly filter through the soil, the ditches also have the net effect of reducing water quality.

A dense deer population browses the native understory and shrub layer heavily. The result is a forest with a layer of tall canopy trees that the deer are unable to damage and an herbaceous groundcover that the deer don't eat. The deer's destruction of the understory impedes forest regeneration because young trees are unable to grow to maturity and replace older, fallen or diseased trees.

The hub's wildlife habitat value is also limited by the constraints that prevent wildlife from entering and leaving the area, and from moving within the hub itself. Neighboring development, fencing, both within the hub and at its boundaries, the railroad tracks, and especially I-95 are barriers to wildlife movement.

As a secondary consideration, non-native invasive plants (NNIP) are also present throughout the hub in low levels. These plants often have prolific reproduction and growth rates, so they can out-compete native plants for water, nutrients and space, yet rarely provide good food sources for native wildlife. Their presence is not currently a threat to forest regeneration in the hub, but deer generally prefer to eat native plants over NNIP, which aids in their spread.

Guilford Branch Forest Hub – Potential Enhancements

Management planning for the hub should include investigating options to prevent development within the hub, such as a permanent environmental easement or public acquisition for parkland or open space. If the hub becomes subject to development, the development should be clustered at the edges of the hub to limit forest clearing and a reduction in the forest interior habitat currently provided by the hub.

There are several management techniques that could be implemented to improve habitat within the hub. The primary actions needed to address the impairments to habitat quality identified through this assessment include: improve water management, facilitate wildlife movement within the hub and from the hub to neighboring lands, and manage deer populations. Secondary actions to enhance habitat quality could be determined in response to an ongoing monitoring effort directed at non-native invasive species.

Techniques to address water management problems could include blocking the ditches that serve as ephemeral and headwater reaches in order to sustain wetlands and recharge the groundwater, or creating vernal pools. A full assessment of Guilford Branch could not be conducted because fencing within the hub limited access, but this stream may also benefit from stream channel restoration. These activities may require the assistance of environmental consultants and engineers to help evaluate and design any changes to site hydrology and consequent changes to habitat, and ensure the proper local, state and federal permits are acquired.

The connectivity of the hub to downstream and nearby corridors and hubs could be improved by measures to make the railroad crossing under I-95 more hospitable to wildlife. A preliminary examination of Howard County wildlife crossings suggests that wildlife might be more willing to use the railroad crossing under the cover of night, perhaps in part because they are less likely to be detected. Additional plants that would offer more cover along the crossing might encourage its use. The habitat value of the hub would also be enhanced by improving the corridors that link it to other habitat in the County.

Improving connectivity within the hub may not be feasible at this time. A large portion of the hub is owned by the Federal Communications Commission and this property is fenced for security reasons, although there are gaps in the fencing. The best technique to manage deer populations would be hunting, which may not be feasible unless all of the owners are amenable.

Additional management actions could also enhance the habitat value of the site, including most of the Common Habitat Enhancements discussed in the second section of this document. Because such activities are not responding to specific, urgent threats, selecting among them would largely depend on the interest and energies of the landowners or other stakeholders. One of the best ways for a landowner to take a structured approach to selecting additional habitat enhancements would be to initiate a Forest Stewardship Plan with the Maryland Department of Natural Resources.

Further Information

Howard County Resources and Programs

- The Stream ReLeaf Program provides free trees for stream buffer plantings (https://www.howardcountymd.gov/ Forestry).
- The Howard Soil Conservation District (HSCD) supports several residential landowner programs such as Backyard Actions for a cleaner Chesapeake Bay http://mda.maryland.gov/resource_conservation/Documents/backyard.pdf. The HSCD also assists agricultural landowners with federal and state cost-share programs for habitat improvements, including the Environmental Quality Incentives Program (http://www.howardscd.org/cost-share).
- The Howard County Deer Management Plan further explains the causes, problems and solutions to overabundant deer populations.
- The Clean Water Howard stormwater management program provides information on managing water resources on private land (http://www.cleanwaterhoward.com/).

Additional Resources

- *The Woods in Your Backyard* is a state program that teaches forest management techniques to property owners with small forest acreage (https://extension.umd.edu/sites/default/files/_docs/WBYCreatingNaturalAreas.pdf).
- The Maryland Department of Natural Resources (MD DNR) provides overview information on invasive species (http://www.dnr.state.md.us/invasives/).
  - MD DNR Forestry Division supports TREE-mendous Maryland, which provides free trees for planting on public lands (http://dnr.maryland.gov/forests/Pages/treemendous/default.aspx).
- The MD DNR Forestry Division provides information on a variety of forest stewardship programs (http://dnr.maryland.gov/forests/Pages/programapps/stewcon.aspx) and can prepare Forest Stewardship Plans for individual properties for a modest fee.
- Wildlife habitat certification programs, such as MD DNR Wild Acres, the National Wildlife Federation and the Wildlife Habitat Council, work with residential, school and commercial property owners (http://dnr.maryland.gov/wildlife/Pages/habitat/wildacres.aspx).
- The USDA has an excellent resource on how to create vernal pools: www.watershedconnect.com/documents/science_management_interventions_wetlands
- The US Fish and Wildlife Service provides a guide to *Native plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed* (http://www.nativeplantcenter.net/resources/).
- The Maryland Native Plant Society provides guidance on buying native plants, including a list of local nurseries that sell native plants, at https://www.mdflora.org/publications/nurseries.html
- The University of Maryland Extension provides information on a variety of homeowner and agricultural landowner programs (http://extension.umd.edu/). The Extension's Home and Garden Information Center gives an overview of invasive insects and pests (https://extension.umd.edu/hgic/invasive-insects-0).
- The National Park Service provides a guide to identify and manage invasive plants - *Plant Invaders of Mid-Atlantic Natural Areas, 4th ed.* (Swearingen et. al. 2010) – that includes information on native plant alternatives (https://www.invasive.org/eastern/midatlantic/).
- The Nature Conservancy provides a guide for the control of invasive species - *Herbicide Use in Natural Areas* (TNC, 2010) http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/illinois/il-vsn-herbicide-use-manual-updated-2011.pdf.

Habitat Management in Howard County

Green Infrastructure Network

In 2010, Howard County made a formal commitment to enhancing and supporting its Green Infrastructure Network and the plants, animals and resources it contains, as well as fortifying the ecological functions, such as water storage or pollinator services, that it provides to sustain the health and quality of life in the County. The County started by defining the geography of the Network, with attention to providing connectivity with Networks in the state and in neighboring counties (Figure 1). The Howard County Green Infrastructure Network, as originally defined in the 2012 Howard County Green Infrastructure Network Plan, includes two basic building blocks: ***hubs***, which are large, natural areas that provide habitat for native plants and animals, and the ***corridors*** that connect them, often along rivers and streams.

What is Green Infrastructure?

Although Green Infrastructure is sometimes used in a narrow sense to refer to stormwater management, Howard County's Green Infrastructure Network is based on the original use of the term, as an ecological system on a scale comparable to other forms of urban infrastructure (for example, road networks or water and sewer systems), but composed of interconnected waterways, wetlands, forests, meadows and other natural areas. A Green Infrastructure Network with healthy resources offers multiple benefits for our communities and economy, including habitat for a variety of native plants and animals, opportunities for nature-based recreation, cleaner air and water, reduced storm runoff and forest that disrupts urban heat islands.

Hubs contain large areas of interior forest and wetlands. Interior forest is generally defined as forest found at least 300 feet from the forest edge and offers higher quality forest habitat, because it is generally more isolated, with a closed canopy that creates moist, shaded growing conditions. Forest interior habitat is also rare, especially in the south and east of the County, because development has fragmented or broken up our remaining forest into ever smaller forest patches.

Hubs were defined to meet the following criteria:

- Interior forests of 50 acres or more with a 300-foot buffer
- Wetlands of 25 acres or larger, including ponds, lakes and reservoirs, with a 100-foot buffer
- State and County parkland and open space that contain these interior forests and wetlands
- Forest, parkland and open space immediately adjacent to these areas

The 51 hubs in the Network include over 20,000 acres, or 14% of the total County area, and range in size from 25 to 2,407 acres. The hubs include major state and county parks as well as other public lands, but almost 28% of the land is privately owned, which creates an important opportunity to support stewardship and good habitat management or acquire easements or land.

Corridors link the hubs via narrow strips of forest or natural habitat that generally follow rivers and streams. The Green Infrastructure Network defined two minimum corridor widths of 300 and 500 feet, with extensions to include adjacent floodplain, wetlands, parkland and open space. The 500-foot corridor width is the preferred option for the Network. However, there are areas within the Network where a 300-foot corridor may be more appropriate, such as on agricultural land. There are 48 corridor connections in the Network, and the 500-foot corridor system contains just over 6,000 acres or 4% of the total County area. The corridors are ecologically important because they serve as physical links among easements, parks, and large blocks of valuable habitat that may not be protected.

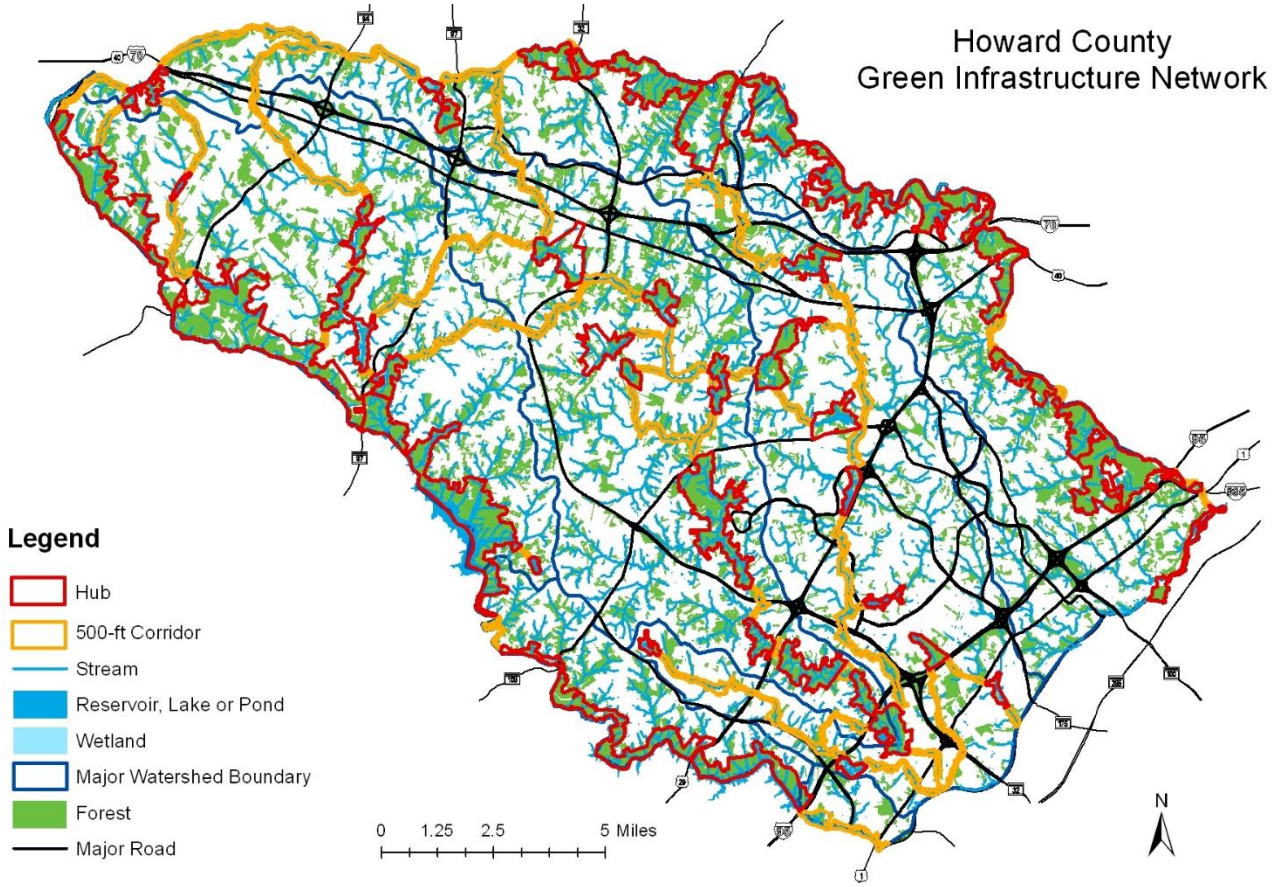


Figure 1. Howard County Green Infrastructure Network

Howard County Green Infrastructure Network Goals

The purpose of Howard County's Green Infrastructure Network Plan is to define, protect and enhance a Green Infrastructure Network that includes and links the most ecologically significant natural areas in Howard County. The Green Infrastructure Network Plan outlines two overarching goals, one for habitat and one for stewardship, each with supporting objectives.

Habitat Goal: Protect, enhance and restore the habitat and natural areas within the Green Infrastructure Network to support a diversity of plant and animal life.

Habitat Objectives:

- Retain, enhance and restore forests, interior forests and wetlands.
- Increase the habitat value of ponds, lakes and reservoirs.
- Enhance and restore stream habitat.
- Manage wildlife to support healthy and diverse populations of native species.

Stewardship Goal: Promote stewardship of the Green Infrastructure Network among individuals, community organizations, businesses, schools and others.

Stewardship Objectives:

- Increase awareness and personal involvement.
- Encourage participation in land preservation programs.
- Promote land management practices that conserve resources, reduce pollution and enhance habitat.

Hub Habitat Management Plans (or HMPs) help achieve both goals for the Network. The HMPs provide information on existing habitat conditions and how to improve those conditions. This information is useful for both public and private landowners who wish to improve habitat on their property. A shared sense of stewardship among landowners is a critical asset in supporting a Network that provides habitat for a diversity of native plant and animal life.

Defining Habitat Value

The Green Infrastructure Network provides an opportunity to enhance the quality of plant and wildlife habitat at a scale much larger than an individual property. For the Network to function as a living framework that shelters plants and wildlife and supports other ecological functions, it must provide both high quality habitat and connectivity (see box on Page 12), so that plants and wildlife can move across the landscape. Landscape in this context includes the physical elements of landforms such as hills and meadows, water bodies such as rivers, lakes and ponds, living elements of land cover including vegetation, human elements including different forms of land use such as agriculture, buildings and roads, and transitory elements such as lighting and weather conditions.

Habitat value can be defined in terms of the four resources that must coexist for plants and animals to live and thrive: food, water, cover, and space. The greater the amount and variety of each of these resources, the more valuable the habitat is for a wider range of species. The following sections offer general guidelines for meeting each of these four resource needs. Individual landowners can use this information to evaluate their property for opportunities to enhance its habitat value. Specific suggestions on how to do so begin in Common Habitat Enhancements (page 19).

