



NATURAL RESOURCE MANAGEMENT PLAN
City of Alexandria, Virginia

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Natural Resource Management Plan

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City of Alexandria
Department of Recreation, Parks, and Cultural Activities
Natural Resources Division
Alexandria, Virginia 22314



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Pink Lady's-slipper (*Cypripedium acaule*).

This plant was once common in Alexandria in upland Oak-Heath Forest and successional Virginia Pine forests. Today, only a few remaining individuals are known from very few sites in the City.
Photo by Gary P. Fleming.

Introduction

This Natural Resource Management Plan (NRMP) represents Alexandria’s first attempt to develop a strategic course of action for preserving, protecting, and sustainably managing Alexandria’s natural resources and native biodiversity. This plan aligns with other initiatives and policies adopted by the City over the years, while expanding on them by specifically addressing natural resource conservation and management.

Natural resources are irreplaceable features of the indigenous landscape that include topography (land shape), geology, soils, surface and ground water, natural communities, plants, and animals. The NRMP is based on a Citywide inventories and assessment of natural resources and habitats, initially in the areas of flora and geology. The policy goals of No Net Loss of City owned natural lands and a Do No Harm approach to natural lands management are the two overarching recommendations of the plan’s recommendations and actions.

Despite its small size, Alexandria harbors a rich diversity of habitats and wildlife. This section of Virginia, including the two neighboring counties Fairfax and Arlington, contains a broad variety of habitats and is perhaps the most floristically diverse in the state (Simmons 2007).

Native flora and plant communities are the dominant natural resources on parkland in the eastern U.S., and those that remain in Alexandria are diverse and require protection and careful stewardship. Native flora and plant communities are the foundation of biodiversity, as well as the measure of an ecosystem’s overall health and functionality. Simply put, the preservation of biodiversity and natural heritage cannot be achieved without the large-scale conservation of native plants and their natural habitats (MBHWG 2014).

This plan comes at a critical juncture in Alexandria’s history, with much of the City built out and infill development and subsequent roadway and utility expansion threatening remaining natural lands. Unlike larger counties and jurisdictions with ample opportunities for acquiring sizable parcels of natural land as a means of conservation, such is not the case in Alexandria as opportunities for conservation via land preservation are limited. Rather, careful stewardship of remaining City natural lands, including non-native invasive species control, are the most important actions we can take in helping to ensure the future sustainability and conservation of Alexandria’s natural resources.

The City of Alexandria and its Department of Recreation, Parks, and Cultural Activities (RPCA) have a strong commitment to the stewardship and sustainability of Alexandria’s natural resources. RPCA is the lead land management agency in Alexandria and oversees and manages over 1,000 acres of parkland and natural area sites.

Effective implementation of the NRMP depends on the cooperation and support of all the City’s departments, residents, and conservation partners. This plan will be updated continually as new information, priorities and goals becomes established.





Goals and Objectives

RPCA’s environmental policy is the sound management of environmental, historical, and cultural resources at each level throughout its scope and operations. In 2018, RPCA adopted the Strategic Plan: 2018-2023, which has Investing in our Natural Environment as one of the four focus areas. The plan states, “Our commitment to natural spaces provides physical, mental, and community benefits, while offering opportunities to engage with and conserve our natural resources.”

The main goal of the NRMP is to preserve Alexandria’s native landscape and natural heritage for present and future generations. Public education regarding the value of the City’s natural resources and their stewardship, as well as opportunities for participation and involvement, are also major goals of the plan.

The purpose of the NRMP is to establish a comprehensive, science-based approach to natural resource management in Alexandria through natural resource conservation and stewardship. This plan also provides recommendations and actions to achieve the resource protection and stewardship mission of RPCA and the long-term management and sustainability of the City’s natural resources.

Public opinion, as expressed through various Needs Assessment (2011, 2013, 2015, & 2017) and other surveys strongly support the conservation and stewardship of Alexandria’s natural resources. The preservation of the native landscape and small town character, as well as protecting and maintaining quality natural areas, are often at the very top of the list of needs voiced by City residents in surveys.

Regulatory Authority

In 1963, under City Code, Section 6-2-1, the authority was assigned to the Director of RPCA for “general management and supervision of all trees, shrubs, plants and vegetation” in the City, except public school sites, and, under Section 6-2-6, the authority to prepare and implement a “master tree, shrub, plant, and vegetation plan for all or any portion of the public places within the City, except public school sites”. As the City’s largest landowner and lead land management agency, with over 1,000 acres of parkland and natural area sites, the responsibility for preserving Alexandria’s biodiversity and natural heritage rests with RPCA, through collaborative efforts with other City departments, residents, and conservation partners.

In 2012, RPCA created the Natural Resources Division and Natural Lands Management Section within RPCA, to preserve Alexandria’s native landscape and rich biodiversity for present and future generations. The Natural Resources Division comprises the Natural Lands Management Section (resource inventory, management, and invasive species control), City Arborist Office (urban forestry operations), and the Jerome “Buddie” Ford Nature Center (environmental education).

The Natural Lands Management Section is responsible for, assessing, inventorying, and sustainably managing the natural resources in parks, waterways, and natural areas throughout the City, including environmental review. This is achieved through science-based conservation methodologies aligned with industry Best Management Practices.



City Characteristics

Alexandria is one of the oldest and historically significant cities in the eastern U.S. Situated almost entirely within the Coastal Plain Province between the Fall Line (Zone) and the tidal Potomac River, it was a destination point for the early explorers, beginning with Captain John Smith’s discovery of the Potomac River in 1608. The City began in 1654 with the development of 700 acres of what is now mostly Old Town and was officially established in 1749 and chartered as a city in 1852. It grew from a series of tobacco warehouses in the early 1700s to become Virginia’s primary northern shipping and trade port from the early 18th century to the mid-19th century when the railroad became important. From that time through the mid-20th century, the City was famous as a major railroad transportation center and bustling waterfront industry. By the 1940s, Alexandria began to grow greatly in population as people settled into the area during the post-World War II economic boom. Home to several of our nation’s founding fathers, the City was incorporated into Washington, D.C. in 1811 and returned to Virginia in 1847.

Alexandria was originally developed using the popular grid pattern of the 18th century (Davey Resource Group et al. 2009). For much of its history, the City’s land area was roughly that of “Old Town”, the lowland section along the river. However, after annexing large areas from Arlington and Fairfax counties in 1915 and 1930 (Alexandria Public Library, Arlington County 1967) and a large upland section from Fairfax County in 1952 (Alexandria Library), Alexandria today occupies 15.32 mi² (9,804.8 ac) and is the most densely populated city in Virginia (VirginiaPlaces.org). In 2017, its population was approximately 160,035 with a density of 10,446 persons/sq. mile (U.S. Census Bureau 2017). The City’s proximity to the nation’s capital, with its extensive public transportation system, makes it a highly desirable place to live.

Environmental Inventory and Analysis

The digitized Geologic Atlas of the City of Alexandria, Virginia and Vicinity is a valuable resource for planners and engineers within City government, as well as private industry and other researchers. A brief overview of Alexandria’s geology and natural landforms follows below.

Alexandria rises in elevation from near sea level at the Potomac River to elevations of 280 feet and higher in western areas of the City near the Fall Zone. Most of Alexandria is underlain by deep beds of sand, gravel, silt, and clay of the early Cretaceous Potomac Formation that were deposited by ancient river systems carrying material from the eroding Appalachians and Piedmont (Mixon et al. 2000, Fleming 2015). The unit as a whole was gradually deposited in an eastward-thickening wedge with sediments reaching thousands of feet deep at the continental margin. The average thickness of the unit is about 500 feet (Obermeir 1984). Locally, the unit varies irregularly in thickness from less than 20 feet to more than 100 feet near the Fall Zone and increases in depth eastward to a depth of 400 or more beneath the Old Town waterfront (Drake and Froelich 1986; Fleming 2015).

The Potomac Formation sand, gravel, silt, and clay deposits vary considerably and occur as interbedded strata or small to massive, heterogeneous lenses (Fleming 2005). Fleming (2015) divided the Potomac Formation in Alexandria into six informal members, including from highest to lowest: Shooters Hill gravel; Arell clay; Chinquapin Hollow fine sandy clay; Winkler sand; Lincolnia silty clay; and Cameron Valley sand. The Potomac Formation is the main water-bearing unit in the region (Johnston 1964).

Overlying and “capping” the Potomac Formation members are four major upland terraces, including from highest to lowest: Seminary terrace, with an average surface elevation of 265 to 275 feet; Dowden terrace, with surface elevations of 240 to 250 feet; Chinquapin Village terrace, with a surface elevation between 185 and 205 feet; and Beverley Hills terrace, with an average surface elevation of 145 to 150 feet (Fleming 2015).

The lowest and youngest gravel terraces in the City are the river terrace deposits of Pleistocene age that occur between 35 and 105 feet in elevation along the Potomac River and its major tributaries – Four Mile Run and the Eisenhower Valley complex of streams (Johnston 1964, Drake and Froelich 1986, Fleming et al. 1994, Fleming 2005). Most of Old Town is built on Pleistocene river terraces, as well as much of downtown Washington, D.C. (Johnston 1964, Obermeier 1984). The Old Town terrace is composed of sand, gravel, and silty clay, with abundant organic horizons (Fleming 2015).