1. FOOD: Provide a variety of food sources

Each species has individual nutritional requirements, so good habitat provides a variety of abundant food sources to accommodate a wide range of species.

Property owners and managers are most likely to improve feeding opportunities for wildlife by planting or protecting the native plants that offer food to the widest variety of native wildlife species. Native plants can provide food in the form of foliage, nuts, fruits, seeds, nectar and pollen. Native plants that provide food for a variety of animals, including insects, birds, small mammals, amphibians and reptiles, have the most habitat value. The US Fish and Wildlife Service (USFWS) publication *Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed* is a useful general reference for information on a wide variety of native plants that offer maximum wildlife value. Native plants have the added value of being well adapted to local growing conditions, so they are more likely to survive and require reduced maintenance once established. Including these plants in plantings can attract additional wildlife species to a property.

2. WATER: Provide and protect clean sources of water

Plants and animals need a variety of clean water sources, which can range from soil moisture, dew, rainfall, groundwater, vernal (or seasonal) pools, ponds, wetlands and streams. Water is needed by wildlife for drinking, bathing, breeding and raising their young. Healthy wetlands and streams with buffer areas of native vegetation support a host of wildlife species and complex plant communities, and improve water quality and water storage. Where these diverse, undisturbed vegetated buffers are wider than 15 feet along a stream or wetland, they also function as natural filter systems to clean surface runoff before it enters the waterbody.

3. COVER: Provide a variety of cover

Wildlife need places to hide, rest, raise their young, and take shelter from the weather. Depending on the species, cover can be found in rock or brush piles, downed logs, thickets, shrubs or trees. Forests, streams, wetlands, ponds and meadows with more layers of vegetation at differing heights provide a greater variety of cover and support more wildlife species.

Healthy forests with vegetative layers, or vertical structure, include well developed herbaceous, shrub, understory and canopy layers (see Figure 2). Supplemental plantings to replace missing vegetative layers can help improve forest habitat, as can allowing standing dead trees, or snags, to remain. Snags can provide cavities for cavity-nesting birds such as many owls, chickadees, and woodpeckers and mammals such as flying squirrels.

In streams, ponds, and wetlands, structural diversity is provided by having water of different depths and flow speeds. Healthy streams provide a mix of fast and slow-moving water at shallow and deep water depths. In streams, structural diversity can be enhanced by wood or boulders that create complex cover for refuge from predators or higher flows. Beavers, as natural architects of the aquatic landscape, create a mosaic of habitats for other species, which thrive in the pools and wetlands they create. In ponds, structural diversity is provided by benches of shallow habitat that provide areas for emergent and aquatic vegetation to grow, create nursery areas for juvenile fish, and offer cover to escape predators.

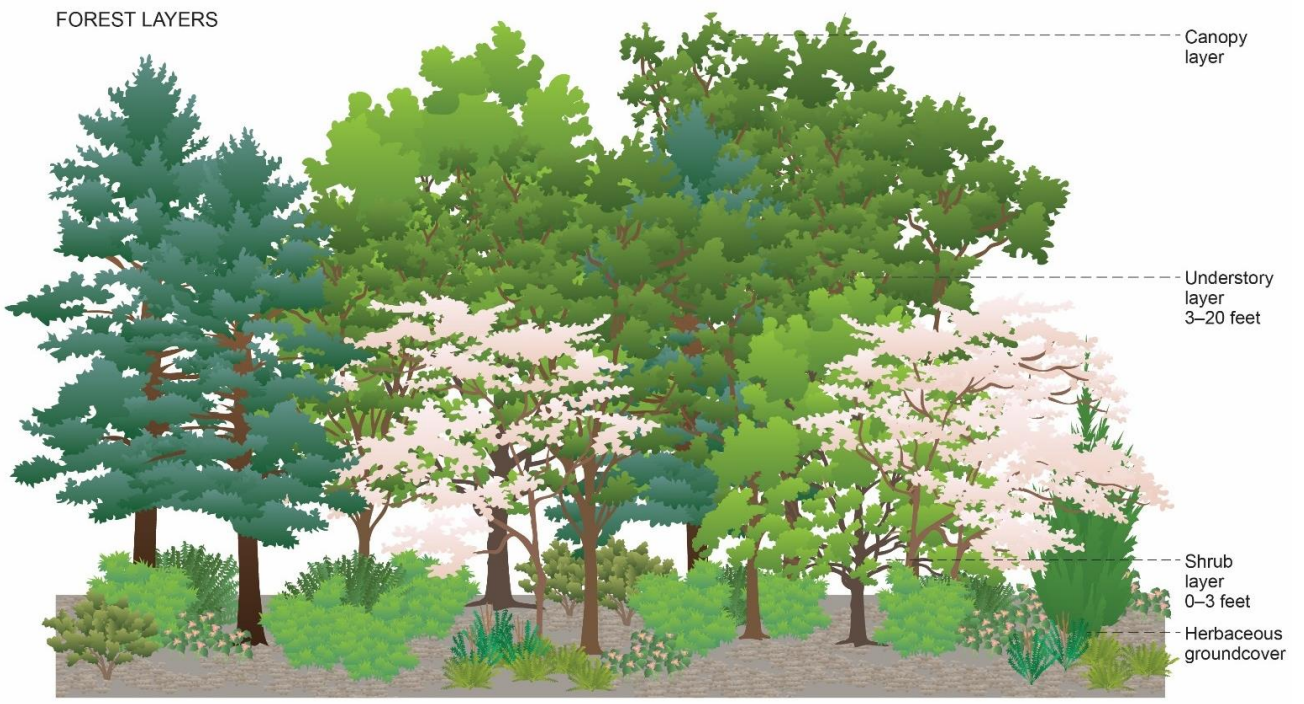


Figure 2. A forest with vertical structure includes herbaceous, shrub, understory, and canopy layers. The canopy is comprised of the trees receiving direct sunlight, whereas other layers are fully or partially shaded.

Protected access to streams, ponds, and other water sources is a key part of cover. Animals that live all or part of their lives in aquatic habitats and the wildlife that visit streams or ponds to drink prefer shelter at the water's edge. Ponds with more diverse natural vegetation along the edges provide a higher habitat value than those with a manicured or mowed edge. Adding native vegetation to exposed or mown pond edges and stream banks will introduce cover and structure in a way that will quickly enhance wildlife habitat.

Meadows provide important cover for nesting, raising young, and escaping predators in addition to ample seasonal forage, such as seeds and insects. On the east coast, meadows tend to naturally change (in a process termed succession) to a forested system if left alone, so management is often necessary to maintain an open meadow. Consequently, meadows are often mowed, which can have a profound effect on the overall quality of the habitat. Mowing does suppress weeds and prevent succession; however, mowing during peak nesting periods for wildlife (typically April through August) or too low to the ground can disrupt wildlife breeding and brooding activities and decimate local populations for ground nesting birds and mammals. Developing a mowing schedule can minimize the impacts of habitat disruption, provide the necessary year-round cover for desirable native wildlife, and potentially decrease the frequency and acreage that is mowed each year. Avoiding mowing altogether and managing for "rewilded" landscaping can also add habitat value to a site, but may require more labor to manage the growth of woody vegetation.

4. SPACE: Provide safe and appropriate space

Plants and animals need safe and appropriate space that can accommodate their entire life-cycle and provide food, water, and cover. Space needs can vary by species and by life-stage within a species. By providing large, connected habitat areas, the Network is better able to accommodate the space needs of a variety of native species. Property owners within the Network can ensure their land continues to provide good quality habitat by protecting and enhancing the woods, meadows, wetlands and streams on their property.

Easements are one way for property owners to ensure permanent protection of the resources on their land. Easements may be donated or purchased, and are held by a local or state land trust. Local land trusts in Howard County include the Rockburn Land Trust and the Howard County Conservancy, and the state land trust is the Maryland Environmental Trust.

If a property is not yet developed, buildings, roads, driveways, gardens, and other site features can be placed to optimize the space that remains. Site planning that minimizes the area of disturbance and development, preserves large blocks or tracts of undisturbed habitat, minimizes the amount of edge habitat where the forest abuts open or developed space, and maintains connections to adjacent habitat can help maintain the habitat value of the Network.

Properties may sometimes contain plant or animal species that are in need of conservation and are listed by the state as endangered, threatened or rare. An endangered species is defined by state law as any species whose continued existence as a viable component of the state's flora or fauna is determined to be in jeopardy. A threatened species appears likely, within the foreseeable future, to become endangered. A rare species or a species in need of conservation requires conservation measures for its continued ability to sustain itself successfully. The Natural Heritage Program at the Maryland Department of Natural Resources can provide guidance on conserving habitat for these species.

Species often become endangered, threatened or in need of conservation due to the loss or degradation of their habitat. It is important to provide habitats that are rare in the landscape, when possible. In Howard County, rare landscapes include forest interior, meadows, areas of low-growing shrubs and trees, and cold-water streams.

Managing landscapes for habitat value and creating or maintaining rare habitats and recreating linkages among habitat blocks improves biological diversity on a system-wide or regional scale. Biological diversity is generally defined as the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Primary Stressors and Threats

There are six primary threats to habitat quality that good management can help to address: loss of habitat and habitat connectivity; property management activities; waste and contaminants; water management impairments; wildlife community imbalance; and non-native invasive species. These threats are discussed in more detail in the following section.

Loss of Habitat and Habitat Connectivity

The County's landscape is a mosaic of habitats of varying value depending on land use. These range from high-value interior forests to low-value parking lots. Wildlife move most freely between habitats of similar value. For example, a forest interior dwelling species such as a pileated woodpecker is more likely to move between patches of forest interior through patches of forest than across agricultural fields. As the connections between like habitats begin to break (a process called fragmentation), the value of both habitats begins to drop. The more isolated a patch becomes from a core habitat such as that found in a hub, the lower the value of the habitat. Over time, urban and suburban development and agricultural activities have fragmented habitats throughout the county, which has isolated plant and wildlife communities and made them more vulnerable to permanent local extinctions by disturbances such as flooding, fire or strong wind storms.

Habitat Connectivity

To conceptualize the significance of habitat connectivity, imagine patches of habitat as stepping stones across a stream channel. If the stepping stones are large and close together, it is easy to walk across and your feet stay dry (high connectivity). The risk of getting your feet wet increases as the stepping stones get farther apart and/or smaller (fragmentation). At a certain point, the stones do not appear to have any value in helping cross the stream, so if you value dry feet, you can no longer cross the stream. As patches of habitat for dry feet, small dry rocks are no longer of value (see Figure 3).

Small patches of forest are not only compromised in terms of their extent, but also by the increased amount of forest that is edge habitat. Forest edges, where the forest abuts open or developed space, are hotter, drier, and more prone to being taken over by invasive species. Many native species cannot or will not live near a forest edge, but instead require interior forest, with its cooler, moister and more isolated habitat. Forest interior species are not adapted to the presence of species that live in edge environments. Edge species can include cowbirds, crows, jays, opossums, raccoons, skunks and domestic dogs and cats. These edge species are often predatory and can reduce the populations of forest interior species such as low nesting birds. Songbirds, for instance, have greatly reduced nesting success in forest edges because that is where brood parasites such as cowbirds are common. Brood parasites lay their eggs in the nest of other birds, and the young intruders are fed by the host parents at the expense of their young. Forest interior species may use habitat closer to the edge if the transition to open space is gradual rather than an abrupt edge.

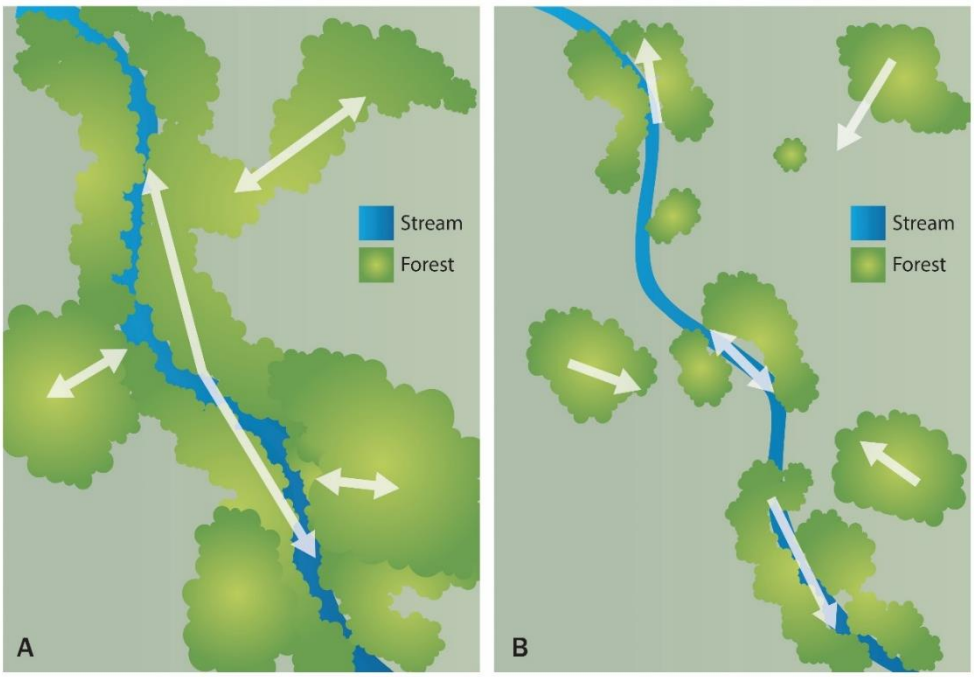


Figure 3. Connected landscapes (A) generally have better habitat value than less connected ones (B). This example shows a riparian corridor that has been fragmented by the loss of forest habitat. Credit: Biohabitats, based on graphic by NRCS.

The Network is specifically designed to respond to the loss of habitat connectivity at the regional scale. The County envisions a living Network of sites that allows animals and plants to migrate across and through the landscape in corridors of high-quality habitat.

Property Management Activities

Every square foot of land has a potential habitat value – a rotting log can host dozens of invertebrates (centipedes, potato bugs, slugs, etc.) which may feed a salamander, a milkweed plant in an urban garden can sustain a handful of monarch caterpillars, a dead tree on the edge of the woods supports invertebrates that are eaten by woodpeckers. Consequently, land management has a direct impact on the abundance and diversity of wildlife inhabiting a space. Habitat values can be compromised by an assortment of routine property management activities, especially if they are performed without consideration for their effects on the ecological systems of a site. Mowing, clearing standing forest for fields or agriculture, and dead tree removal can destroy breeding habitat, remove nesting sites, and reduce the habitat value of a site by destroying cover and foraging opportunities. Other habitat disturbances include unplanned foot trails or informal roads that can cause erosion and fragment existing natural resource areas, as well as dumping trash, contaminants, or even yard waste. Of these, mowing regimes are one of the easiest to alter and control for the benefit of wildlife.

Managing unused open areas for turf by regular mowing reduces available cover and food for local wildlife populations. In addition to the cost of labor, fuel and equipment, regular mowing can have a profound influence on plant and animal diversity. Mowing too frequently, for example, halts the normal successional processes by which a plant community develops and diversifies over time. Instead of

allowing a gradual addition of low-growing woody plants, mowing favors grasses, homogenizes plant heights, and keeps the overall habitat complexity very low, which means limited nesting sites and food sources. The loss of cover is especially important at habitat transitions such as water and woodland edges. Mowing close to ponds and streams directly compromises habitat by forcing animals to access a vital resource without the benefit of shade or cover for protection from predators. Mowing next to ponds and streams also reduces the vegetative buffer that absorbs the overland flow of water during rain events, which reduces water quality and thereby impairs aquatic habitat (see Photo 1).

Photo 1. A restored wetland (left) typically offers ample vegetation for cover at pond edges, whereas mowing to the edge of a pond (right) reduces its habitat value.

Waste and Contaminants

Similar to humans, wildlife are sensitive to physical and chemical contaminants in their habitat, especially those in water. Examples of materials hazardous to wildlife include glass, fishing line and hooks, plastic bags and packaging, bottles, cans, and scrap metal. Fishing line can trap and/or constrict limbs and necks, fishing weights can cause lead poisoning, and broken glass can cut feet. Small animals can become trapped inside containers. Sea life often mistake floating plastic or balloons for food. The plastic mesh around a Christmas tree or on erosion control products and even plastic rings for six-packs can entangle and entrap wildlife, leaving them exposed and vulnerable to the elements or predators.

Contaminants of concern in improperly disposed of trash include household, automobile, and personal care products, including pharmaceuticals, and pesticides. These can suppress animal immune systems, disrupt reproduction, cause mutations, change how animals try to avoid predators, and disrupt thyroid function, which controls metabolism. The higher an animal is in the trophic structure (food chain) of a community, the more likely it is to ingest contaminants. For example, a bald eagle is much more susceptible than a chickadee, because of the accumulation of toxins through the food chain. Aside from being a threat to wildlife health and safety, trash is an aesthetic and structural intrusion on the landscape, occupying space that would otherwise have ecological function.

Water Management Impairments

Naturally vegetated areas such as meadows and forests allow stormwater or runoff from rainfall and snowmelt to flow across the ground and filter slowly through the soil and vegetation before entering nearby waterways. Often the majority of natural flow paths are below the surface in the groundwater. This ensures the waterways receive a steady supply of cool, clean water. As land use changes, these natural flow pathways are disrupted and threaten plants and wildlife by altering the availability of water.

With an increase in impervious cover from buildings, roads, and parking lots, stormwater cannot infiltrate into the ground to reach nearby streams and wetlands (see Figure 4). Instead, the stormwater rushes across the pavement, washing pollutants such as oil, pesticides and salt into nearby storm drains. In older developed areas, this stormwater may be discharged directly to nearby streams through ditches or pipes, which release a torrent of warm, polluted water that erodes banks and the bottoms of the stream channels, dislodging and displacing aquatic life.

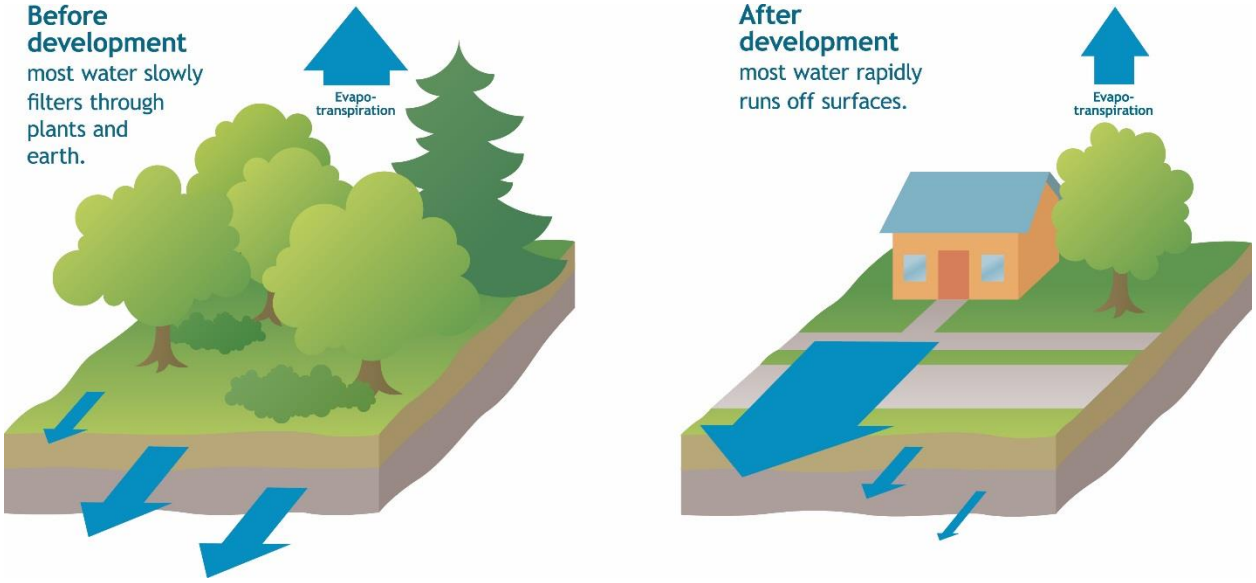


Figure 4. Natural hydrological flows (left) and altered flows after development (right). Credit: Biohabitats.

When unmanaged runoff causes stream channels to cut down or incise and erodes soil from the stream banks, streams cannot easily overflow onto the adjacent floodplain at times of high storm flows. In contrast, most healthy stream systems can readily overflow their banks during storms onto broad floodplains that absorb or at least temporarily hold much greater quantities of water. This is an important function in systems that are subject to flooding, because the floodwaters cause less channel erosion, and sediment and pollutants can settle out of the floodwaters onto the floodplain.

Wetlands can also be damaged by polluted stormwater discharges and changes to their water regime. In the past, ditches or swales were dug in wetlands to quickly drain water and allow the land to be farmed. Plugging or filling these ditches can help restore normal water flows within the wetland.

Streams and wetlands also reflect upstream conditions within their watershed and even continue to do so through time. Some legacy issues such as past land clearing and development with poorly managed stormwater continue to affect downstream stream and wetland health and the diversity of plants and wildlife they support.

Stormwater management has been required in Howard County since 1984, and over time, management measures have improved to better treat the quantity and quality of the stormwater discharging to nearby streams. More recent changes to stormwater management requirements now specify methods of treatment that include onsite retention and infiltration through vegetation and soil to greatly reduce the volume, speed, and contamination of runoff.

Wildlife Community Imbalance

A healthy wildlife community is one where available resources (food, water, cover, space) can sustain the community in dynamic equilibrium over time. Wildlife community imbalance occurs when one or more species knock an ecosystem out of balance through overconsumption or displacement of other species, or disruption of other key habitat features. This is often associated with the presence of non-native invasive species, which outcompete or simply outnumber the native species and disrupt the balance of the system. Sometimes, however, the imbalance can occur with a native species whose control mechanisms have been disrupted or removed.

One striking example of a wildlife community imbalance in Howard County and throughout central Maryland is the overpopulation of native white-tailed deer relative to the space available to support them, which is due to both habitat loss and to the elimination of natural apex or top predators (wolves and mountain lions). These deer thrive in edge habitat, eat vegetation in farm fields and suburban gardens, endanger drivers on our roadways, and serve as a reservoir for ticks and insect-borne diseases.

Dynamic equilibrium

The concept of dynamic equilibrium is similar to a checking account. Resources (money) come in and resources are consumed (bills). Sometimes there is a little more money at the end of the month and sometimes a little less, but on average there is enough. If consumed resources exceed the incoming resources for too long, the system becomes stressed. Over time a new equilibrium may need to be established based on fewer or different resources (for example, need to shift from eating rabbits to mice).

Overabundant deer populations are also having a negative impact on our remaining forests and other natural areas, reducing the populations of many native plants and compromising habitat for a variety of other animals. One of the critical habitat impacts from deer is effects on forest regeneration. Forests in which too many tree seedlings are consumed by deer may become unable to regenerate and develop a stratified vertical structure wherein only the largest canopy trees and an herbaceous groundcover are able to persist (see Photo 2).

The overabundance of deer is simply one symptom of a larger problem. White-tailed deer are overabundant because they have less competition from other browsers and no natural predators left in this region. Disruption of these natural systems of predation and competition is a problem that is not limited to deer. The effects of other imbalances may be less apparent but they are pervasive, and some cause additional problems for humans. For instance, where wetland habitat is degraded or the patch of land is too small to support healthy populations, there might be few or no frogs and salamanders to consume insect larvae, and pests such as mosquitoes are more likely to flourish in puddles and standing water.

Photo 2. Overpopulations of deer can damage plant communities and prevent forest regeneration. Rubbing (L) and browsing young plants (R) prevents them from reaching maturity. Credit: Biohabitats.

Non-Native Invasive Species

Globalization and the easy transport of plants and animals across oceans and over great distances has resulted in the introduction of non-native invasive plants (NNIP) that compete with native plant species. According to the Invasive Plant Atlas, over 1,200 NNIP are present in natural areas of the US. These non-native invasive species are sometimes heartier than natives during times of disturbance and they often have prolific reproduction and growth rates, so they compete with native plants for water, nutrients and space and can even displace the more valuable native plants. NNIP often do not provide the same habitat value as native plants, because they do not provide the same food sources for native wildlife.

Historically some plants were introduced to help prevent soil erosion on public lands before it was understood how destructive they could be in native ecosystems. Disturbed and fragmented habitat patches are especially susceptible to competition from invasive plant species, whereas robust and diverse native plant communities are better able to resist them. Pro-active management of the vegetation in a hub or corridor can reduce the likelihood of it becoming overtaken by invasive plants. Property owners should take care not to introduce or plant NNIP, such as English ivy, bamboo, butterfly bush, Bradford or Callery pear and Norway maple, which are commonly sold at garden centers. Plant Invaders of Mid-Atlantic Natural Areas, published by the USFWS, is an excellent general reference for learning how to identify and control NNIP.

Damaging invasive species can include various types of organisms, and introduced invertebrate pests are among the most harmful. The Emerald Ash Borer (EAB), for example, which appeared in the US in 2002, has required treatment, removal, and replacement of affected native ash trees that has cost over 10 billion dollars according to the US Department of Agriculture (USDA) Forest Service estimates. This invasive, non-native insect species destroys native ash trees when their larvae burrow and feed in the ash bark, eventually damaging the tree's ability to transport moisture and nutrients from the soil to the

tree's leaves, causing the tree's decline and death. The EAB is beginning to be an issue for all ash tree species in the region, creating an imbalance in the makeup of regional forests and removing important habitat for other native wildlife species. This has happened previously in our forests, when the native American Chestnut and American Elm were decimated by the chestnut blight and Dutch elm disease, respectively, both accidentally introduced fungal diseases. The gypsy moth and Asian long-horned beetle are other common and damaging invasive species in our forests. The European starling was introduced to New York's Central Park in the early 1890s and now competes with our native birds for nesting cavities. The northern snakehead fish that was introduced from Asia is a voracious predator that is disrupting natural food webs. Further information on invasive species is available from the University of Maryland Cooperative Extension.

Common Habitat Enhancements

Many properties within the Network could benefit from habitat improvements. A variety of techniques can be used to improve a property's ability to provide food, water, cover and space. Because hubs were identified according to the natural features and without regard to property ownership, private landowners have an important role to play in the management of their habitat value, both for the land they own that falls directly within hubs and as "good neighbors" to the hubs. Landowners can sometimes make simple changes in property management that will save them time and money and increase their property value, while also increasing habitat quality. There are several techniques that are broadly applicable to most properties within the Network:

- Adjust mowing schedules and strategies
- Install bat boxes and bird houses
- Remove trash and contaminants
- Manage stormwater and restore natural flow patterns
- Enhance ponds and wetlands
- Create and enhance vernal pools
- Manage deer populations
- Enhance forests with native species and vegetation management
- Manage non-native invasive plants (NNIP)

These techniques are discussed in general terms in the following sections and the Habitat Management Plans for the individual hubs elaborate upon those that respond to specific threats in the hub. In addition links to supplemental resources on implementation, maintenance and operation of the techniques are embedded in applicable sections.

Adjust Mowing Schedules and Strategies

Hubs usually contain large wetlands and forests, so broad-scale mowing is not a common practice. However, mowing is used in areas such as parks, near ponds and along shorelines and in neighboring lands. The properties adjacent to hubs are critically important to the habitat connectivity that animals experience as they move across a landscape, and mowing sometimes proceeds according to tradition or

routine rather than through consideration of the costs and benefits of the activity. Properly timed mowing and rotational mowing can be used to stimulate growth of the native warm-season grasses and flowers that provide food and cover in the latter part of the growing season. For example, it can be used to control annual weeds, maintain plant communities of different heights, maintain trails, and control woody invasion in grasslands.

In general, mowing should be done only in the early spring (March 1-31) or late summer (August 16-31) to avoid the primary nesting and brood-rearing season for grassland wildlife, including eastern meadowlarks, bobwhite quail, rabbits and deer. Mowing too soon before nesting season reduces the height of wildlife cover, while mowing too late in the season reduces the amount of winter cover (including thermal protection) and possibly winter food supply (seeds and berries). Before the growing season, landowners should decide whether particular species are of special interest on their property, which may affect mowing regimens.

Pond shorelines are often mowed to limit the growth of woody vegetation on the dam or maintain access. Limiting mowing to allow naturalized buffers along ponds provides the added benefit of discouraging nuisance wildlife such as Canada geese, which gather in open grassy areas. Large goose populations can lead to overwhelming amounts of fecal coliform (bacteria) associated with concentrated amounts of their waste washing into the water, but they are less likely to gather in areas with diverse native vegetation along a waterway.

MD DNR provides more information about mowing at http://dnr.maryland.gov/wildlife/Pages/habitat/wamowing.aspx.