Quaternary alluvium underlies modern floodplains and depositional bars close to and along streams in the City, and is as much as 20 feet thick in places (Drake and Froelich 1986). The unit is comprised of sand, silt, gravel, and clay, generally with coarser material towards the bottom. Most of the material is derived from Coastal Plain sediments resulting from streams draining the upland terraces and Potomac Formation.

Exposed crystalline rocks of the Piedmont and Fall Zone occur in westernmost Alexandria at the eastern limits of the Holmes Run Gorge at Rynex Natural Area, Dora Kelley Nature Park, and Holmes Run Scenic Easement. Bedrock outcrops consist of metamorphosed sedimentary rocks of the Indian Run Formation, Lake Barcroft Metasandstone, and Accotink Schist intruded by early Ordovician plutons of Falls Church Tonalite and Occoquan Granite (Fleming 2015).

For further information on Alexandria’s geology, peruse the Geologic Atlas of the City of Alexandria, Virginia and Vicinity on the City’s website.

Vegetation

Alexandria’s native vegetation is an irreplaceable natural resource. Almost all of the forests and wetlands one sees throughout the City today are remnants of a long ago landscape when Alexandria was largely forested and rural. Today, the majority of the remaining individual components of this landscape exist in greatly reduced numbers and in highly fragmented, isolated conditions, typical of urban settings.

Of the 2,540 vascular plants considered native to Virginia (John Townsend, pers. comm.), remarkably nearly a third occur in Alexandria.

For further information regarding Alexandria’s flora and natural communities, see Native Vascular Flora of the City of Alexandria, Virginia on the City’s website.

Species of Conservation Concern

As of this writing, the highly rare extant flora in Alexandria that are state-listed, three are ranked S1 (critically imperiled), including Glandular Cinnamon Fern (*Osmundastrum cinnamomeum* var. *glandulosum*), Crested Sedge (*Carex cristatella*), and Pear Hawthorn (*Crataegus calpodendron*); River Bulrush (*Bolboschoenus fluviatilis*) is ranked S2 (imperiled); and three are on the “watchlist” with S3

status, including Soft Fox Sedge (*Carex conjuncta*), Bearded Sprangletop (*Diplachne fusca* var. *fascicularis*), and Giant Burreed (*Sparganium eurycarpum*) (Townsend 2015).

The total number of documented, native historical species is 116 (13.84% of the known flora of Alexandria). Most Alexandria historical species are considered lost, with little likelihood of rediscovery. This is largely the result of the loss of natural habitat.

Reflecting the increasing trend of urbanization throughout the City, including the conversion of natural areas and open space from a wild condition to artificial, landscaped settings, are the 388 total species that are ranked as very rare and critically imperiled in Alexandria (A1 and A2; see Key to City Rank in the appendix). A further index of species rarity owing largely to loss of habitat are the 134 uncommon to rare, “watchlist” plants listed for Alexandria (A3; see Key to City Rank).

Combining the total numbers of historical, imperiled, and uncommon to rare flora (76.13% of the City’s total native flora), the outlook for the future sustainability and preservation of much of Alexandria’s native flora and biodiversity is impaired. A moratorium on any further net loss of natural lands on City owned parkland, waterways, and open space, and continued natural lands management and stewardship will go a long way towards halting this trend and stabilizing dwindling, fragmented populations.



Goldenrod (*Solidago* spp.).

Generally with clusters of golden yellow flowers, this member of the Aster Family usually blooms in late summer to early fall and provides a feast for bees and other pollinators. Photo taken at George Mason Park by R.D. Williams.



City Plans and Initiatives

RPCA Strategic Master Plan

Alexandria adopted its Strategic Master Plan for Open Space, Parks & Recreation in 1992, and continuously updates this as Small Area Plans (SAP) are revised. This plan comprises of 15 small area plans for neighborhoods and areas citywide. One of the stated goals of the Strategic Master Plan is to preserve and expand open space throughout the City.

Open Space Plan and Update

In 2017, the Alexandria Open Space Plan Update (OSPU) was adopted by the City, addressing recommendations pertaining to open space in the 1992 Master Plan. The OSPU established a framework for addressing Alexandria's short- and long-term open space needs. It defines an approach that maximizes the City's limited open space opportunities by creating a system to build upon Alexandria's dense, urban condition. In addition, the OSPU framed the initiative for Alexandria with a list of 15 simple and direct goal statements:

- Goal 1. Protect and enrich existing parks
- Goal 2. Develop innovative opportunities for creating additional open space
- Goal 3. Complete implementation of the Potomac River Waterfront Plan
- Goal 4. Protect and expand the stream valleys and other environmentally sensitive areas
- Goal 5. Create an open space network in new development areas
- Goal 6. Protect and preserve institutional open space
- Goal 7. Maximize use of public school open space areas
- Goal 8. Preserve and protect cemeteries
- Goal 9. Create public open space from vacant land
- Goal 10. Link and expand pedestrian, bicycle, and trail system
- Goal 11. Enhance streetscapes and gateways
- Goal 12. Expand citywide street tree program and protect existing trees and woodland areas
- Goal 13. Encourage the creation of Civic Parks at and adjacent to Metro stations
- Goal 14. Beautify interchanges and highway corridors
- Goal 15. Protect privately owned open space

In the 2014 City of Alexandria Open Space Plan Update (OSPU), the City achieved, as of January 2013, the addition of 103 acres of open space – just over the 100-acre goal. With this achievement of the 100-acre goal set forth in the plan, the City has maintained the ratio of 7.3 acres per 1,000 residents. The open space ratio in the City can be maintained until 2025 without additional land acquisitions. If the City receives all of the open space promised in the small area plans, it can maintain this ratio until 2045.

A supplement to the OSPU is the Guide to Voluntary Land Conservation Options (located on the City’s website), which provides options to voluntarily conserve environmentally significant property, such as conservation easements, living trusts, and others.

Landscape Guidelines

In 2007, the City adopted the Landscape Guidelines outlining Best Management Practices (BMPs) and industry standards in landscape planning and implementation in Alexandria, including a statement of the need for recognizing and conserving “environmentally sensitive or ecologically important sites”—largely through “inventory and detailed study.” This document is being updated as of 2018, and will outline the standard landscape information required for each of the review processes and stages, and the methodology used to meet these requirements. As a result, proper implementation of the Landscape Guidelines contributes greatly toward achieving the City’s social, economic and environmental goals in close coordination with other City plans and policies (from Chapter 2A: Landscape Process Overview-Draft).

Eco-City Charter, Environmental Action Plan

Beginning in spring 2007, the City partnered with Alexandria’s Environmental Policy Commission (EPC) and Virginia Tech’s Department of Urban Affairs and Planning (UAP) to design and facilitate a new, strategic collaborative planning process, called Eco-City Alexandria, to create an Eco-City Charter and Environmental Action Plan to guide Alexandria toward environmental sustainability. Alexandria’s Environmental Policy Commission (EPC) was the project’s principal advisor along with representatives from the Alexandria City Council and City staff. The Eco-City Alexandria team completed an inventory of existing City programs and plans called GreenVentry and examined best practices from across the country and around the world to create a Compendium of Model Programs and Practices. The City adopted the Eco-City Charter in 2008 and the first Environmental Action Plan in Virginia in 2009.

The “Eco-City Alexandria” establishes policies, plans, and programs for sustaining the environment, including:

- | | |
|-----------------|-------------------------------|
| Water Resources | Air Quality |
| Climate Change | Land Use and Open Space |
| Green Buildings | Environmental Health |
| Energy | Implementation, Education and |
| Solid Waste | Outreach |
| Transportation | |

The Eco-City Environmental Action Plan 2030 (EAP) was formally adopted by City Council in June 2009, and it outlines the goals and activities that will help the City and its residents achieve the vision outlined in the Eco-City Charter. The charter, which was the first of its kind in the region, outlines the City’s guiding principles and vision for a sustainable Alexandria. The EAP Revision Phase 1 highlights short-term actions in five focus areas through 2023, and was adopted by City Council in October 2018. Phase 2 will focus on mid- to long-term actions, of the five focus areas and all time frames for the remaining topic areas and will be adopted in 2019.

Urban Forestry Master Plan

The Urban Forestry Master Plan was adopted in 2009, with increasing Alexandria’s tree canopy coverage to 40% of the City as its main goal. This is to be achieved mainly through tree plantings that expand the urban forest network. The plan also recognized controlling non-native invasive plant species as a “high priority”. This document is currently under revision to review and update tree canopy goals and establish an updated direction for the urban forest health. This document should be prepared for adoption in 2019.

Regional Natural Resource Management Group

In 2012, Natural Resources Division, together with its counterparts in Arlington and Fairfax counties, formed the Regional Natural Resource Management Group for the purpose of networking and sharing information regarding Best Management Practices in natural resource management. The group is composed of over 100 partners of natural resource management professionals at the federal, state, and local level of all the neighboring jurisdictions in the D.C. region, including interdepartmental City staff.

In 2012, the Natural Resources Division produced a list of all the non-native invasive plants considered to be a threat in Alexandria. This list is revised semi-annually and is available online as a regional conservation planning tool and educational resource.

Also, in 2012, Natural Resources Division initiated a program to raise public awareness and appreciation for Alexandria’s natural areas by installing signage to designate those areas in Alexandria that comprise notable remnants of natural heritage and floral biodiversity (“Native Plant Conservation Zone”).

Environmental and Sustainability Management System (ESMS)

As part of the Eco-City Alexandria initiative and consistent with its mission, RPCA enrolled in the Virginia Tech Environmental and Sustainability Management System Institute 2013–2014 Class and began developing an Environmental and Sustainability Management System (ESMS) to secure ISO 14001 Certification—an international standard and certification for operating a business in a way to minimize its impact on the environment and promote environmental safety.