Install Bat Boxes and Bird Houses

The conversion of forest to other land uses and changes in land management practices have greatly reduced the availability of suitable nesting habitat for wildlife that use knotholes or excavated cavities in large dead trees and branches. Loss in this type of nesting habitat can lead to declines in the abundance and diversity of local wildlife populations, especially birds and bats. One strategy to improve the availability of this type of nesting habitat is to install artificial bird houses and roosting structures, which are known as nest boxes. Nest boxes for birds or bat boxes are manmade structures in various forms, shapes and sizes, that meet the nesting requirements of the target species (e.g., eastern bluebird, tree swallow, American kestrel, little brown bat). Nest and bat boxes that are properly installed and maintained in an area with adequate food, water, cover and space improve wildlife reproductive success. Selecting the location and number of nest and bat boxes depends heavily on context. They can generally be used to enhance all types of habitat, depending on the target species. Young forests can be good sites for nest and bat boxes because they often have few standing dead trees for forest interior cavity nesters. Boxes along fencerows and forest edges are good for other species such as bluebirds and swallows. Therefore, each nest box enhancement should begin with identifying the target species.

Once the nest boxes are installed, they should be monitored and maintained on an annual basis. Maintenance includes ensuring the box is in good structural condition and removing old nesting materials, mice, insects and debris that have accumulated.

Larger projects can involve volunteers for construction, installation and/or maintenance and monitoring. The Howard County Department of Recreation and Parks currently maintains and monitors bluebird nest boxes in several parks. These boxes are maintained and monitored by volunteers and results are reported to a national database, NestWatch.org.

Nest box plans and installation directions are readily available for download from The Cornell Lab of Ornithology at http://nestwatch.org/learn/all-about-birdhouses/. For additional species such as bats, more resources can be found through the Pennsylvania Game Commission at http://www.pgc.pa.gov/InformationResources/GetInvolved/Pages/WildlifeHomePlans.aspx.

Remove Trash and Contaminants

Property owners should ensure that trash is disposed of properly and use wildlife proof storage containers. Some properties may contain dump sites, where previous landowners disposed of trash, often in low lying areas such as wetlands or stream banks. If possible, these dump sites should be cleaned up, but sometimes the trash removal may cause more harm than good, particularly if it leaves an area susceptible to erosion. In these cases, it may be better to remove the top layer of trash and stabilize the area with added soil and native vegetation. Consultation with land management agencies may be helpful to determine the best course of action.

Although the commitment to clean up onsite trash may be significant, getting the job done usually does not require training, experience, or up-front research. It probably will, however, require resources either in the form of time or financial compensation to a contractor. Depending on the size and components of trash deposition, large equipment may be required, which will typically disturb the soil to some degree via tracks and/or digging. In this case, the guidance beginning on page 26, “Enhance Forests with Native Species and Vegetation Management,” and “Manage Non-Native Invasive Plants,” may be useful.

Contaminants are more complicated to address and may require transport to an appropriate disposal area or consultation with the County Health Department for cases where contaminants have entered the soil or water. The nature and source of contaminants will need to be identified, the source discontinued, and the pathway of contaminants ascertained. Cleanup options will depend on the materials affected and which contaminants are of concern.

Manage Stormwater and Restore Natural Flow Patterns

There are many techniques for improving water management in and near the hubs. These techniques are selected for given sites based on the historic pathways of streams and drainages, existing and nearby development, current stormwater management infrastructure, topography, vegetation and cost. When developed areas border the hubs, such as is often the case in the southern and eastern portions of the county, stormwater from offsite is one of the most important habitat threats. Managing hub habitat will sometimes mean improving off-site water management. Techniques can include redirecting drain spouts so flow is across vegetation rather than paved areas, capturing rain water in rain barrels for use in irrigation, installing rain gardens to filter the runoff through vegetation and soils, and establishing forested streamside buffers.

Within the hubs, where streams are severely eroded, stream restoration may be the best way to enhance habitat. Eroded streams with deep channels and high stream banks can be lifted so that the water in the channel overflows the stream banks onto a broad floodplain during storm events. In other cases, eroded stream banks can be reshaped to form narrow floodplain benches adjacent to the channel (see Figure 5). Restored floodplain connectivity traps fine sediments, engages various ecological processes in the riparian area to store and filter water, and provides breeding habitat for amphibians. Stream restoration can also add meanders or bends to overly straightened streams, stabilize eroding banks, and add pools, rocks, and large woody debris to increase the variety of habitat within the channel. Most stream restoration efforts require the expertise of professionals to select and design the appropriate restoration techniques and require county, state and federal permits.

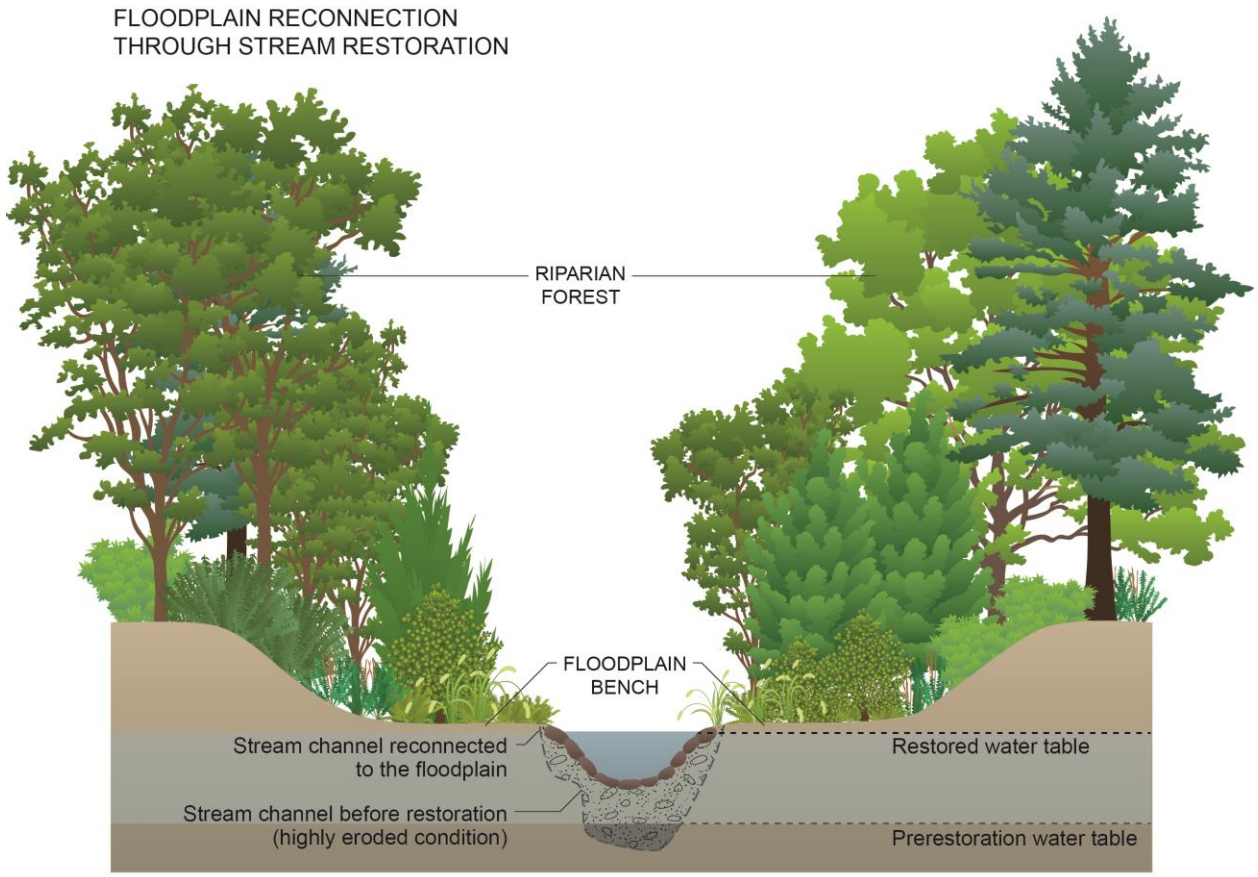


Figure 5. One common goal of stream restorations is to reconnect the stream to its floodplain and recreate the floodplain bench (flat streamside areas that are regularly inundated) of hydric (poorly drained) soils that support water-loving and flood tolerant plant species.

The Clean Water Howard stormwater management program provides information on managing water resources on private land http://www.cleanwaterhoward.com/ .

Enhance Ponds and Wetlands

All ponds and lakes in Maryland were created by dam construction, so they are not a natural feature of the landscape. However, most can still provide valuable habitat and can be enhanced by increasing the variety of habitat within and adjacent to the pond (see Figure 6). Many of these enhancement techniques are also applicable to wetlands with open areas of water.

Ponds with steep edges are inferior habitat. Aquatic wildlife fare better in ponds that have a variety of water depths, including shallow water areas with gradual slope changes used to access the shelter of vegetation, woody debris or rocks. This gives smaller fish a place to escape predation from larger fish, provides macroinvertebrates (insects, snails, clams, worms) refuge from small predators such as crayfish, and provides those small predators refuge from raccoons and other larger predators. There are several techniques for enhancing pond habitats to provide shallows and shelter.

One of the simplest habitat enhancements is supplemental planting of native wetland plant species to increase the diversity of native plants. In addition to providing habitat benefits, establishing fringe or shoreline wetlands and buffers also protects water quality by providing a surface for plants to uptake nutrients and other pollutants and stabilizes the pond edge with dense root mats. Where pond edges are steep or eroded, live-branch layering is a stabilizing technique that weaves branches together to fill holes and slumps and provides a foundation of natural material that can trap soil and support plants.

Floating wetlands can add escape habitat and improve water quality in ponds. They are small man-made islands covered with native wetland plant species that can provide similar wetland habitat functions in ponds, but they are anchored in the safety of open water, which reduces the risk of predation by some more terrestrial species. It is possible to purchase designed installations and also to create them on the small scale, though they must be maintained.

Finally, adding structure along pond or wetland edges in the form of logs and boulders is one of the easiest ways to improve foraging habitat and provide refuge for amphibians and other aquatic organisms. Such structure also provides basking habitat where turtles and snakes can warm themselves, which is important for their metabolism. Land-based wildlife also fare better if they can access ponds from the shelter of shoreline vegetation or other structures that offer cover such as rocks or logs.

See Wetland and Pond Enhancements for more details and links to installation methods.

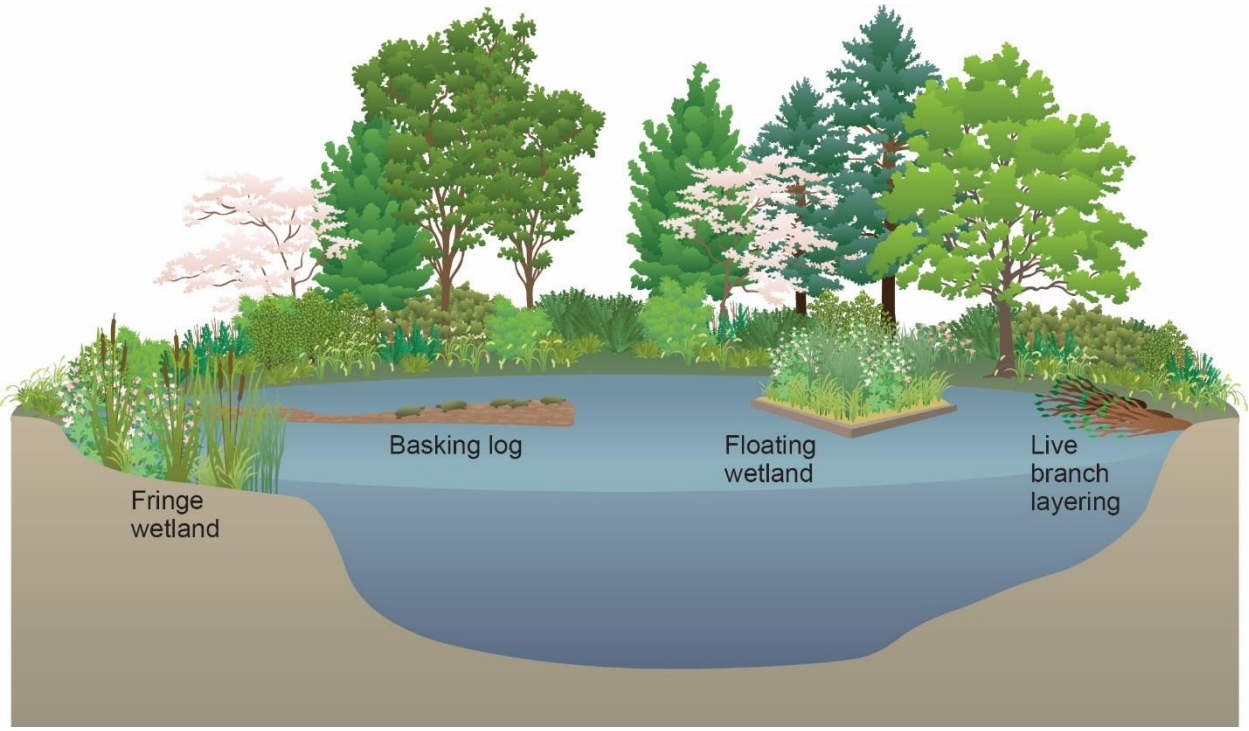


Figure 6. There are a variety of techniques that can be used to enhance the habitat provided by ponds and wetlands.

Outside of manmade ponds, there may be other opportunities to create or enhance wetlands within the hubs. If the hydrology of wetlands has been disrupted, restoring it to a more natural pattern is often the most effective way of enhancing wetlands. For instance, blocking man-made ditches or gullies can create wetlands where water filters into the ground slowly. As the water seeps through the soil it is cleaned and cooled before more slowly discharging to a stream channel. Such wetlands, whether forested, in scrub-shrub habitat, or in meadows, host abundant amphibian populations. Depending on the activity, wetland enhancement may require county, state and/or federal permits, and changing wetland hydrology may require the expertise of professionals, at least in the planning stages.

Create and Enhance Vernal Pools

Vernal pools are shallow, seasonal or temporary wetlands that form when spring rain or snowmelt fills low areas that have poor drainage and are not directly connected to a flowing stream. Vernal pools are small features, typically less than one acre in size. Periodically they dry up, most often in late summer and early fall. In part because they were often drained for agriculture and because they do not enjoy the same level of regulatory protection as streams, vernal pool habitats are rare and threatened across the landscape.

Even small patches with stable vernal pools provide a variety of habitat benefits. The pools provide critical habitat for breeding amphibians and macroinvertebrates because their seasonal nature eliminates the risk of predation by fish and other aquatic predators. To allow insect and amphibian larvae to develop, ninety or more consecutive days of pooled water are needed over the winter and spring. When the conditions are right, a small pool can support breeding activities for hundreds of

amphibians in early spring, and many of the individuals reared in a pool will return to the same pool to breed when they reach maturity. Vernal pools also reduce runoff, capture sediment, and recharge groundwater.