The development and implementation of the ESMS Program is part of RPCA’s Three-Year Business Plan. To date, a written Environmental Policy has been adopted by RPCA as part of implementing the ESMS initiative. RPCA is also developing Standard Operating Procedures to implement key aspects of this initiative. Of the four Significant Aspects in RPCA’s ESMS, reducing agro-chemicals and their negative effects on natural lands and waterways is the aspect that most pertains to the NRMP.

In 2015, owing to RPCA’s development and implementation of its ESMS and environmental policy, RPCA was awarded the Exemplary Environmental Enterprise (E-3) certification by the Virginia Department of Environmental Quality. Full compliance and certification for ISO 14001 is anticipated in the next several years.

Park Planning Initiatives

The Citywide Parks Improvement Plan was formalized in 2016 to address improvements for six of the City’s largest parks. Though recreational facilities and amenities are the primary focus of the plan, management of non-native invasive species and expanding tree plantings in parks are also included as important actions.

Water Quality Regulations

Water quality within the City of Alexandria is subject to federal, state, and local laws and regulations. These include the Chesapeake Bay Preservation Act (Bay Act), the Chesapeake Bay TMDL, the Virginia Stormwater Management Program, and Alexandria’s Environmental Management Ordinance. The administration of water quality regulations is conducted by Transportation and Environmental Services.

The Bay Act was enacted by the Virginia General Assembly in 1988 as a critical element of Virginia’s non-point source management program. The Bay Act is designed to improve water quality through effective land management and land use planning. Included in the Bay Act are two types of environmentally sensitive lands: Resource Protection Areas (RPAs) and Resource Management Areas

(RMAs). RPA protections are designed to preserve perennial streams, tidal wetlands, tidal shores, and certain non-tidal wetlands as outlined in the Environmental Management Ordinance. RMA protections ensure that all lands within the City are properly used and developed to protect water quality. Additionally, the City’s Environmental Management Ordinance provides safeguards for natural channel intermittent streams and non-tidal wetlands. Protections for these areas are outlined in the City’s Environmental Management Ordinance, which also outlines water quality treatment requirements during site development and redevelopment.

In 2010, the Chesapeake Bay Total Maximum Daily Load (TMDL) was established by the EPA setting pollution reductions for nitrogen, phosphorous, and sediment in the six Chesapeake Bay watershed states and the District of Columbia. In response to the creation of the TMDL, the City developed the Chesapeake Bay TMDL Action Plan. The Phase 1 plan includes strategies and milestones to meet the required 5% pollutant reductions by 2018. The Phase 2 plan will include strategies and milestones to meet an additional 35% in pollutant reductions.

In the fall of 2014, RPCA partnered with the Department of Transportation and Environmental Services (T&ES), Office of Environmental Quality, to coordinate the City’s response to changes in the Virginia Stormwater Management Program. These actions included assistance with the revision of the City’s Environmental Management Ordinance, refining and creating new processes, and providing additional resources to meet Stormwater Management Regulations and the Municipal Separate Storm Sewer System (MS4) General Permit Regulations.

Natural Resources Division Inventories

In 2015, Natural Resources Division completed the Native Vascular Flora of the City of Alexandria, Virginia, the first verifiable, comprehensive floristic study of Alexandria’s native flora and natural communities, including conservation ranks for each entity. This important planning and baseline inventory resource is a greatly improved and revised version of the previous Flora of 2009, which was essentially an annotated checklist of native flora. It is available online at the Alexandria Flora Project webpage.

In 2015 and early 2016, a major revision of the 2008 Geologic Atlas of the City of Alexandria, Virginia and Vicinity was contracted by the City. This important planning resource commissioned by RPCA is also a first of its kind milestone for the City. It is available online at the Alexandria Geology webpage.

Both the Alexandria Flora and Geologic Atlas complement the Standard and Requirement-Reference section of the Landscape Guidelines by providing a thorough, up-to-date inventory of all the City’s native vegetation, geology and soils, and water resources.



Natural Resource Management

Inventory of Natural Lands of Conservation Interest

This NRMP is the first City plan to assess, delineate, and include all remaining City natural area sites as defined spatial areas of a GIS dataset (see Plate 1). In most cases, boundaries were carefully delineated to include only functioning sections of natural land and not areas occupied by buildings; athletic facilities, including artificial turf ballfields; and other hardscapes. For example, approximately 5 acres along Backlick Run of the 46.29 acres comprising Ben Brenman Park (RPCA lists the park as 59.3 acres) are included because so few natural features remain throughout the park. However, at a few sites, natural area remnants are too scattered within a mosaic of artificial features to allow readable, large-scale mapping.

It is an important reminder that while the GIS layers and online graphics provide a good overview of sites and parcel boundaries, they are in no way a substitute for the accuracy of on-the-ground surveys and site assessments by qualified professionals.

The total of all remaining natural area sites in Alexandria is 1,205.72 acres, comprising all City, state, federal, and privately owned lands (see Plate 1).

OWNERSHIP	NUMBER OF ACRES
City-Owned Natural Area Sites and Conservation Easements	529.12
Privately Owned Natural Area Sites	415.98
State Owned Natural Area Sites	19.05
Federally Owned Natural Area Sites	241.57

City-Owned Natural Area Sites and Conservation Easements

The total of all City owned natural areas and parkland, including conservation easements, is 529.12 acres (see Plate 4). These sites are actively stewarded and managed by RPCA Natural Resource Division.

Privately Owned Natural Area Sites

The total of all privately owned natural area sites in Alexandria is 415.98 acres (see Plate 2). These sites are not regularly stewarded by natural resource management staff but nonetheless include some of the largest and most important natural areas remaining in the City. Many of these sites are in some form of protective easement.

It is important to note that privately owned lands shown on Plate 2 are not identified and presented here in

the pursuance of conservation easements by City staff or others. These properties are included in the NRMP for consistency because they represent significant concentrations of native biodiversity and natural features, forest canopy, including notable and old-age trees, and water resources. All remaining natural areas in the City together are critical in maintaining forest connectivity and ecological sustainability throughout Alexandria and vicinity. Over the years, RPCA Natural Lands Management Section has worked with various landowners of these sites in an advisory capacity regarding non-native invasive plant control, Best Management Practices, resource assessments, and natural lands management.

State-Owned Natural Area Sites

The total of all state-owned natural area sites in Alexandria is 19.05 acres (see Plate 1).

Federally Owned Natural Area Sites

The total of all federally owned natural area lands in Alexandria, largely comprising U.S. National Park Service (NPS) properties at Daingerfield Island, George Washington Memorial Parkway, and Jones Point Park, is 241.57 acres (see Plate 3). NPS lands in the City total 233.97 acres. U.S. Department of Defense (DOD) natural lands in Alexandria, comprising the Alexandria National Cemetery and forested sites adjoining Institute for Defense Analyses and the Winkler Botanical Preserve, total 7.59 acres.

All of these sites are critical refugia for native biodiversity. Because of their importance, the Natural Resources Division has partnered with NPS over the last 15 years in providing assistance with non-native invasive plant control and natural resource management.

Best Management Practices for Natural Lands

Best Management Practices (BMPs) are features, methodologies, and practices that help ensure that environmental stewardship and management of natural resources are accomplished in an ecologically appropriate and environmentally sound manner. All hold central the concept of Do No Harm and to keep sites natural and cause as little disturbance as possible.

Inventory and Monitoring

Natural resource management includes vegetation surveys and natural resource inventories and assessments throughout the City's parks, natural areas, open space, wetlands, and waterways for the purposes of planning, management, and resource protection and restoration. Initial baseline inspections and inventories, as well as ongoing monitoring of natural sites, aid in developing appropriate management practices for specific natural areas on public property.

The vascular flora of the City of Alexandria was extensively surveyed from 2000 through 2015. Surveys and historical collections yielded a total of 840 native species (including infraspecific taxa and hybrids) representing 385 genera and 131 families. The City of Alexandria Herbarium (AVCH) is the repository for a baseline collection of native and exotic plant species and is an invaluable resource for conservation planning.

To further broaden our understanding of local vegetation types, quantitative compositional and environmental data were collected from ten 400 m² sample plots, one 200 m² plot, and six 100 m² plots in the City of Alexandria. Vegetation sampling data from five 400 m² plots of virtually identical forested communities from adjacent Arlington County were also gathered during this time, as well as seven 400 m² plots and one 100 m² plot from nearby lands in Fairfax County. Plots were sampled using the relevé method (*sensu* Peet et al. 1998). All natural community data were analyzed using a combination of cluster analysis, statistical analyses, and ordination by the Virginia Department of Conservation and Recreation,

Division of Natural Heritage (DCR-DNH) as part of the United States National Vegetation Classification (USNVC)- National Park Service, National Capital Region (NCR) project.

Inventorizing and monitoring all of Alexandria’s natural area sites and features is an ongoing, continual process that allows us to assess the overall health and condition of natural resources, any threats to natural features, and the effectiveness of our stewardship program. Additional inventories should include mammal, avian, insect, amphibian, and other similar groups that would assist in understanding the historic and current populations.

Non-Native Invasive Species Control

Non-native invasive species have increasingly become a major threat to natural areas, parks, forests, and wetlands by displacing native species and wildlife and significantly degrading habitats. Today, they are considered perhaps the greatest threat to natural areas and global biodiversity, second only to habitat loss resulting from development and urbanization (Vitousek et al. 1996).

Human health impacts directly or indirectly associated with non-native invasive species, such as higher infestations of Lyme disease-bearing ticks in areas with high concentrations of certain invasive plants, have also sharply increased (Allan et al. 2010, MBHWG 2014).

The Virginia Department of Conservation and Recreation, Division of Natural Heritage, has identified 90 non-native invasive plants that threaten natural areas and lands in Virginia (Heffernan et al. 2014). Swearingen et al. (2010) includes 80 plants from a list of nearly 280 non-native invasive plant species documented within the mid-Atlantic region. The Maryland Department of Natural Resources, Wildlife and Heritage Service, “estimates that 40% of Maryland listed rare plant species are threatened by one or more non-native invasive plants” (MBHWG 2014). Largely overlapping with these and other regional lists are 104 species that were documented in the City of Alexandria during vegetation surveys and natural resource assessments by RPCA Natural Lands Management Section over the last two decades.

Non-native invasive species are those that are not native to a particular place or habitat, as a result of human intervention. A non-native invasive plant is here defined as one that exhibits some degree of invasiveness, whether dominant and widespread in a particular habitat or landscape—regardless of the quality or condition of the site—or much less common but long-lived and extremely persistent in places where it occurs. The presence of non-native invasive plants is largely the result of soil and habitat disturbance, though many invasive species are capable of eventually spreading from degraded areas into relatively undisturbed sites, such as interior forest.

Hundreds of exotic plants, growing in a variety of habitats, occur in Alexandria. However, only exotic plants that are especially invasive, damaging, and persistent, including species that produce a pervasive seed bank and those that prevent natural succession by native plants, are included on the Alexandria invasive plant list, which is available online.

Non-native invasive species in Alexandria are monitored by the Natural Resources Division, which also coordinates and oversees various control efforts, including collaborative projects with other City departments and staff, partner organizations, and volunteers.

RPCA, with the assistance of a specialty contractor and the participation of hundreds of volunteers annually, had consecutive landmark years in 2014 and 2015 reclaiming and restoring many tens of acres of City natural areas and parkland through the removal of non-native invasive plants. This work was officially recognized as an “environmental highlight” on both of the 2014 and 2015 Alexandria’s Top-Ten Environmental Accomplishments lists.

Ecological Restoration Plantings

To preserve existing biodiversity, it is important to differentiate between natural sites and artificial, developed or cultural landscapes, and to allow existing seed banks of native plants to grow and sites to naturally revegetate, specifically in public natural areas being conserved or restored. Adding plantings to parks (i.e., riparian buffer plantings) or planting bare ground after invasive exotic species are removed is not always recommended, even if native species are used. Rather, these areas should be monitored to evaluate if successive growing seasons required additional planting or whether the native seed bank has flourished. However, planting with appropriate early succession and common native plants is recommended at select sites that are devoid of existing native vegetation, especially at sites where soil stabilization is the recommended or required practice.

Reintroducing plants that were historically known from the City, or are rare or in serious decline, is an important ecological restoration practice by Natural Resources Division that helps maintain biological diversity throughout the City. This involves responsibly collecting seed or rescued material from local natural sources (primarily in Fairfax and Arlington counties), as well as obtaining “restoration grade” plant material from local provenance nurseries, and planting in appropriately matched habitats in Alexandria. Such conservation measures are also in accord with the National Seed Strategy for Rehabilitation and Restoration 2015-2020 (PCA 2015). Plant reintroduction, however, should never be considered a viable substitute for protecting or properly managing existing rare plant populations (PRTF 1999).

ESMS and SOPs

Of the four Significant Aspects in RPCA’s Environmental and Sustainability Management System (ESMS), reducing agro-chemicals and their negative effects on natural lands and waterways is the aspect that most pertains to natural resource management. To this effect, RPCA produced and issued the Standard Operating Procedure (SOP) for pesticide use in the City of Alexandria: RPCA Standard Operating Procedures for Invasive Species Control and Herbicide Use in the City of Alexandria.

Partnerships and Volunteers

The volunteer support of citizens, organizations, and partners is essential to the conservation of Alexandria’s natural resources and biodiversity. The City is fortunate to have such a dedicated, well developed, and robust network of volunteers and conservation partners, including but not limited to, the Alexandria Beautification Commission, Alexandria Environmental Policy Commission, Arlington Regional Master Naturalists (ARMN; which includes many active members and projects in Alexandria), Friends of Dora Kelley Nature Park, Friends of Monticello Park, Friends of Timberbranch Parkway, Northern Virginia Conservation Trust (NVCT), Tree Stewards of Arlington and Alexandria, Virginia Native Plant Society, Volunteer Alexandria, Wakefield-Tarleton Civic Association, innumerable school and church groups, and City residents.



Management Plan & Recommendations

Natural Resource Management covers a diverse range of methods, research, and techniques. Its approach needs to cover a multitude of areas and environmental layers. This document seeks to outline the management goals for the City’s natural resources.

Acquiring additional open space parcels and easements alone are not enough to achieve conservation goals and preserve Alexandria’s biodiversity and natural resources, largely because remaining potential natural area sites are few and together do not proportionately represent significant levels of biodiversity. Moreover, acquisition of land does not inclusively address resource management.

To address these needs, these recommendations are divided into the following four major categories:

Management

This focus area of Natural Resource Management sets the foundation for the work to be accomplished in a broad sense. Overarching principals, recommendations, policies and projects that assist the focus and direction of other areas are listed here.

- 1) Science Based Management - Require adherence to science-based, adaptive management methods in all natural resource management activities, to include the guidelines and principles of ecological restoration in all planting activities located in City owned natural areas, following the Landscape Guidelines with a higher preference to native plant stock.
- 2) Best Management Practices – Industry BMPs should be utilized regarding natural resource management. These are continually researched and updated by Natural Resource Division and shared with staff, City departments, conservation partners, and residents concerned with natural resource management and conservation. One such example of a BMP is to promote the use of models based on nearby, similar ecosystems when developing restoration planting palettes, and the use of locally appropriate, native plants in City landscape design and planting projects, as well as tree plantings and tree sales.
- 3) Natural Site Management Plans – Develop site specific management plans for natural areas, whether the site is fully a natural area, or there is a natural area within an active park. The application of assessed conservation rankings should be an element considered during the plan developments.
- 4) Proactive Management – The intent is to move from a reactive management approach where there are large infestations of invasive material, to a proactive, sustainable management approach that conducts follow-up treatments and reduces the need to address large-scale projects in the long-term.
- 5) Conduct inventories – The City has conducted geology and flora inventories, but there are additional needs to ensure that management plans are developed which include all data possible. This plan recommends that future inventories in the areas of avian, mammal, insect, amphibian, and other population types to be conducted in the next five (5) to ten (10) years to enhance the data that can be

used in plan development.

- 6) Site Mapping – This goal is to more accurately map natural areas as a whole or within existing parks, and place this data in GIS. This data should be aligned and verified with other RPCA data sets.
- 7) Policy Recommendations – To support the work of protecting and restoring natural resources, this plan promotes the research and implementation of policies at various levels supporting the mission of RPCA and the Natural Resources Division. It should be noted that these policies only cover those lands under the current jurisdiction of RPCA as stated in the Introduction. Policy development and recommendations will be on-going, but at this time would include the following:
 - a) Adopt the overarching policy goal of No Net Loss of City-owned natural lands and parkland. “Natural lands” do not necessarily infer pristine sites, but encompass all remaining natural and semi-natural sites, forested areas, meadows, and waterways, including sand and gravel depositional bars, freshwater tidal communities, and wetlands (see Native Vascular Flora of the City of Alexandria, Virginia).
 - b) Adopt the action and policy goal of Do No Harm as the overarching principle governing all aspects of natural resource management and land use in City-owned natural areas. The precept Do No Harm is a safeguard reminder to those working with living systems to not cause damage or harm by their actions, directly or indirectly, and to always consider unintended effects that might occur when altering, managing, or enhancing natural areas.
 - c) Recommend that all park improvement, planting, and other plans involving City parks with natural areas be reviewed by the Natural Resources Division.
 - d) Expand the footprint of remaining natural areas and/or create buffers around remaining natural areas.
 - e) Adopt the policy that natural land forms and geologic features be preserved as much as feasible during planning and development projects.
 - f) Specify that the updated and revised Non-Native Invasive Plants of the City of Alexandria, Virginia serve as the official invasive plant list for the City of Alexandria.
 - g) Revise City Code, Section 6-2-5, “Permitted Trees, etc.” to exclude all non-native invasive species listed in the “Major Trees” and “Minor Trees” sections.
 - h) Specify that species found to be invasive in Alexandria that are included on the City’s invasive plant list not be planted in City-owned parks and lands.
 - i) Expand the provisions authorizing the removal of vegetation on public lands under City Code, Section 6-2-8, to include non-native invasive species.
 - j) Promote the importance of natural resource management and the non-native invasive species control program, and continue the funding of these efforts through RPCA.
 - k) Engage Transportation and Environmental Services (T&ES) and other City departments during all phases of development and restoration in all stream restoration and outfall improvement projects, to ensure that natural resource management practices and BMPs are included in the project.

Conservation

Conservation seeks to manage and protect existing natural areas using ecologically sound practices.