Creating a vernal pool involves design, construction, maintenance and monitoring. Vernal pools can be constructed by making a shallow depression in the soil, and they may or may not require a liner to hold rainfall, depending on the local soils. If small vernal pools are already present, they can usually be enhanced to last more than ninety days and improve breeding habitat for amphibians, generally by deepening or expansion. Factors to consider in the design or enhancement of a vernal pool include existing topography, soils, drainage patterns, and underground utilities (water, gas, sewage pipes). Care should be taken not to disturb existing wetlands and any digging within a wetland or vernal pool will require a federal/state wetland permit. It is possible for a private landowner to design and create a vernal pool, but many landowners will need assistance from experienced consultants or contractors. Creating a vernal pool may also require county, state or federal permits.

The USDA has an excellent resource on how to create vernal pools:
www.watershedconnect.com/documents/science_management_interventions_wetlands

Manage Deer Populations

Since 1999, Howard County has had a Comprehensive Deer Management Plan in place. This plan outlines the growth of the County's deer population and the actions required to manage it so that conflicts with county residents and the harmful effects of deer on natural systems are minimized. The plan includes two categories of management options: both lethal and nonlethal population control measures and techniques to manage deer behavior or prevent access to certain areas.

Controlling deer populations through hunting is often a recommended habitat management strategy. Reducing deer populations improves forest growth in the long run, with attendant benefits to the cover and forage available to wildlife. The County uses hunting to manage deer populations on County parkland and open space. Many hunters are willing to pay or barter goods, services or labor (help on the farm or occasionally skilled services such as those by a licensed electrician) for exclusive permission to hunt on private land. Landowners can develop contracts for how, where and when they allow hunting on their property. Most hunters are respectful and appreciative of the opportunity to hunt.

Property owners considering allowing hunting on their land should be aware that Howard County prohibits the discharge of firearms on properties of less than ten acres within the metropolitan district (the eastern portion of the County) and within 100 yards of the right-of-way of any public road. State law also prohibits the firing of any firearm or bow and arrow within 150 yards of occupied structures without the owner's permission.

Managing deer behavior and preventing their access is possible but not easy or inexpensive. Fencing is an effective but expensive option that reduces the habitat value for other wildlife. Other possibilities that reduce the attractiveness of a property to deer, such as removing preferred food and cover plants, or using chemical repellants or scare devices, also compromise the habitat suitability. In addition, large-scale applications for natural area protection are often financially or logistically impractical.

Additional information about deer management is available from Howard County Department of Recreation and Parks at https://www.howardcountymd.gov/Departments/Recreation-and-Parks/Natural-Resources/Wildlife#Tab_ModuleID_13781_TabID_1395

Enhance Forests with Native Species and Vegetation Management

Forest enhancement comprises a suite of methods for both hubs and neighboring lands, and a strategic approach can be guided by a Forest Stewardship Plan. Many forest enhancement methods focus on increasing and supporting native plant communities, which provide habitat value to wildlife both within the hubs and in neighboring properties.

Landowners near the hubs are encouraged to maintain and, if possible, replace portions of their non-native landscaping with native plant species. This is especially important when planting near naturalized areas. Most native species of wildlife will be best served by communities of native plants that are adapted to the local climate and soils, and therefore require less fertilizer and watering than non-native species to do well. They also tend to be more resistant to insects and disease, so they need less pesticide intervention.

Native plant communities, if allowed to undergo normal succession, are represented by a diversity of grasses, forbs (herbaceous flowering plants), shrubs, and different age classes of canopy-forming trees. Succession is the progression of one plant community to another over time. In Maryland, plant succession typically progresses from grassland or meadow to shrubs then to young forest and ultimately to mature, old-growth forest. Wildlife species have different preferences for the changing conditions in openness, canopy cover and height, plant species assemblages, food availability, and the presence of standing or fallen dead trees that succession brings. Some species, such as ruffed grouse, woodcock, voles, mice, and shrews, require the openness of early forest successional stages. Other species, such as bald eagles, flying squirrels, red-backed voles, and some bats, prefer old-growth forests.

Although forest interior species will avoid edges no matter their species composition, a multi-tiered vegetative structure encourages local wildlife diversity, especially if there is a patchwork of community types that includes fields and woodlands. Edges that transition from forest to more open shrub habitat and eventually to open fields are less harsh and therefore preferred by desirable songbirds, fox, opossum, and raccoon. In contrast, abrupt transitions from forest to hot, bright, open fields deter wildlife and tend to be avoided.

Most forest patches in Howard County have been heavily impacted by non-native invasive plant (NNIP) species and the increased numbers of white-tailed deer. The combination of competition from NNIP and intense browsing from the deer has caused a drastic reduction in the regeneration of desirable canopy tree species and reduced the diversity of understory shrub species. Vegetation management strategies can address these problems, but they are likely to recur if the threats of deer and NNIP are not controlled. Therefore deer exclusion or control and NNIP control should be addressed prior to investment in vegetation management. Where these conditions can be met, vegetation management strategies could include:

- Supplemental Interior Planting – to increase diversity and jumpstart understory development by installing plants that have grown above the browse height of white-tailed deer.
- Supplemental Edge Planting – to provide transitional habitat that supports increased wildlife diversity while improving the quality of forest interior.
- Thinning – the removal of select species with little habitat value in thick stands can offer more of a chance for trees that offer better habitat to grow and promote diversity in tree age classes.
- Soil Enhancement – to supplement planting pit soils to facilitate establishment of native vegetation.

Few forest enhancement activities require permitting, but it is strongly recommended that these activities be done under the guidance of a Forest Stewardship Plan, prepared by a licensed professional forester. A Forest Stewardship Plan prepared with a goal of habitat enhancement, will provide site specific guidance for practices such as NNIP management, thinning and supplemental planting.

The USDA Forest Service supports a resource for landowners that offers woodland owners guidance on creating a plan for their land: http://dnr.maryland.gov/forests/Pages/programapps/stewcon.aspx.

Manage Non-Native Invasive Plants (NNIP)

Ideally, property owners and managers should control the NNIP to a level that does not interfere with the diversity of the native plant community and its ability to regenerate. This can include reducing the existing coverage of NNIP and reducing the potential for new invasions of NNIP. For certain NNIP, called noxious weeds, the state mandates their control due to their threat to agriculture.

Factors that facilitate the establishment of NNIP include ground disturbance, mowing, new plant species invasions, and nuisance wildlife herbivory (e.g. the feeding by white-tailed deer, which tend to prefer native plants over NNIP). Many common management activities allow NNIP to flourish, including:

- Mowing along roadways
- Farm field abandonment, which leads to increases in weedy vegetation
- Planting of NNIP in ornamental landscape plantings
- Physical disturbance of the soil and seed bank by clearing and grading

It is important to know which species are NNIP, as many native plants are easily mistaken for non-natives. Also, some plants thought of as “weeds” are palatable to wildlife, such as some nettles and ragweed.

Due to the diversity of NNIP, the strategy to reduce them at each site will likely be multi-faceted and include reducing the risk of spreading NNIP through management, as well as direct control techniques – mechanical, chemical, and biological. Mechanical methods include cutting, mowing, girdling or pulling. Chemical methods include foliar or cut stem herbicide applications. Biological methods include releasing predators or bacterial populations in the NNIP population.

Confronting NNIP varies greatly by species and is generally more expensive for every year the plants are allowed to spread, which means that it may be desirable to start control measures where NNIP are not yet dominant. Control can be especially difficult if NNIP are present on adjacent properties that are not undergoing management efforts, so property owners may wish to coordinate efforts with their neighbors. Because deer tend to prefer native species, overabundant deer populations can impede natural or supplemented regeneration, so NNIP management should occur in conjunction with deer management if both are needed. Although specific permits are not generally required, non-mechanical control methods such as using herbicides are usually regulated to prevent environmental contamination. At a small scale, this may simply mean complying with the directions on the herbicide packaging. While small-scale efforts can be undertaken by a landowner, significant infestations may require volunteer labor crews or professional landscape contractors and licensed herbicide applicators. Once control of NNIP is achieved, ongoing monitoring and follow up efforts are necessary to maintain control.

The National Park Service and U.S. Fish and Wildlife Service regularly update their guide to invasive species, which includes information on 80 species and guidance on their control: https://www.invasive.org/eastern/midatlantic/

Habitat Assessment Purpose and Methods

As stated in the Green Infrastructure Network Plan, Howard County's goal is to develop a habitat management plan (HMP) for each of the hubs in its Green Infrastructure Network. This document is one of the first hub HMPs developed for the Green Infrastructure Network, though some of the county and state-owned hubs have existing management plans that address habitat value. Each HMP begins with a site assessment of the hub to identify the natural resources present, their condition and any enhancement and restoration opportunities. The foremost considerations are habitat value in terms of a hub's ability to provide food, water, cover and space, but opportunities to improve stormwater management are an important secondary consideration, given the pervasive effects of poorly managed stormwater.

The Guilford Branch Forest Hub was assessed by ecologists in November 2014. This assessment used tailored habitat assessment sheets that included separate forms for site overview, non-native invasive species, and stream and wetland quality. For each forest stand within the hub, the most important features and plant species of the hub were described. The datasheets used for the assessment are provided in Appendices 1-3.

The following habitat variables were characterized and mapped:

- Wetlands: presence/absence/classification
- Wildlife community: evidence of habitat use through direct observation and spoor
- Stream habitat quality
- Vegetative community and structure
- Non-native invasive species: occurrence inventory

Aerial photography was used to determine initial forest stand boundaries, and then a field survey was used to confirm or adjust the boundaries. Field work was largely structured around vegetation transects, routes through the various forest communities that the ecologists walked to make observations. Biohabitats conducted a qualitative vegetation inventory by classifying the habitats into vegetation communities and walking transects through those communities. While walking these routes, plant species were identified and recorded, along with a relative abundance metric with values of present, common, or abundant.

Forest structure and tree species were examined according to several metrics, including the % closed forest canopy, successional stage, and depth of the litter. Each species of tree was recorded and marked as rare, common or abundant. Height data on the tree species were collected to reflect the vertical structure in height-class layers of herbaceous, shrub, understory, and canopy vegetation (see Figure2). Many species appeared in more than one size class—so, for example, young tulip poplars could occur in the understory and mature ones in the canopy. In addition, the canopy structure was recorded, so that tulip poplars might be recorded as both dominant in the canopy (receiving full sun) and co-dominant (if some individuals were shaded but over 20 feet tall). Tree canopy species were recorded as suppressed if they received little or no direct light and were therefore unable to grow to their full potential. Figure 7 shows the relationships among various crown position classes.

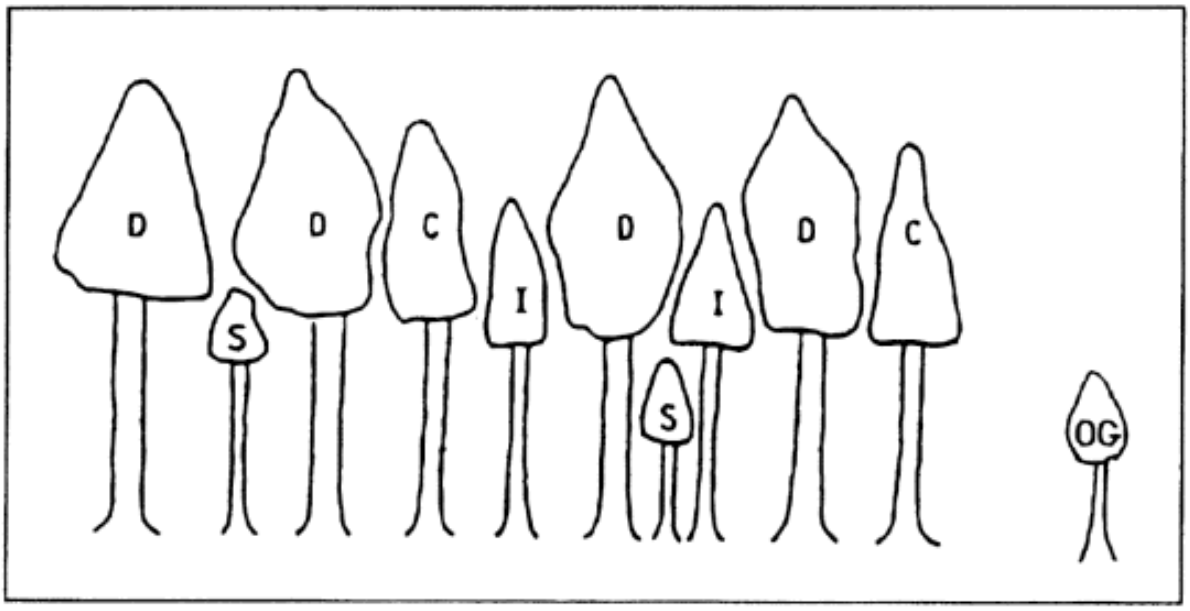


Figure 7. Crown Position Classes: D = dominant, C = codominant, I = intermediate, S = suppressed, OG = open–grown. Dominant trees receive the most light, whereas the codominant class is shaded from the sides. The intermediate class reaches the canopy, but never penetrates up to full sun, and suppressed trees do not reach the canopy level and never receive full sun. Source: https://www.fs.fed.us/psw/publications/documents/gtr-155/06-duriscoe.html

This habitat assessment did not include a wetland delineation for regulatory purposes, but instead captures field observations that were then sketched onto the field maps and represented in Figure 11. The wetlands were assessed according to the US Fish and Wildlife Service classification scheme originally

developed in 1979. The Cowardin system groups wetlands according to their physical (water and soil), chemical (salinity) and biological (vegetation) features. For further information on the Cowardin Classification, refer to *Classification of Wetlands and Deepwater Habitats of the United States* (https://www.fws.gov/wetlands/documents/classwet/index.html).

Stream habitat quality was evaluated using a slight modification of the Maryland Biological Stream Survey (MBSS) Habitat Assessment (http://dnr.maryland.gov/streams/Publications/R4Manual.pdf), which is broadly applicable and provides a high-quality, standard departure point for an evaluation of instream habitat. Streams are scored according to factors including their substrate (woody debris and pebbles in the streambed that can shelter invertebrates vs. fine sediment as would be washed down in eroded streams), water velocity and depth (diverse versus uniform flow), pool and eddy quality (complexity versus lack of pools), embeddedness (whether pebbles in the streambed are buried in sediment), and shading from overhead vegetation along the streambank. Other observations on the presence of trash and bank erosion were also recorded. Because this protocol was designed to assess the habitat quality of free-flowing streams, the scoring system penalizes stream segments with still, deep pools such as those formed by beaver dams. Although they receive lower scores, pools in some cases do increase the overall habitat quality of a stream by adding structural diversity to the aquatic habitat. Areas with MBSS scores that are incongruous with the quality of the wildlife habitat are noted in the text.

Finally, the relationships among the habitat elements listed above were evaluated to determine habitat suitability and availability. This evaluation guided the management recommendations for the hub.