1. Expand Natural Resources– Explore opportunities and strategies for land acquisition and conservation easements, in collaboration with the Open Space Plan Update direction and conservation partners, giving ecologically significant lands and those surrounding natural areas the highest priority. Public participation in this process is welcomed and encouraged.
2. Protect Natural Lands - Protect natural resources and sites, and provide an additional, higher level of scrutiny for all activities and projects adjoining natural lands. Specify that all proposed activities for such areas conform to the standards and principles of ecological restoration and Best Management Practices. Maintain established managed meadows as open, native grass-dominated

habitats. Managed meadows are unique habitats and important refugia in Alexandria for native grasses, wildflowers, and other species not found elsewhere in the City. Moreover, they are important features for ground water infiltration and recharge, as well as maintaining water quality and protecting waterways. Natural lands should be designated with interpretive signage.

3. Actively Manage Natural Sites - This is in alignment with the Environmental Action Plan’s (EAP) goal of increasing the amount of actively managed sites by 2023 in the short term. This should cover all natural area designations, and management plans should be created for each site.
4. Invasive Management Control – There should be a strategy developed to control invasive species that have compromised a specific site. This development should be proactive and sustainable, in alignment with the Management section.

Restoration

Restoration becomes necessary when sites have been modified through development or environmental factors, and the decision has been made to restore them back to a natural site.

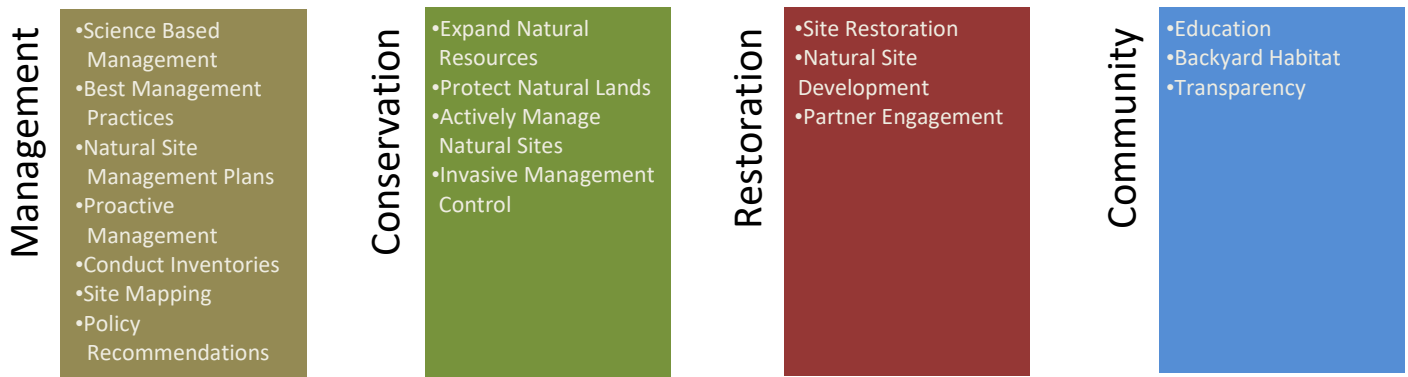
1. Site Restoration – Restorations can cover areas such as habitat, waterways, meadows, forests, as well as other ecotypes.
2. Natural Site Development – In some locations, it will be desired to convert an existing site use to a naturalized site. In these instances, there needs to be a site specific conversion and management plan developed, and approved by internal and external stakeholders prior to implementation.
3. Partner Engagement – During planned or potential restoration projects, whether initiated by RPCA or others, be involved in cross-departmental efforts to support BMPs and current industry restorative practices in the project.

Community

The community and its citizens should have the opportunities to learn about, and become engaged with, nature.

1. Education – Provide opportunities for the public to engage in environmental and natural resource based education, including interpretive signage and markers; embrace and pursue opportunities for citizen education and participation in all facets of natural resource conservation and stewardship.
2. Backyard Habitat – Develop a citizen program that provide resources and demonstration sites, as well as resources, for private property owners to have certified habitat on their land. This encourages engagement by the public in natural resources.
3. Transparency – Provide more information on the website, develop better metrics, and indicate timelines for project completion to better communicate goals and expectations.

In summary:



Implementation

Upon adoption of the Natural Resource Management Plan (NMRP), the Natural Resources Division of RPCA will develop plans outlined in this document, prioritizing strategies and developing timelines and fiscal implications for budget planning. Staff and partners will be engaged to assist in completing the objectives outlined here, and the plans will be shared with the public as part of transparency and public engagement.



White Oak acorns, or mast, growing on a newly planted tree in fall 2018, at Ben Brenman Park. Photo by R.D. Williams.

Appendix 1: Natural Communities and Habitats

The 25 natural community types in Alexandria can be broadly divided into four groups: 1) tidal freshwater communities; 2) alluvial communities; 3) non-alluvial wetlands; and 4) upland forest communities. Semi-natural habitats mainly include disturbed sites, such as open areas and fields, successional forest, railroad tracks, abandoned sand and gravel mines, and impoundment wetlands. Conservation rankings follow each community description.

1) Freshwater Tidal Wetlands (Estuarine System)

Freshwater Tidal Wetlands comprise a number of diverse, regularly or irregularly flooded, lunar tidal communities. Today, most freshwater tidal wetlands are now globally uncommon to rare as a result of restricted global range, sea level rise, non-native invasive plants, habitat loss, and other factors (Fleming et al. 2013).

Common Spatterdock Mudflat Type: *Nuphar advena* Tidal Herbaceous Vegetation (USNVC: C EGL004472). Alexandria's last surviving examples of this community type occur at the mouth of Hunting Creek south and west of Jones Point Park to the Fairfax County shoreline. Global/State/Alexandria Ranks: G4G5/S3/A1.

High-Energy Tidal River Shore (Common Threesquare / Northern Type): *Schoenoplectus pungens* Tidal Herbaceous Vegetation (USNVC: C EGL004188). Examples in Alexandria mainly occur along the Potomac River at Canal Center Plaza Park, Oronoco Bay Park, and Jones Point Park, with smaller occurrences along lower Four Mile Run and Hunting Creek. Global/State/Alexandria Ranks: GNR/S1?/A1.

High-Energy Tidal River Shore (Water-Willow Type): *Justicia americana* Tidal Herbaceous Vegetation (USNVC: C EGL006579). Good examples in Alexandria occur along the Potomac River at Oronoco Bay Park and Jones Point Park. Global/State/Alexandria Ranks: GNR/SU/A1.

Tidal Freshwater / Oligohaline Aquatic Bed (Tapegrass Type): *Vallisneria americana* - *Myriophyllum spicatum* Semipermanently Flooded - Tidal Herbaceous Vegetation [Provisional] (USNVC: C EGL006048 (in part)). This community type occurs in shallow water along the Potomac River from Daingerfield Island to the mouth of Hunting Creek. Global/State/Alexandria Ranks: GNR/SU/A1.

Tidal Freshwater Marsh (Mixed High Marsh Type): *Impatiens capensis* - *Persicaria arifolia* - *Peltandra virginica* - (*Typha angustifolia*) Tidal Herbaceous Vegetation (USNVC: C EGL006325). Large expanses of freshwater tidal marsh once covered the mouth of Hunting Creek and tidal Cameron Run; inlets along the Potomac River such as Oronoco Bay; areas along the GWMP at Daingerfield Island; and the tidal section of Four Mile Run. The largest remaining stands occur at the mouth of Hunting Creek near Jones Point Park, despite major recent losses and degradation resulting from the Woodrow Wilson Bridge expansion and widening of the Capital Beltway. Very old remnant marshes occur at Four Mile Run Park and Daingerfield Island along the GWMP, with the several-acre marsh at Four Mile Run Park being the best example. Remnant tidal marshes are somewhat isolated from direct tidal flooding as a result of altered land use in the early 20th century, but remain largely intact owing to the deep, permanently saturated, mucky soils that have existed in these places for millennia. Global/State/Alexandria Ranks: GNR/S4?/A1.

Freshwater Tidal Shrub Swamp: *Alnus serrulata* - *Salix nigra* / *Pilea (fontana, pumila)* Tidal Shrubland (USNVC: C EGL006843). Examples today occur at the mouth of Hunting Creek, Jones Point Park, and

Oronoco Bay Park. Global/State/Alexandria Ranks: GNR/SU/A1.

Freshwater Tidal Hardwood Swamp: *Fraxinus profunda* - *Nyssa biflora* - (*Fraxinus pennsylvanica*) / *Ilex verticillata* / *Persicaria arifolia* Tidal Forest (USNVC: CEGLO06287). Remaining examples in Alexandria occur at the mouth of Hunting Creek at Jones Point Park, Daingerfield Island, GWMP, and Four Mile Run Park. Global/State/Alexandria Ranks: G3/S3/A1.

Successional Black Willow Shrub Swamp. Examples of this important wildlife habitat in Alexandria occur along the boardwalk at Daingerfield Island, Four Mile Run Park, Jones Point Park, and along the tidal reaches of Hoof's Run at African American Heritage Park. GNR/SNR/A1.

2) Alluvial Floodplain Communities (Palustrine System)

Coastal Plain / Piedmont Floodplain Swamp (Green Ash - Red Maple Type): *Acer rubrum* – *Fraxinus pennsylvanica* / *Saururus cernuus* Forest (USNVC: CEGLO06606). This community type was undoubtedly more widespread along the Potomac River and large streams in Alexandria in the past. Today, examples remain at Four Mile Run Park, Daingerfield Island, old Cameron Run channel floodplain forest, and Clermont Swamp Forest. Global/State/Alexandria Ranks: G3G4/S3S4/A1.

Northern Coastal Plain / Inner Piedmont Mixed Oak Floodplain Swamp: *Quercus (phellos, palustris, michauxii)* - *Liquidambar styraciflua* / *Cinna arundinacea* Forest (USNVC: CEGLO06605). Today, the most extensive examples of this type in Alexandria occur at Clermont Swamp Forest along seepage braids of the Bush Hill tributary of Backlick Run south of the stream and the railroad tracks, with smaller stands along the old Cameron Run channel floodplain forest. Tarleton Park and eastern parts of Ben Brenman Park (formerly Cameron Station) at the convergence of Backlick Run and Holmes Run represent an ancient mosaic of backswamps and braided microchannels of this type with hydrology now cut off resulting from the re-configured Holmes Run stream channel. Massive, old-age bottomland oaks along Ashby Street, E. Glebe Road, and interior parts of Auburn Village, as well as Manning Street, are also relics of a vast, ancient backswamp community that once occupied parts of lower Four Mile Run. Global/State/Alexandria Ranks: G3G4/S3?/A1.

Southern Piedmont / Inner Coastal Plain Floodplain Terrace Forest: *Liquidambar styraciflua* - *Quercus (michauxii, shumardii)* - *Carya cordiformis* / *Ilex decidua* / *Carex amphibola* Forest (USNVC: CEGLO07006). The site encompasses a several-acre expanse of rich, alluvial floodplain forest along an ancient oxbow channel of Cameron Run at Cameron Run Regional Park and behind the Vola Lawson Animal Shelter (small sections of rich floodplain forest and flora also occur directly to the northeast at the old Cameron Run channel floodplain forest. This tract, which has come to be known as “Ward’s Woods” by some, is the sole remaining example in the City of this type and probably represents a northern extension of a community that was once likely more widespread throughout the lower Cameron Run watershed. Global/State/Alexandria Ranks: G3G4/S3/A1.

Piedmont / Central Appalachian Silver Maple Forest: *Acer saccharinum* - *Acer negundo* / *Ageratina altissima* - *Laportea canadensis* - (*Elymus virginicus*, *Elymus macgregoryi*) Forest (USNVC: CEGLO06217). Most remaining sites of this type in Alexandria are highly degraded and weedy, with the best remaining examples occurring at Jones Point Park. Global/State/Alexandria Ranks: G4/S4/A1.

Piedmont / Central Appalachian River Birch - Sycamore Forest: *Betula nigra* - *Platanus occidentalis* Forest (USNVC: CEGLO02086). This type comprises the dominant vegetation along Holmes Run from the eastern end of the Holmes Run Gorge at Shirley Highway to the confluence with Backlick Run, as well as along Backlick Run.

Coastal Plain / Piedmont Small-Stream Floodplain Forest: *Liquidambar styraciflua* - *Liriodendron tulipifera* / *Lindera benzoin* / *Arisaema triphyllum* Forest (USNVC: C EGL004418). Small examples of this community occur in Alexandria at Rynex Natural Area, Chinquapin Park, First Baptist Church property on the south side of Taylor Run, and along Timber Branch. Global/State/Alexandria Ranks: G4/S4/A1.

Piedmont / Central Appalachian Sand Bar / River Shore (Low Herbs Type): *Eragrostis hypnoides* - *Lindernia dubia* - *Ludwigia palustris* - *Cyperus squarrosus* Herbaceous Vegetation (USNVC: C EGL006483). The best examples of this community in Alexandria occur along Holmes Run from N. Van Dorn Street to Duke Street and Cameron Run between Ben Brenman Park and the Capital Beltway (495) crossing. Global/State/Alexandria Ranks: G3/S3/A1.

Piedmont / Central Appalachian Sand Bar / River Shore (Tall Herbs Type): *Eupatorium serotinum* - *Persicaria (lapathifolia, punctata, pennsylvanica)* Herbaceous Vegetation (USNVC: C EGL006481). Good examples in Alexandria are found along Holmes Run from N. Van Dorn Street to Duke Street and Cameron Run between Ben Brenman Park and the Capital Beltway (495) crossing, with weedier examples along lower Four Mile Run. Global/State/Alexandria Ranks: GNR/S2S3/A1.

3) Non-Alluvial Wetlands (Palustrine System)

Woodland Seeps. Woodland seeps are found in a number of places throughout Alexandria, with the best remaining examples at Rynex Natural Area, Dora Kelley Nature Park, and the Winkler Botanical Preserve. Global/State/Alexandria Ranks: GNR/SNR/A1.

Northern Coastal Plain Terrace Gravel Bog: *Nyssa sylvatica* - *Magnolia virginiana* - (*Pinus rigida*) / *Rhododendron viscosum* - *Toxicodendron vernix* / *Smilax pseudochina* Woodland (USNVC: C EGL006219). The privately owned Beatley Bog complex remains Alexandria's sole surviving Magnolia Bog. Global/State/Alexandria Ranks: G1/S1/A1.

Coastal Plain / Outer Piedmont Acidic Seepage Swamp: *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* / *Viburnum nudum* / *Osmundastrum cinnamomeum* - *Woodwardia areolata* Forest (USNVC: C EGL006238). Alexandria's largest and best remaining example of this community occurs along the toe slope of the Chinquapin Village terrace on the south side of Taylor Run at Chinquapin Park ("Chinquapin Hollow" of L.F. Ward). Smaller examples occur to the west at 1201 Key Drive (private residence) and along lower Winkler Run. Global/State/Alexandria Ranks: G3/S3/A1.

Coastal Plain Depression Swamp (Willow Oak - Red Maple - Sweetgum Type): *Quercus phellos* - *Acer rubrum* - *Liquidambar styraciflua* / *Vaccinium (formosum, fuscatum)* Forest (USNVC: C EGL00610). This community was once prevalent in Alexandria on poorly drained sections of the Seminary, Dowden, and Chinquapin Village terraces. Today, one undeveloped site remains on the privately owned vacant lot at 2707 N. Rosser Street and a contiguous section in the back yard of the residence at 2709 N. Rosser Street. Global/State/Alexandria Ranks: G3/S2/A1.

4) Low-Elevation Mesic Forests (Terrestrial System)

Coastal Plain / Outer Piedmont Basic Mesic Forest: *Fagus grandifolia* - *Liriodendron tulipifera* - *Carya cordiformis* / *Lindera benzoin* / *Podophyllum peltatum* Forest (USNVC: C EGL006055). The rich alluvial levee along Holmes Run at the western end of Dora Kelley Nature Park; sections of rich floodplain and cove slopes of the Holmes Run Gorge at Dora Kelley Nature Park; and the Holmes Run Scenic Easement are all good examples of Basic Mesic Forest in Alexandria. Global/State/Alexandria Ranks: G4/S3/A1.

Northern Coastal Plain / Piedmont Mesic Mixed Hardwood Forest: *Fagus grandifolia* - *Quercus* (*alba*, *rubra*) - *Liriodendron tulipifera* / (*Ilex opaca*) / *Polystichum acrostichoides* Forest (USNVC: C EGL006075). Good examples of Mesic Mixed Hardwood Forest occur in Alexandria at Dora Kelley Nature Park, Monticello Park, and St. Stephen's and St. Agnes School: Lower School Campus. Global/State/Alexandria Ranks: G5/S5/A3.

Low-Elevation Dry and Dry-Mesic Forests and Woodlands (Terrestrial System)

Piedmont Acidic Oak-Hickory Forest: *Quercus alba* - *Quercus rubra* - *Carya tomentosa* / *Cornus florida* / *Vaccinium stamineum* / *Hylodesmum nudiflorum* Forest (USNVC: C EGL008475). The south- and west-facing slopes of the Winkler Botanical Preserve and northwest-facing slopes at Parkfairfax Woods comprise the best remaining examples in Alexandria of Acidic Oak-Hickory Forest. Weedy but important stands also occur at Yoakum Parkway Woods, Stevenson Park, Dora Kelley Nature Park, NOVA Alexandria Campus along N. Beauregard Street, INOVA Alexandria Hospital Scenic Easement, and St. Andrew's United Methodist Church. Global/State/Alexandria Ranks: G4G5/S4S5/A1.

Piedmont / Central Appalachian Mixed Oak / Heath Forest: *Quercus alba* - *Quercus* (*coccinea*, *velutina*, *montana*) / *Gaylussacia baccata* Forest (USNVC: C EGL008521). As little as two decades ago, Alexandria hosted some of the largest and finest expanses of this community in northeastern Virginia on Mark Winkler Company lands at Mark Center and the heavily forested Stone Tract along W. Braddock Road. Unfortunately, all of these sites were developed since that time. Smaller, good examples in Alexandria are found today at Dora Kelley Nature Park, Winkler Botanical Preserve, NOVA Alexandria Campus behind the Bisdorf Building, Polk Avenue Park, Seminary Forest, Patrick Henry Park, INOVA Alexandria Hospital Scenic Easement, Episcopal High School woods along N. Quaker Lane, Robert Leider Park, and Forest Park. Global/State/Alexandria Ranks: G5/S5/A2.

Central Appalachian / Inner Piedmont Chestnut Oak Forest: *Quercus montana* - (*Quercus coccinea*, *Quercus rubra*) / *Kalmia latifolia* / *Vaccinium pallidum* Forest (USNVC: C EGL006299). The large, north-facing slope at the Winkler Botanical Preserve and the similar-aspect site at Monticello Park are the best remaining examples of the evergreen Oak-Heath Forest type in Alexandria. Other good examples are found at Stevenson Park, Rynex Natural Area, Dora Kelley Nature Park, Polk Avenue Park, private residence at 4875 Maury Lane above the Beatley Bog, Seminary Forest, and Parkfairfax Woods along Gunston Road. Global/State/Alexandria Ranks: G5/S5/A2.