Guilford Branch Forest Hub

Guilford Landscape Context

The Guilford Branch Forest Hub is located in southeast Howard County (see Figure 8) and is a locally important forest patch of approximately 150 acres that includes a large area of forest interior habitat. Guilford Branch originates in the northern portion of the hub and flows south through the hub. The stream then flows south through the Guilford Little Patuxent Corridor, connecting the Guilford Branch Forest Hub to the Little Patuxent Savage Corridor at the Anne Arundel County border.

An ephemeral channel that originates in the southeast corner of the hub runs south under Interstate 95 (I-95), becoming a perennial stream as it runs through the Chase Quarry within the Guilford Dorsey Corridor. This corridor connects the Guilford Branch Forest Hub to the Dorsey Wetland Hub. A railroad crossing under I-95 adjacent to the corridor also provides some habitat connectivity across the interstate. The hub lacks connections to any upstream corridor or hub. This isolation reduces the habitat value of the hub, but the hub's interior forest still provides important habitat for the Network, especially because it serves as an entry point to the Network for wildlife.

Guilford Branch Forest Hub *At a Glance*	
Size	Approximately 150 acres
Habitat types	Young and Mature Mesic Forest; Streams; Wetlands
Threats	Overabundant Deer; Manmade drainage ditches; barriers to wildlife movement
Management Opportunities	Preservation, Improve connectivity, Increase water storage, Control deer, Create vernal pools
Habitat Values	
Food	Diverse communities of native plants with high wildlife value and year-round food supplies
	Present, though heavily browsed, understory and shrub layer
	Abundant downed woody debris and snags for insects and grubs
Water	Appropriate habitat for a small, simple stream
	Wetlands are in high-quality interior forest, combining the benefits of cover with the aquatic resources
Cover	Shrub and herbaceous layer is sparse or absent
	Canopy cover and structure in mature forest is good
	Good vertical structure in understory and within canopy
Space	Site serves as a habitat refuge from adjacent commercial, industrial and residential developments

Zoning and Land Use

The Guilford Branch Forest Hub is a finger-shaped stretch of land bounded by a railroad to the northeast and by I-95 to the southeast. Residential developments, the Federal Communications Commission and Guilford Elementary School are located immediately to the west. Across the railroad tracks, there is light industrial and commercial development. Much of the hub is zoned as Low Density Residential (R-20) and New Town (NT), with a small area of High Density Residential (R-A-15).

There are six property owners within the hub, but the majority of the hub is owned by the Federal Communications Commission (FCC). The FCC maintains a fence that restricts access to their property in the western portion of the hub, and did not grant permission to access their property for the hub survey

and investigation. The second largest property owner is the Howard Research and Development Corporation, which owns land between the FCC property and the railroad track. The third largest property owner is the Maryland State Highway Administration (MSHA), which owns a parcel of land adjacent to I-95. The other property owners have small portions of land within the northern tip of the hub.

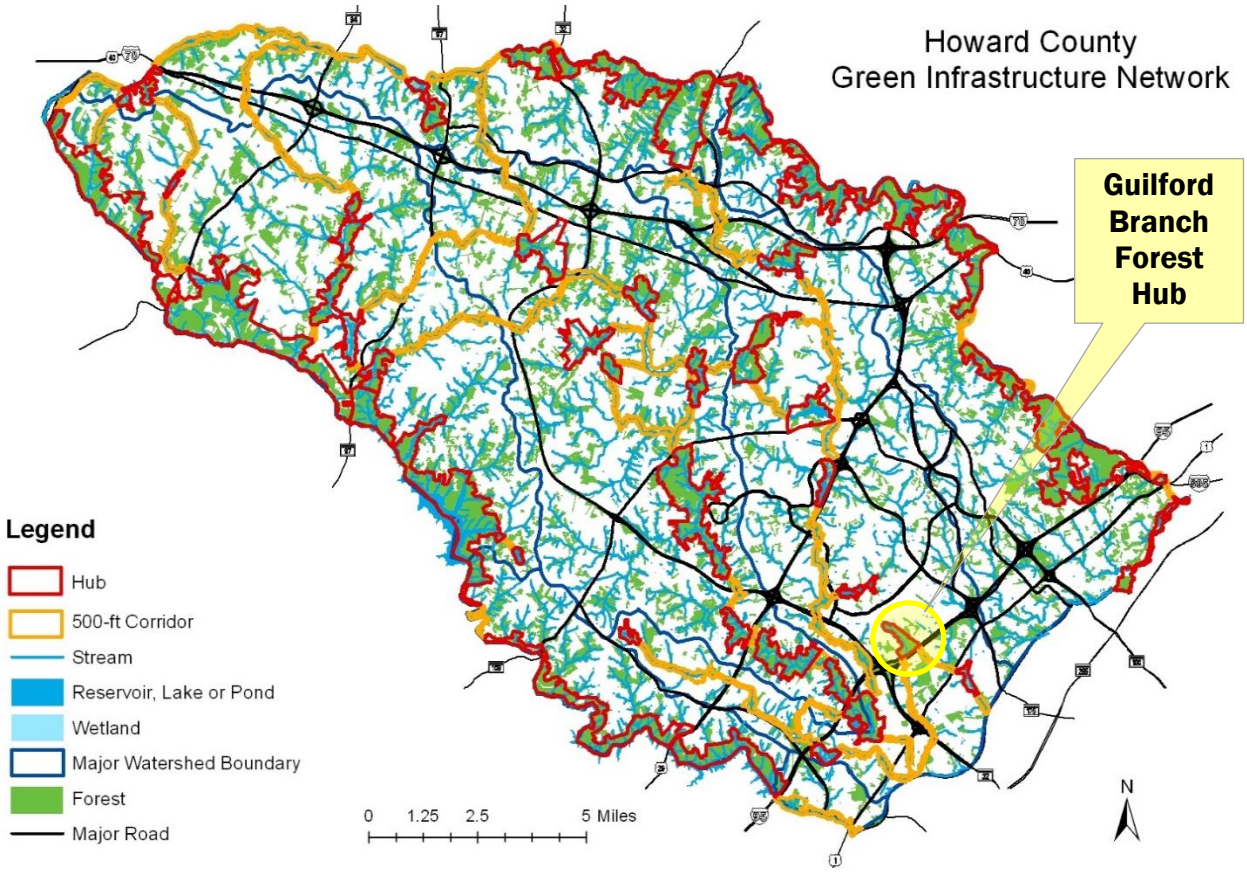


Figure 8. Guilford Branch Forest Hub in relation to the Howard County Green Infrastructure Network.

Guilford Site Features

The Guilford Branch Forest Hub was completely forested and connected to neighboring forest as recently as 1966. At that time there was an open gravel mine just to its north, and in subsequent years, the hub's connectivity was sharply reduced as the railroad and I-95 were constructed. Also, in the early 1980s, a tall fence bisecting the site was built by the FCC. Today the hub contains the headwaters of the perennial Guilford Branch, and the assessed northeastern third of the hub contains a small intermittent tributary to Guilford Branch, three ephemeral channels, and two small wetlands. The hub is a mosaic of young and mature mesic forest. Mesic forests have medium moisture supplies, as compared to wet conditions (Hydric) or dry conditions (Xeric). Mesic forests are sometimes called upland forests.

Topography and Soils

The Guilford Branch Forest Hub falls within the piedmont physiographic region, with its typical low rolling hills. The site elevation ranges from 320 to 360 feet, with moderately steep rises near I-95. The soils are uniformly deep, most with over 80 inches of depth before an obstacle or bedrock is reached. The soil's parent material is generally clayey sediment that is well-drained or moderately well-drained outside the stream bed. In the higher areas farther from the waterway, the soil tends to be derived from the bedrock underneath, where it has weathered in place. In the drainage ways and along the stream, the soils have instead been deposited by water moving across the landscape. Within the channel, the water table is higher and the soils have less capacity for infiltration. Hydric soils are confined to areas directly along the stream and drainage ways. Hydric soils form under conditions of enough saturation, flooding or ponding during the growing season to develop anaerobic conditions. They are poorly drained and associated with wetlands and stream headwaters. Please see Figure 9 for the site topography and Figure 10 for the soils map.

Wildlife Benefits

This hub provides relatively high habitat value in that it is largely forested, with a significant area of forest interior habitat, and not dominated by invasive species or undergoing management activities that are not friendly to wildlife (see summary chart above). It may serve as an important refuge or staging area for wildlife that have wandered into it or become trapped in the adjacent commercial areas. Wildlife can then connect to the core habitats along the Patuxent River at the County border. The oak and hickory forest type provides a high quality food for wildlife in the form of nuts and acorns, and the perennial stream provides a reliable water source. As noted previously, a majority of the hub was not accessible for survey and investigation, though it seemed to offer good habitat based on aerial photography and a visual assessment from the fence line.

Forest Community Types

The assessed portion of the Guilford Branch Forest Hub contains two forest community types – young and mature mesic forest – within seven forest stands. Please see Figure 11 for the locations of the community types within the hub and Appendices 1 & 3 for detailed plant lists for each forest stand.

Photo 3. Abandoned mining site in Stand 3, with regrowth of young mesic forest.

YOUNG MESIC FOREST (STANDS 1-3, 5, & 7)

These stands of young, mixed deciduous/coniferous forest are bounded to the northeast by the railroad track. While some variation

exists among the stands, they are similar in development and composition. In particular, the northernmost stand (Stand 1) in this forest type is heavily dominated by Virginia pine, and an abandoned mining site in the south-central portion of Stand 3 is surrounded by very young regrowth of pioneering tree species (see Photo 3).

Generally, the canopy is most commonly 12-20" diameter at breast height (DBH) Virginia pine, tulip poplar, black gum, red maple and black cherry, in some places dominated by >20" DBH red maple or 12-20" DBH white and red oak. The usually dense sub-canopy contains 6-12" DBH red maple, black gum, beech, persimmon, flowering dogwood, red, pin, willow and white oaks, black cherry, sassafras, green ash, hickory and American holly. The understory and shrub layers are comprised mainly of <6" DBH red maple or oaks, high- and lowbush blueberry, greenbrier, *Rubus* species (including raspberry, blackberry and wineberry) and Japanese honeysuckle. Deer browse was noted to varying degrees throughout the hub, and deer rubs were noted on arrowwood, which is present but not dominant in Stand 1.

Occurring primarily on the forest edges, NNIP within these stands are locally abundant and include Japanese stiltgrass, multiflora rose and Japanese honeysuckle. Woody debris is abundant in this young forest because of both recent blow-downs and the history of the stand. As in many nearby areas, the current forest likely arose as an even-aged stand of pines growing at high density on a converted agricultural field. When such stands develop quickly and the young trees are close together, many of the trees eventually die, leaving abundant woody debris on the forest floor.

MATURE MESIC FOREST (STANDS 4 & 6)

Flanked on both sides by young mesic forest, these mature mesic forest stands surround ephemeral headwater channels that, although altered in form and flow by stormwater runoff and ditching today, appear in maps from the 1800s. The stands are comprised of a mature, mixed deciduous, hardwood forest with a canopy dominated by >20" DBH mixed oak species (white, swamp white, red and scarlet) but also containing 12-20" DBH red maple, tulip poplar, black gum and mockernut hickory. The sub-canopy contains <12" DBH red maple, tulip poplar, white oak, beech, black gum, mockernut hickory and black cherry. The understory is relatively open, containing limited cover provided by a few scattered flowering dogwood, musclewood, beech, black gum and black cherry. The shrub and herbaceous layers contain sparse amounts of the NNIP species greenbrier, Japanese stiltgrass and Japanese honeysuckle. Woody debris is present but not extensive in the mature forest, with a few large-diameter logs on the ground.

Evidence of deer browse is present in both stands. The shrub layer of Stand 6 is less developed than one would expect in the absence of deer.