Semi-Natural Habitats

Good examples of the following habitats are rare in Alexandria. However, they are not ranked, despite containing rare species, because they are semi-natural environments.

1) Impoundment Wetlands

Impoundment wetlands are man-made structures that impound streams, ground water flow, or rainwater, such as ponds, ditches and swales, and reservoirs. Clean water sites are very important for wildlife, especially species of amphibians and odonates (dragonflies and damselflies).

The large, shallowly ponded impoundment wetland at Dora Kelley Nature Park, formed by impeding the flow of two groundwater seepages and diverting some of the flow from the Chambliss tributary into the wetlands; spring-fed pond at the center of the Beatley Bog complex; wet ditch in the footprint of the old Dominion Mill Race along Wheeler Avenue; shallow impounded water at the floor of the abandoned Alexandria Reservoir; old tidal channel along the west side of the GWMP adjoining Potomac Greens Park; and wet ditches along the edge of the historic Tidal Freshwater Marsh community at Daingerfield

Island are all valuable habitats.

2) Open Areas, Meadows, and Hedgerows

These sites comprise woods edges and semi-open groves; open, grassy areas; old fields; hedgerows; cemeteries; abandoned sand and gravel pits; road edges and banks; railroad tracks; and managed meadows.

3) Successional Forest

Successional forest in our region is a transitional vegetation type of past-cleared upland forest that is comprised of mature, tall stands of Virginia Pine (*Pinus virginiana*) intermixed with a diversity of maturing hardwoods and other flora. Such areas are important for wildlife and are refugia for light-demanding Virginia Pine and other conifers. Stands at Forest Park, Fort Ward Park, and the Winkler Botanical Preserve are the best remaining examples of successional forest in Alexandria.

4) Old Town Masonry

The exterior stone and brick walls of the historic Wilkes Street Tunnel (old Orange & Alexandria Railroad, c. 1851) between S. Royal and S. Fairfax streets in Old Town, as well as the brick masonry seawall along the north side of the Windmill Hill Park cove, are the only known stations in Alexandria for Purple Cliff-brake (*Pellaea atropurpurea*) — a fern that primarily grows on exposed rock. Rock Pellitory (*Parietaria pensylvanica*) frequently grows on brick and stone walls of Old Town; Trailing Pearlwort (*Sagina decumbens* ssp. *decumbens*) is common in cracks of brick sidewalks and cobblestone streets throughout Old Town. The masonry of the Hooff's Run Bridge of the old Orange & Alexandria Railroad supports the only known station in the City for Blunt-lobed Woodsia (*Woodsia obtusa* ssp. *obtusa*).

Appendix 2: Key to Rankings

Key to City Rank (unofficial designation based on occurrences within the City of Alexandria):

A1: At very high risk of extirpation from Alexandria owing to extreme rarity (5 or fewer populations), very steep declines, or other factors.

A2: Very rare and imperiled with 6 to 20 occurrences, steep declines, or other factors making it vulnerable to extirpation in Alexandria.

A3: Uncommon to rare in Alexandria with between 20 and 40 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Alexandria.

A4: Uncommon but not rare in Alexandria; some cause for long-term concern due to declines or other factors.

A5: Common, widespread, and abundant in Alexandria.

AH: Formerly part of the Alexandria biota with expectation that it may be rediscovered. AX: Believed extirpated from Alexandria with virtually no likelihood of rediscovery.

AU: Alexandria status unknown.

A_?: Denotes inexact numeric rank (e.g., A3?).

Key to State Rank (Townsend 2015):

S1: At very high risk of extirpation from the state due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

S2: At high risk of extirpation from the state due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

S3: At moderate risk of extirpation from the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

S4: Uncommon but not rare; some cause for long-term concern due to declines or other factors. S5: Common, widespread, and abundant.

SH: Known only from historical occurrences but still some hope of rediscovery.

SX: Not located despite intensive searches and virtually no likelihood of rediscovery.

SU: Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

S_?: Denotes inexact numeric rank (e.g., S3?).

Key to Global Rank (NatureServe 2015, Townsend 2015):

G1: At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2: At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3: At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G4: Uncommon but not rare; some cause for long-term concern due to declines or other factors. G5: Common, widespread, and abundant.

GH: Known only from historical occurrences but still some hope of rediscovery.

GX: Not located despite intensive searches and virtually no likelihood of rediscovery.

GU: Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

G_?: Denotes inexact numeric rank (e.g., G3?).

G_Q: Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this

uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower conservation priority (e.g., G3Q).

G_T_: Signifies the rank of a subspecies or variety. GNR: Global rank not yet assessed.

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Appendix 3: Plates of Natural Areas

The following are plates of natural areas as identified within the City. As part of the management plan, all data will be verified and combined with other RPCA datasets.

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Remaining Natural Area Sites in the City of Alexandria

Ownership Type

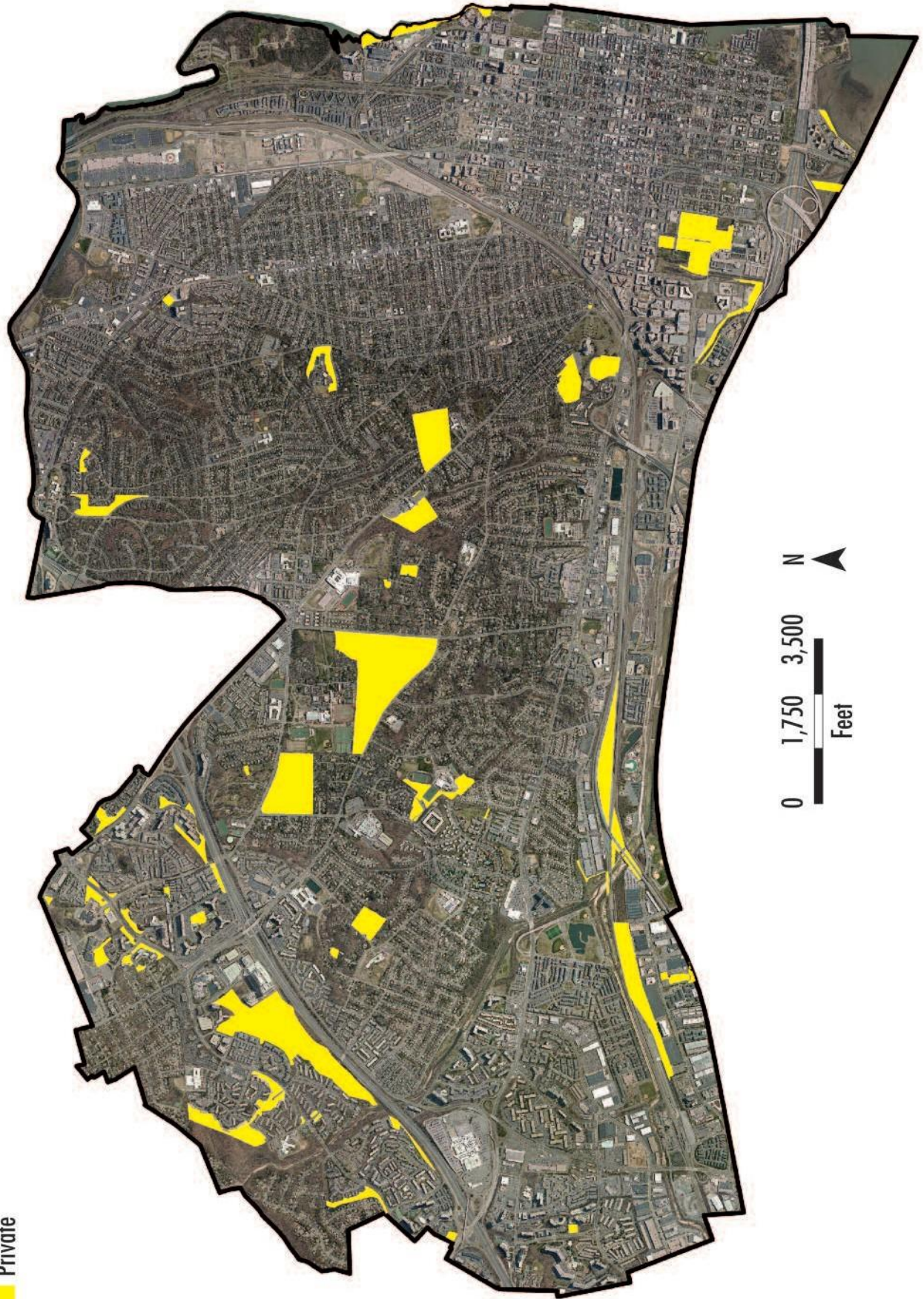
- City of Alexandria
- Commonwealth of Virginia
- Private
- Easement
- DOD
- NPS