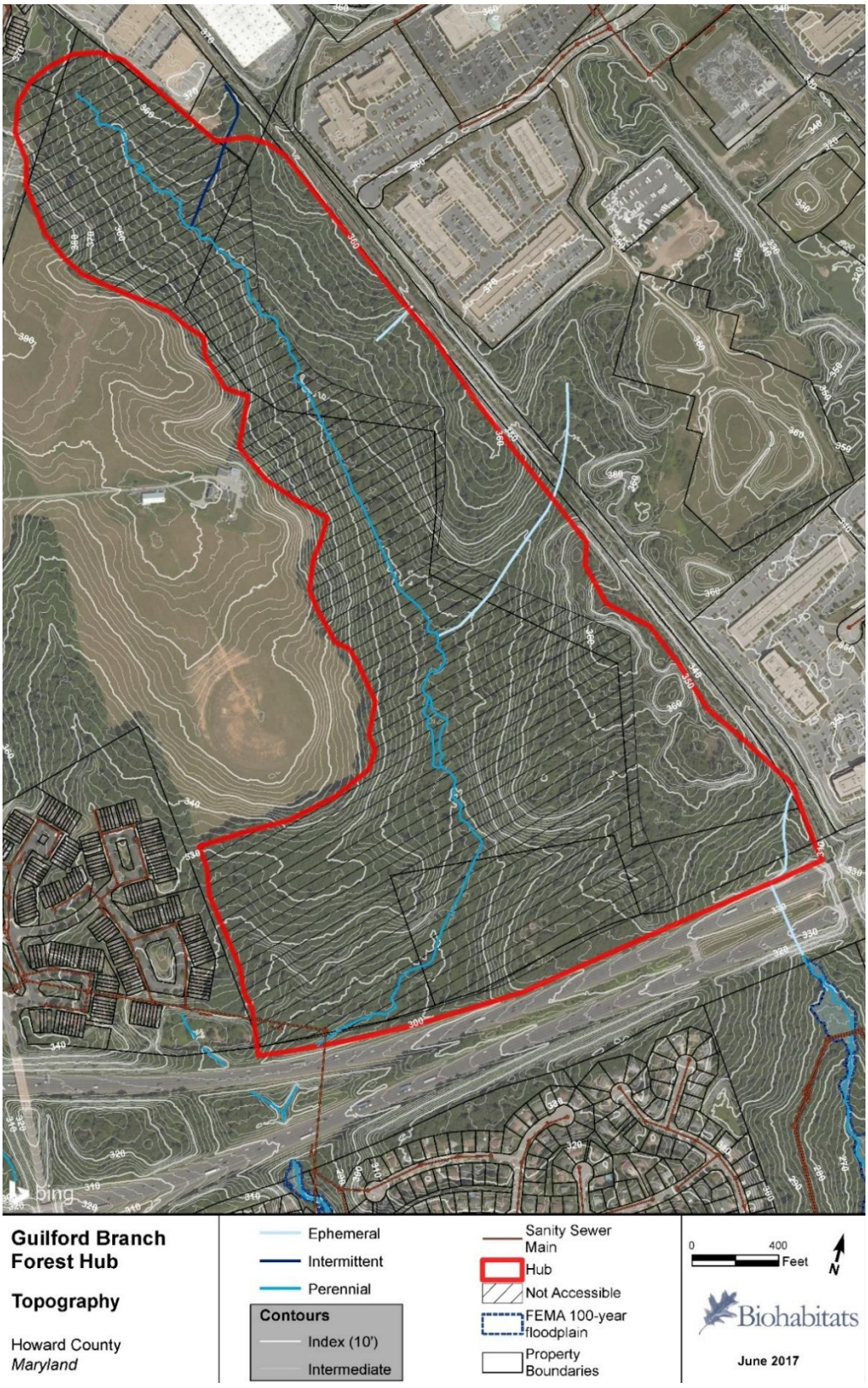
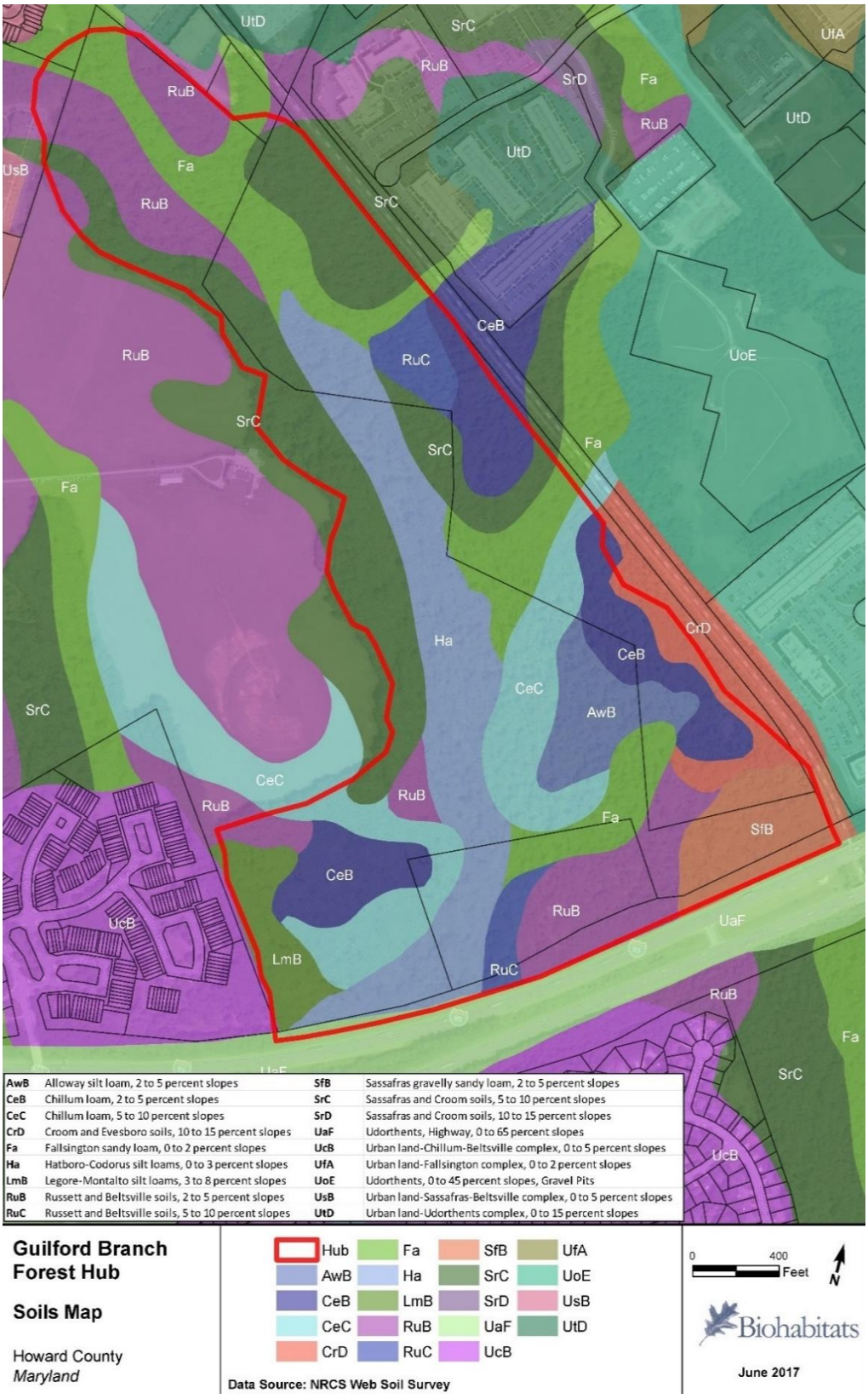


Figure 9. Guilford Branch Forest Hub Topography



AwB	Alloway silt loam, 2 to 5 percent slopes	SfB	Sassafras gravelly sandy loam, 2 to 5 percent slopes
CeB	Chillum loam, 2 to 5 percent slopes	SrC	Sassafras and Croom soils, 5 to 10 percent slopes
CeC	Chillum loam, 5 to 10 percent slopes	SrD	Sassafras and Croom soils, 10 to 15 percent slopes
CrD	Croom and Evesboro soils, 10 to 15 percent slopes	UaF	Udorthents, Highway, 0 to 65 percent slopes
Fa	Fallsington sandy loam, 0 to 2 percent slopes	UcB	Urban land-Chillum-Beltsville complex, 0 to 5 percent slopes
Ha	Hatboro-Codorus silt loams, 0 to 3 percent slopes	UfA	Urban land-Fallsington complex, 0 to 2 percent slopes
LmB	Legore-Montalto silt loams, 3 to 8 percent slopes	UoE	Udorthents, 0 to 45 percent slopes, Gravel Pits
RuB	Russett and Beltsville soils, 2 to 5 percent slopes	UsB	Urban land-Sassafras-Beltsville complex, 0 to 5 percent slopes
RuC	Russett and Beltsville soils, 5 to 10 percent slopes	UtD	Urban land-Udorthents complex, 0 to 15 percent slopes

Figure 10. Guilford Branch Forest Hub Soils

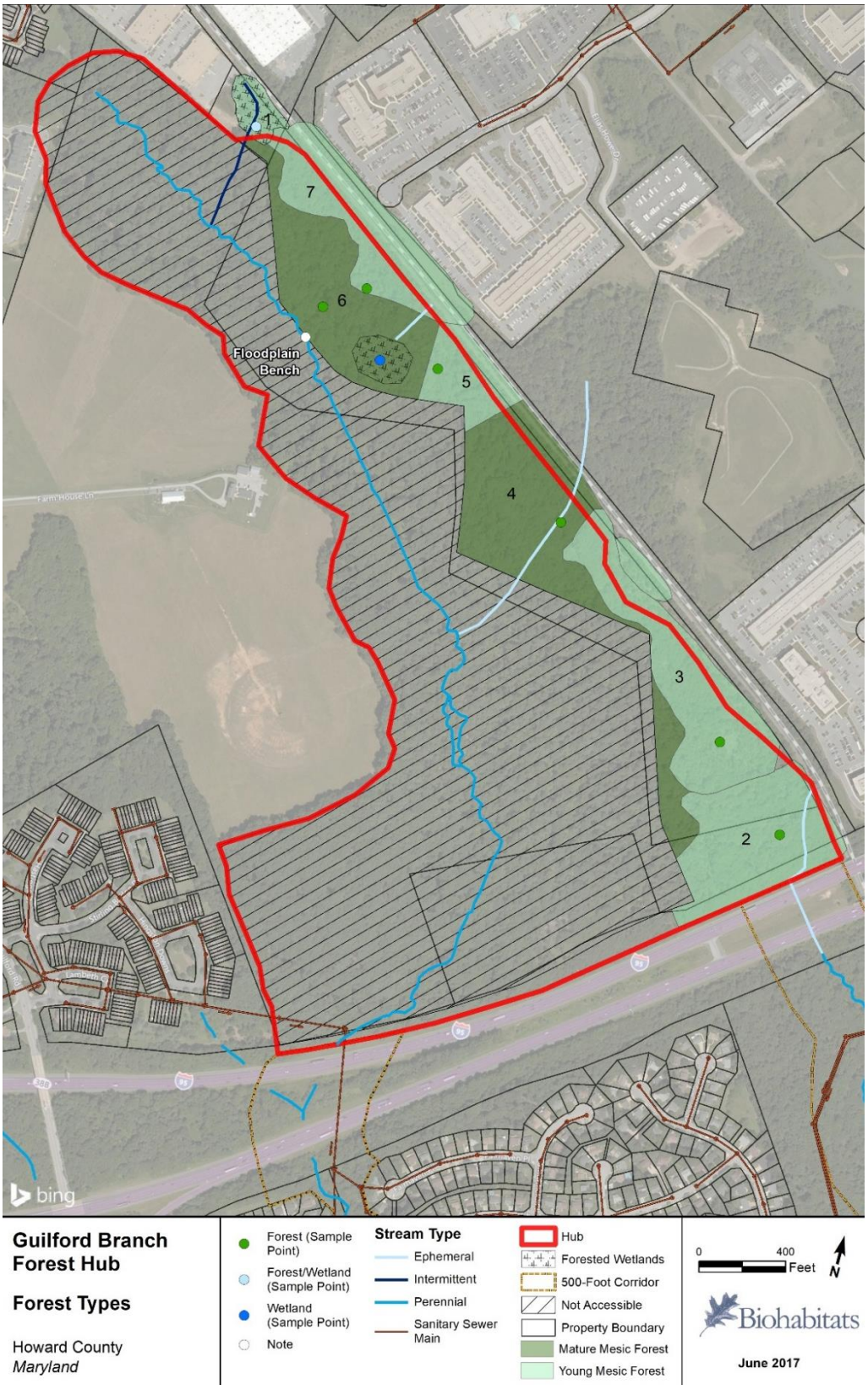


Figure 11. Guilford Branch Forest Hub Community Types

STREAM AND WETLAND ASSESSMENTS

For the collection of field data, the stream and wetland habitat in the hub was subdivided according to its ecological characteristics. The assessed portion of the Guilford Branch Forest Hub contains two small wetlands, the perennial Guilford Branch, which originates in the hub, a small intermittent tributary, and three small ephemeral channels.

YOUNG FORESTED WETLAND (WITHIN STAND 1)

Two patches of forested wetlands are in the northwestern section of the hub. The northwestern-most Stand 1 surrounds an intermittent headwater channel or ditch that is fed by the outfall from a stormwater management facility. (Although this stand is located outside the currently delineated boundaries of the hub, it was evaluated as part of this hub assessment.) This young stand is comprised of a mixed hardwood, palustrine, forested wetland with a canopy of 12-20" DBH red maple, pin oak and tulip poplar. The understory and shrub layers are relatively open, providing limited cover in the form of a few scattered highbush blueberry, American holly, red cedar, smooth alder, southern arrowwood, and saplings of green ash, beech, black gum and black cherry. The groundcover and herbaceous layers contain sparse amounts of ground pine, partridgeberry and greenbrier. Occurring primarily on the forest edges, NNIP within this stand are locally abundant and include Japanese stiltgrass, multiflora rose and Japanese honeysuckle. Woody debris is extensive in this young forest, again because it grew as an even-aged stand.

The wetlands of this stand are not mapped on National Wetland Inventory (NWI) or Maryland Department of Natural Resources (MDNR) wetland maps. The wetlands are predominately saturated with some spotty patches of shallow, approximately 1" deep standing water in depressions, but the standing water is not adequate to provide significant breeding habitat for amphibians.

FORESTED WETLAND AND EPHEMERAL CHANNEL (WITHIN STAND 6)

Slightly southeast of the first stand of forested wetlands, a second wetland area within Stand 6 is hydrologically connected to Guilford Branch, though not immediately adjacent, and contains a palustrine forested wetland and an ephemeral channel fed by stormwater. The ephemeral channel (see Photo 4) is an excavated ditch that was dug to convey flow from the nearby commercial area. This flow is concentrated by a culvert under the railroad tracks. This channel flows for approximately 200 feet before it splays out into Stand 6 and forms the forested wetland.

Photo 4. Ephemeral channel in Stand 6 crossing the Guilford Branch Forest Hub.

These wetlands are not mapped on NWI or MDNR wetland maps. Local pockets of standing water reached a depth of approximately 4", but they vary with rainfall and are unlikely to persist long enough to support breeding amphibians. Because of excessive flows from the outfall channel, the wetland is subject to erosion and sedimentation.

Guilford Branch and Floodplain Bench (within Stand 6)

This hub contains the headwaters for Guilford Branch, a stream that flows southeast for approximately 4,000 feet and then south for an additional 1,200 feet before entering a culvert under I-95. Only a short segment (approximately 100 ft) of the channel was accessible for the assessment and may not be representative of the entire reach. The channel was a slightly incised, perennial, riffle/pool system with a sand and gravel bed (see Photo 5). Overall the system is shallow with some overhead cover, overhanging banks and bank erosion. The stream habitat scores were in the marginal range primarily due to the lack of flow diversity and large amounts of sediment and embeddedness.

Photo 5. Guilford Branch in Stand 6.

Immediately adjacent to Guilford Branch, a floodplain bench of shallow wetland habitat has formed in an oxbow or a remnant of a former channel alignment. It creates a seasonally flooded/saturated, persistent, palustrine forested (PFO1E) wetland

dominated by broad-leaved deciduous vegetation. These wetlands are not mapped on NWI or MDNR maps. Some pockets of standing water were observed, but it is uncertain whether or not the pooled water persists long enough to support breeding amphibians. The floodplain bench appears to be a relic landform from a past disturbance that has stabilized, vegetated and now provides stable habitat.

Intermittent Stream (Stand 1)

A constructed ditch extends from the northwest tip of Stand 1 and flows southeast and then south for approximately 650 feet to its confluence with Guilford Branch. This constructed ditch has developed into an incised intermittent riffle/pool stream with a predominately sand and gravel bed (see Photo 6). Overall, the habitat within the reach scored in the marginal to poor range due to high embeddedness, fine substrates and a lack of flow diversity. This channel appears to be negatively influencing the hydrology and consequently, the ecology of the young forested wetlands in Stand 1.

Photo 6: Intermittent stream in Stand 1.

Ephemeral Channels (within Stands 2 and 4)

Stand 2: This ephemeral channel traverses the eastern corner of Stand 2 and flows south to a culvert under I-95 to a perennial tributary to Dorsey Run. This tributary flows through Chase Quarry and ultimately becomes the North Tributary in the Dorsey Wetland Hub. In its present condition, the ephemeral channel receives a small amount of upland drainage from Forest Stand 2, but much of the channel's historic flow is now diverted along the railroad tracks, which were cut into the existing landscape at a lower elevation. The ephemeral channel only flows under extreme storm events and provides little habitat in its current condition.

Photo 7. Ephemeral Channel in Stand 4.

Stand 4: This ephemeral channel forms in a small forested area to the north of the railroad tracks and is fed by sheet flows which are concentrated as it enters the hub by the culvert passing under the tracks. This concentrated flow has formed a shallow, gravel-bottomed channel that flows south through Stand 4 (see Photo 7). Due to its ephemeral nature, the channel provides only short-term value to wildlife within Stand 4.

Current Management

The Guilford Branch Forest Hub has no known current management activities, though the bulk of it is fenced and was not available for a site assessment. The majority of the hub is privately owned and has development potential, which could be seen as an emerging threat.

Primary Threats and Recommendations

Overall, the Guilford Branch Forest Hub is in good condition and provides a valuable resource to wildlife in its urban context. Management planning should include investigating options such as a permanent environmental easement or public acquisition for open space or parkland to prevent development within the hub. If the hub becomes subject to development, the development should be clustered at the edges of the hub to limit forest clearing and a reduction in the forest interior habitat currently provided by the hub.

This section summarizes a few of the opportunities to further enhance that habitat value and meet the larger goals for the management of the Green Infrastructure Network. There are three primary emergent threats that could be addressed through management actions: water management impairments, barriers to wildlife movement, and an overabundance of deer. Non-native invasive plant species are classified as a secondary threat, because the populations of NNIP in the hub are not yet posing a significant threat to habitat. However, such conditions change quickly, so the appropriate monitoring should be included in habitat management planning.

Most of the Common Habitat Enhancements in the second section of this document could also be used to enhance the habitat value of this hub. Because such activities are not responding to specific, urgent threats, selecting among them would largely depend on the interest and energies of the landowners or other stakeholders. One of the best ways for a landowner to take a structured approach to selecting

additional habitat enhancements would be to initiate a Forest Stewardship Plan with the Maryland Department of Natural Resources.

Water Management

IMPAIRMENTS

The hydrology of the Guilford Branch Forest Hub has been altered by constructed drainage ditches and stormwater outfalls. The ditches drain runoff directly to the stream channel rather than allowing it to filter through the soil, having the net effect of reducing water quality. Conveying water in manmade channels or from outfalls that concentrate flows also increases its velocity during storm events, which has erosive effects on the receiving stream channel. Both features can degrade the available wetland habitat by depriving the wetland systems of water.

These threats can be addressed by managing stormwater by slowing upland flows, restoring and improving water management on site to restore natural flow patterns, and creating vernal pools. Experienced environmental consultants and professional engineers should be consulted to help evaluate and design any changes to site hydrology. Even if projects can be implemented without equipment or special training, professionals can model the effects of such changes to water flow and upland storage of water, and ensure that the proper local, state and federal permits are acquired.

Photo 8: Stand 2 ephemeral channel draining to culvert under I-95.

Photo 9: Stand 4 ephemeral channel entering the hub through a culvert under the railroad tracks.

SLOWING UPLAND FLOWS

Although not a management recommendation for land within the boundaries of the Guilford Branch Forest Hub itself, it may be possible to address stormwater by slowing upland flows into the outfalls from nearby commercial, industrial and residential properties (see Photos 8 & 9). There may be opportunities to retrofit some existing stormwater management facilities so that water is retained or filtered before reaching the hub. Where flows are not piped, increasing the surface roughness of flow paths by allowing downed wood to remain on the landscape can slow water and give it more opportunity to filter into the soil. Water that filters through uplands more slowly, with more time in

contact with the soil microbes, is better for wildlife and ecosystem health because it discharges more slowly, with less erosive force, and water quality is improved.

Restore and Improve Water Management on Site

There are old drainage ditches scattered across the property in Stands 1, 2, 4 and 6. One of the simplest approaches to restore and improve the hydrology for many of the smaller channels within the hub would be to fill or block these ditches, allowing the water to back up and re-wet the forest floor. In Stand 1, the existing wetland would be enhanced by connecting the constructed ditch to its floodplain. Opportunity is limited in Stand 2, because of the railroad's diversion of water flow. In Stand 4, the channel could be easily modified to be shallower, which would slow the flow and provide longer-term benefits such as infiltration, vernal pool habitat and/or sustained subsurface flows. In Stand 6, it may be possible to add complexity in the form of pools or riffles in the channel and enhance the wetland's roughness and ability to retain water on the surface. Doing so would leave the soil wetted for more of the year, make the water more available to wildlife, and provide water quality benefits.

Within the hub, most of the main channel of Guilford Branch falls on the FCC property and was not accessible for evaluation. Based on a limited visual inspection, it appeared that there was bank erosion and incision along the stream channel, which suggest the opportunity for a more concerted effort at stream restoration. Stream restoration and channel improvements can range from relatively simple interventions such as placing large rocks and downed wood near the banks to enhance the structural complexity and thereby improve the habitat quality of the channel, to wholescale regrading and erosion control projects that could permanently change the face of the landscape. In this case, the simplest management action may be to add woody debris near the banks, thus creating shallow subsurface flows and disrupting the concentrated flow path, but a full assessment of Guilford Branch on the FCC property would be required to guide management in the future.

Create Vernal Pools

There are two major opportunities for creating and supporting vernal pool habitat in the Guilford Branch Forest Hub, centered on the two present-day ephemeral streams in Stands 4 and 6, the latter of which already holds a forested wetland. Both are very flat and retain some water already, indicating that the soils (Fallsington sandy loam) and general hydrological regime are conducive to the development or expansion of vernal pools.

A third site in the southeastern corner of the hub, in Stand 2 near the ephemeral channel, seems to have the appropriate hydrologic regime today, but the drainage has been highly altered, and the underlying soil is more gravelly and may drain too quickly to support seasonal pools.

Permits may be required to create the pools if they are constructed within the limits of a regulated waterway (e.g., ephemeral channel or stream) or fall within the 100-year floodplain, but they might be created without equipment or a complex design process once the appropriate locations and depths are determined. Further information and technical guidance is available in the USDA Vernal Pool Guide:

www.watershedconnect.com/documents/science_management_interventions_wetlands

Wildlife Communities and Connectivity

Impairments

Young trees in this hub have suffered severe impacts due to browsing from the high density of white-tailed deer, and seedlings are often eaten before they can establish adequate root systems to sustain future growth. The dense deer population browses the understory heavily, impeding forest regeneration. Over half of the Guilford Branch Forest Hub is fenced, which poses challenges for wildlife moving across the landscape, although the fence was down in at least one location and had large openings in a few others. In addition, despite the passage provided by the railroad underpass, I-95 presents a significant barrier to most species of wildlife and many plants, and has direct impacts such as noise disturbance to breeding songbirds near the interstate.

Control Local Deer Populations

Deer overbrowse poses a significant threat to the habitat value in Guilford Branch Forest Hub. The evidence of rubbed and girdled trees and deer browse on saplings is found throughout the assessed portion of the hub. At over 150 acres, the hub could support managed deer hunts within areas that meet setback requirements for firearm and bow and arrow use. Hunting is not always easy to manage in populated urban areas, so property owner and neighbor permission and education would be an important preliminary step prior to introducing any form of lethal deer control. On the other hand, managed hunts can be a revenue source.

Support Local Connectivity

Because of the impediment to wildlife and plant movement and water flow created by I-95, management of this hub should prioritize reducing its isolation from nearby habitat. The unused railroad track that runs the length of the hub to the northeast could be a powerful opportunity to enhance connectivity and reduce barriers to wildlife movement. The railroad underpass bridge (see Photo 10) and culvert at I-95 currently represent the only opportunities for wildlife to safely cross I-95 at the southeastern edge of the hub. There is limited opportunity to enhance the culvert because it is relatively small in diameter, but there is an opportunity to enhance the underpass crossing by adding plant and shrub cover that would make a wider range of wildlife more likely to use it.

Photo 10: Unused railroad crossing under I-95.

There is an additional large culvert crossing at I-95 in the southwestern edge of the hub, but it is unclear how accessible this crossing is for wildlife because of the fencing around the FCC property. Opportunities to remove the fencing to improve connectivity within and from the hub are limited, as long as the property is owned by the FCC.

Managers should also consider the connectivity outside the hub, and could indirectly improve the habitat value by ensuring that wildlife entering the hub can find safe passage to the rest of the Network once they leave it. At a minimum, future updates to the Network map should include the underpass at I-95 as part of the Network.

Secondary Threats and Recommendations

In addition to the primary threats, there is also a secondary threat to habitat quality from non-native invasive plants (NNIP). NNIP are present throughout the site but are more abundant along the forest edges. Overall, their presence is not currently a pressing management concern or priority for investment of resources, because they are not inhibiting forest regeneration. Furthermore, the invasive species that are present are at very low levels and most likely distributed across the entire hub, which would make eradication or control a very costly and time-consuming process. Since the NNIP are at low densities and deer browse is the primary factor limiting the establishment of native plant communities, addressing NNIP is not a high priority for immediate management action. Nevertheless, it does bear mention and observation into the future and is therefore a secondary threat.

Monitor and Assess Non-native Invasive Plant Species

Although there is not a current critical problem with invasive species, this may be poised to change in future years, so the best course of action for the present would be to establish a replicable baseline assessment of the NNIP species (which is included in this assessment in Table 1) and their densities (which were not evaluated) and follow the development of their populations into the future. A baseline assessment followed by monitoring every five years should be adequate to detect any important changes in the NNIP populations and catch sudden changes or impairments to habitat quality before they become unmanageable. Along with plant species, it will be important to monitor any other invasive pests that may be an issue in the region, such as the Emerald Ash Borer.

Table 1. Non-native Invasive plant species observed at Guilford Branch Forest Hub

	Common Name (Scientific Name)	**Forest Stand (Abundance/Strata)**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**W6***
Herb	Japanese Stiltgrass (*Microstegium vimineum*)	E/H	E/H	E/H	P/H		P/H		P/H
Shrubs	Japanese Barberry (*Berberis thunbergii*)								P/U
	Multiflora Rose (*Rosa multiflora*)		P/H						
	Privets (*Ligustrum obtusifolium, L. ovalifolium, L. sinense and L. vulgare*)	P/UH							
	Wineberry (*Rubus phoenicolasius*)							P/H	
Vine	Japanese Honeysuckle (*Lonicera japonica*)	E/H	E/H	E/H	P/H	P/H	P/H	P/H	E/H
	Abundance: P = Present, E = Extensive Strata: U = Understory, H = Herbaceous *The forested wetland within Stand 6								

Glossary of Terms

Baseflow – stream flow as maintained between storms and runoff events by groundwater discharge.

Biodiversity – the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Buffer – a vegetated area near a water body that filters stormwater runoff, and helps shade and partially protect the water body from the impacts of adjacent land uses.

Connectivity – the degree to which the landscape facilitates animal movement and other ecological flows.

Diameter at breast height (DBH) – tree diameter measured at 4.5 feet above the ground.

Downed woody debris – dead branches or trees that fall to the forest floor, where they provide habitat for amphibians and host dense concentrations of grubs and other invertebrates.

Dynamic equilibrium – a dynamic equilibrium is a stable balance of processes such as that reached in a mature forest where the numbers of individuals in various age classes stay roughly the same.

Edge habitat – Habitat located at an abrupt transition between habitat types, such as a forest next to a mowed lawn or an agricultural field.

Embeddedness – the extent to which rocks (gravel, cobbles, and boulders) are sunken into the silt, sand, or mud of a stream bottom. Generally, the more the rocks are embedded, the less rock surface is available as habitat for aquatic macroinvertebrates and for fish spawning. Excessive silty runoff from erosion can increase a stream's embeddedness.

Emergent – emergent plants are taller than their neighbors.

Epifaunal substrate – the relative quantity of natural resources in the stream, such as cobble, large rocks, fallen trees, logs and branches, and undercut banks. These features provide feeding locations or sites for spawning and nursery functions of aquatic invertebrates and other organisms.

Floodplain – an area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding.

Floodplain access – a stream has floodplain access if it is able to overflow its banks and saturate the stream-side soil within its floodplain. As a rule of thumb, a functioning stream should access the floodplain every year or two.

Forest Stand – a contiguous community of trees that are uniform in species and age (compared to neighboring communities).

Forage – *v*, search over an area in order to obtain food or provisions; *n*, food for animals.

Forbs – herbaceous flowering plants.

Fragmentation – the division of large blocks of contiguous habitat into small patches.

Forest interior – areas of forest more than 300 feet from the forest edge.

Hydric Soils – soils formed under saturated conditions.

Invertebrate – animals that have no spine, a class that includes all insects.

Incised – rivers and creeks that have cut downward into the riverbed and eroded the bottom of the channel. Incised channels are often the product of rapid stormwater discharge.

Landscape – includes the physical elements of landforms such as hills and meadows, water bodies such as rivers, lakes and ponds, living elements of land cover including vegetation, human elements including different forms of land use such as agriculture, buildings and roads, and transitory elements such as lighting and weather conditions.

Mesic – Refers to environmental conditions that have medium moisture supplies as compared to wet conditions (hydric) or dry conditions (xeric). Mesic forests are sometimes called upland forests.

Metabolism – physical and chemical processes needed to maintain life.

Macroinvertebrate – organisms that lack a spine and are large enough to be seen with the naked eye.

Neotropical – of or designating the biogeographic region that includes southern Mexico, Central and South America, and the West Indies.

Palustrine – inland wetlands that do not have flowing water.

Physiographic province – a geographic area in which the geology and climate history have resulted in landforms that are distinctly different from adjacent areas. Howard County's physiographic provinces include the Piedmont, or plateau under the Appalachian Mountains, and the Coastal Plain, which extends down to the Atlantic Ocean.

Rewilded landscaping – rewilded is a landscaping aesthetic that draws on natural looks and allows plants to jumble and overlap in riotous energy. Can be a form of restoration.

Riparian – of or relating to lands adjacent to rivers and streams.

Rootwad – the base of a tree, including the root fan and lower trunk.

Scrub-shrub – a type of wetland dominated by woody vegetation under 20 feet tall including true shrubs and young trees.

Snag – a standing dead tree.

Spoor – animal sign such as scat, tracks, or scent.

Stream flow – water moving down a stream or channel.

Structural diversity – refers to the physical complexity of the habitat. In a forest, structural diversity is high if there is a mixture of species and height classes in the trees. In a waterbody, structural diversity is high if there is water of different depths and flow speeds.

Succession – the change in an ecological community over time. For example, after a larger disturbance such as a flood, the first plants to grow on newly deposited sediment might be called a "young" community. Once large, long-lived shade trees are present, the community might be referred to as "mature."

Upland flow – water that moves across a landscape towards a stream or drainage channel.

Urban heat island – a city or metropolitan area that is significantly warmer than the surrounding rural area due to human activities.