Privately Owned Natural Area Sites in the City of Alexandria

Ownership Type

Private



Federally Owned Natural Area Sites in the City of Alexandria

Ownership Type

- DOD
- NPS



City-Owned Natural Area Sites and Conservation Easements

Ownership Type

- City of Alexandria
- Easement



City-Owned Natural Area Sites and Easements

1	AAHP	African American Heritage Park: 5.729 acres of tidal Hooft's Run; Successional Black Willow Shrub Swamp; and passive use park.	11	CR	Cameron Run Regional Park: 6.975 acres of Southern Piedmont/Inner Coastal Plain Floodplain Terrace Forest and remnant bottomland forest groves intermixed with passive and active recreational facilities.	19	GHP	Goat Hill Park: 2.274 acres of Piedmont Acidic Oak-Hickory Forest remnant and passive use park.
2	ABP	Armistead Boothe Park: 3.223 acres of remnant bottomland forest groves intermixed with passive and active recreational facilities.	12	DK	Dora Kelley Nature Park: 41.919 acres of Central Appalachian/Inner Piedmont Chestnut Oak Forest; Piedmont/Central Appalachian Mixed Oak/Heath Forest; Piedmont Acidic Oak-Hickory Forest; Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest; Coastal Plain/Outer Piedmont Basic Mesic Forest; Woodland Seeps; Impoundment Wetland; and passive use park.	20	GM	George Mason Park: 2.5 acres of remnant groves of Piedmont Acidic Oak-Hickory Forest.
3	AP	Angel Park: 10.318 acres of Taylor Run; Open Areas; Successional Forest; and passive and active recreational facilities.	13	EP	S. Early Street Park: 0.425 acres of Strawberry Run; Piedmont Acidic Oak-Hickory Forest remnant; and passive use park.	21	HC	21) Tidal wetlands at mouth of Hunting Creek (HC): 111.086 acres of Potomac River shoreline; Common Spatterdock Mudflat Type; High-Energy Tidal River Shore (Common Threesquare/Northern Type); Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type); Tidal Freshwater Marsh (Mixed High Marsh Type); and Freshwater Tidal Shrub Swamp.
4	BBP	Ben Brenman Park: 8.25 acres of the last remaining, mostly natural stretch of Backlick Run in Alexandria, including exposed outcrops of lithified Cameron Valley sand; confluence with Holmes Run.	14	FMR	Four Mile Run Park: 18.281 acres of remnant Tidal Freshwater Marsh (Mixed High Marsh Type); Freshwater Tidal Hardwood Swamp; Coastal Plain/Piedmont Floodplain Swamp; and remnant bottomland forest groves intermixed with passive and active recreational facilities.	22	HRP	Holmes Run Park: 57.427 acres of Holmes Run from the east side of Shirley Highway (395) to the confluence with Backlick Run (H); Piedmont/Central Appalachian Sand Bar/River Shore (Low Herbs Type); Piedmont/Central Appalachian Sand Bar/River Shore (Tall Herbs Type); Piedmont/Central Appalachian River Birch - Sycamore Forest; Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest; old Holmes Run channel; and the Beatley Library Meadow.
5	BHCE	Battery Heights Conservation Easement: 2.779 acres of Strawberry Run and Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest.	15	FP	Forest Park: 20.405 acres of West Branch Taylor Run; Piedmont/Central Appalachian Mixed Oak/Heath Forest; Successional Forest; and passive use park.	23	HRS	Holmes Run Scenic Easement: 9.35 acres of Holmes Run between N. Beauregard Street and Shirley Highway (395) and Coastal Plain/Outer Piedmont Basic Mesic Forest.
6	BP	Beverly Park: 1.895 acres of remnant trees; cove-like Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest; and passive use park.	16	FS	Founders Park: 4.222 acres of Potomac River shoreline and Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type).	24	HS	Hammond School: 7.172 acres of Successional Forest and the Hammond School Meadow.
7	C	Cameron Run: 29.983 acres of the modern Cameron Run channel from the confluence of Holmes Run and Backlick Run to Hooft's Run; Piedmont/Central Appalachian Sand Bar/River Shore (Low Herbs Type); and Piedmont/Central Appalachian Sand Bar/River Shore (Tall Herbs Type).	17	FW	Fort Ward Park: 39.917 acres of Piedmont/Central Appalachian Mixed Oak/Heath Forest; Piedmont Acidic Oak-Hickory Forest remnant; Successional Forest; Open Areas and Meadow; and remnant forest groves intermixed with passive and active recreational facilities.	25	HW	Hospital Woods West: 6.00 acres of old-age Central Appalachian/Inner Piedmont Chestnut Oak Forest.
8	CH	Chambliss Park: 2.186 acres of Piedmont Acidic Oak-Hickory Forest and woodland seeps.	18	FWP	Fort Williams Park: 7.981 acres of Strawberry Run; Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest; and passive use park.	26	HWE	Hospital Woods East: 2.276 acres of Successional Forest.
9	CNP	Clermont Natural Park: 5.333 acres of Northern Coastal Plain/Inner Piedmont Mixed Oak Floodplain Swamp.				27	HWS	Hospital Woods South: 4.00 acres of Piedmont Acidic Oak-Hickory Forest.
10	CP	Chinquapin Park: 4.94 acres of Coastal Plain/Piedmont Small-Stream Floodplain Forest and Coastal Plain/Outer Piedmont Acidic Seepage Swamp along Taylor Run.						

City-Owned Natural Area Sites and Easements

28	JHP	Joseph Hensley Park: 2.014 acres of Successional Forest.	40	R	Rynex Natural Area: 9.247 acres of Rynex Run; Central Appalachian/Inner Piedmont Chestnut Oak Forest; Piedmont Acidic Oak-Hickory Forest; Coastal Plain/ Piedmont Small-Stream Floodplain Forest; and Woodland Seeps.	50	TLP	Tide Lock Park: 1.043 acres of acres of Potomac River shoreline and Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type).
29	JL	801 Janney's Lane: 0.214 acres of Successional Forest.						
30	JMP	James Mulligan Park: 3.065 acres of Successional Forest.	41	RG	Rivergate Park: 0.079 acres of Potomac River shoreline and Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type).	51	TP	Tarleton Park: 3.641 acres of remnant groves of Northern Coastal Plain/Inner Piedmont Mixed Oak Floodplain Swamp; Open Areas; and passive use park.
31	KC	Kust Conservation Easement: 1.263 acres of old-age Central Appalachian/Inner Piedmont Chestnut Oak Forest.	42	RLP	Robert Leiter Park: 1.304 acres of Piedmont/Central Appalachian Mixed Oak/Heath Forest and passive use park.	52	TR	Taylor Run Park: 3.475 acres of Taylor Run; Open Areas; and Successional Forest.
32	KSP	King Street Park: 0.020 acres of Potomac River shoreline and Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type).	43	SF	Seminary Forest: 4.761 acres of Central Appalachian/Inner Piedmont Chestnut Oak Forest; Piedmont/Central Appalachian Mixed Oak/Heath Forest; and Piedmont Acidic Oak-Hickory Forest.	53	TRR	10 Russell Road: 0.291 acres of woodland grove.
33	M	Monticello Park: 6.381 acres of the headwaters of the Hume Spring tributary; old-age Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest; old-age Central Appalachian/Inner Piedmont Chestnut Oak Forest; and Woodland Seep.	44	SP	Stevenson Park: 4.837 acres of Central Appalachian/Inner Piedmont Chestnut Oak Forest; Piedmont/Central Appalachian Mixed Oak/Heath Forest; Piedmont Acidic Oak-Hickory Forest; and passive and active recreational facilities.	54	UP	Upland Park: 0.228 acres of Open Area and Meadow.
34	OB	Oronoco Bay Park: 9.13 acres of Potomac River shoreline; Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type); and Tidal Freshwater Marsh (Mixed High Marsh Type).				55	WH	Windmill Hill Park (includes Shipyard Park shoreline): 6.056 acres of Potomac River shoreline and Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type).
35	OCCR	Old Channel of Cameron Run: 6.791 acres of the old channel of Cameron Run; confluence with the tidal mouth of Hooff's Run; and remnant freshwater tidal vegetation.	45	SXS	S. Reynolds Street Woods: 0.984 acres of Piedmont Acidic Oak-Hickory Forest remnant.	56	WSCC	Wilkes Street Cemetery Complex (includes Douglass Cemetery and Penny Hill Cemetery): 3.664 acres of Open Areas and old-age trees.
36	PA	Polk Avenue Park: 2.352 acres of Piedmont/Central Appalachian Mixed Oak/Heath Forest; Successional Forest; and passive use park.	46	SSE	Stonegate Scenic Easement: 3.253 acres of Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest and Woodland Seeps.	57	WST	Wilkes Street Tunnel: 0.116 acres of masonry of the historic Wilkes Street Tunnel (old Orange & Alexandria Railroad, c. 1851) that support the City-rare Purple Cliff-brake (<i>Pellaea atropurpurea</i>) fern.
37	PG	Potomac Greens Park: 17.4 acres of remnant tidal channel and passive use park.	47	T&D	Telegraph & Duke Meadow: 4.861 acres of Meadow and Successional Forest.	58	YP	Yookum Parkway Woods: 1.037 acres of Piedmont Acidic Oak-Hickory Forest remnant.
38	PH	Patrick Henry Park: 5.946 acres of old-age Central Appalachian/Inner Piedmont Chestnut Oak Forest; Successional Forest; and Open Areas and Meadow.	48	TAP	Taney Avenue Park: 2.567 acres of Open Area; Successional Forest; and passive use park.			
39	PL	Point Lumley Park: 0.071 acres of Potomac River shoreline and Tidal Freshwater/Oligohaline Aquatic Bed (Tapegrass Type).	49	TBP	Timberbranch Parkway: 6.19 acres of Timber Branch and Coastal Plain/Piedmont Small-Stream Floodplain Forest.			

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