

Chapter 3



Bill Wallen

Northern flicker

Existing Environment

- Introduction
- Regional Setting
- Socioeconomic Setting
- Special Regional Conservation Areas and Activities
- Potomac River Refuge Complex Administration
- Mason Neck Refuge Environment
- Featherstone Refuge Environment

Introduction

This chapter describes the physical, biological, and social environments of Mason Neck and Featherstone Refuges. The environment of the third refuge in the Potomac River Refuge Complex—Occoquan Bay Refuge—is described in a separate CCP for that refuge (USFWS, 1997). Specifically included in this chapter are descriptions of the regional and refuge settings, current refuge administration, and refuge resources and programs. In particular, we describe components of the biological diversity, integrity, and environmental health of these refuges because these details are crucial in planning for their future management under the provisions of the Refuge System Administration Act (16 U.S.C. § 668dd-668ee) and other laws. Appendix F provides an informative overview of the cultural resources on both refuges.

Regional Setting

Tidal Potomac River Basin

The Potomac River begins in West Virginia and is fed by tributaries from Pennsylvania, Maryland, and Virginia. It flows over 380 miles from its headwaters, expanding to more than 11 miles wide as it flows into the Chesapeake Bay. The Potomac River Basin (see map 1.4) includes 14,670 square miles in four states including Virginia (5,723 square miles), Maryland (3,818 square miles), West Virginia (3,490 square miles), Pennsylvania (1,570 square miles), and the District of Columbia (69 square miles) (Interstate Commission on the Potomac River Basin ICPRB, 2006).

The tidal Potomac River includes that portion of the river influenced by tides and extends for 117 miles from its head-of-tide, located approximately 1/2-mile upstream of Chain Bridge in the District of Columbia, to its mouth at Point Lookout in Maryland and Smith Point in Virginia. The surface area of all tidal waters, including Potomac River embayments and tidally influenced tributary rivers, streams, and creeks, is about 434 square miles. The land area of the tidal river is 2,537 square miles, or approximately 1/6 of the entire Potomac River Basin area (Lippson et al., 1979).

Many people rely on and enjoy the abundant resources of the tidal Potomac River. It supplies almost four million area residents with clean drinking water, provides a wide variety of natural resources such as critical wildlife habitat, and supports historical and cultural resources of national significance (DWSPP, 2007). The tidal river is recognized as regionally significant habitat for many fish and birds. More than 200 species of birds, including the bald eagle, breed there. The river also provides important habitat for 70 species of fish (TPL, 2006).

Potomac River Refuge Complex Units

The Refuge Complex is located in northern Virginia, approximately 25 miles south of Washington, D.C. It is situated on a roughly 8-mile section of the Potomac River's Virginia shoreline between Pohick Bay and Neabsco Creek (see map 1.1). This portion of Virginia is in the Mid-Atlantic Coastal Plain Physiographic Area of broad rolling hills and moderate slopes (BLM, 2004).

The Climate

The climate of the Refuge Complex area is variable. The area is influenced by the Chesapeake Bay, as well as the Atlantic Ocean to the east and the Appalachian Mountains to the west. The weather in the refuge area is characterized by cold, dry, continental-polar winds from the west ("westerlies") and northwest during the winter, and warm, humid, maritime-tropical winds from the south and southwest during the spring and summer. Precipitation averages 39 inches per year, and is evenly distributed throughout the year. January, February, and April are the driest months, with less than three inches of precipitation. Snowfall averages less than 10 inches per year. The maximum recorded snowfall of

25 inches fell in February 2010. The annual mean daily temperature for the area is 57°F. The growing season, based on average first and last killing frosts, is from April 15 to October 15. The mean number of cloudy days per month ranges from 11 in June to 16 days in December and January (USFWS, 2005a).

Regional Climate Change Projections

Under our discussion of issues in chapter 2, we note that climate change is of increasing concern because of its potential effects on land, water, and biological resources. Also of major concern are effects on human health and effects to human built infrastructure. Generally, the concerns center on the impacts from warming air and water temperatures, changing patterns of precipitation, significant acceleration of sea level rise, changes in season lengths, the decreasing range of nighttime versus daytime temperatures, and increasing frequency and intensity of severe weather events (TWS, 2004).

While there is currently little information specific to Mason Neck or Featherstone Refuges, there is a building body of information about the climate change implications for the State and the Chesapeake Bay region. For our discussion below, we refer to two reports: the State of Virginia's "Climate Change Action Plan" and "Virginia's Strategy for Safeguarding Species of Greatest Conservation Need from the Effects of Climate Change." We encourage you to read the reports in their entirety for a better understanding of the current knowledge and projected impacts of climate change in the region surrounding the refuges.

Governor's Climate Change Action Plan

In 2007, Virginia's Governor Timothy M. Kaine issued Executive Order 59 (E.O. 59; 2007), establishing the "Governor's Commission on Climate Change." The Commission was comprised of a wide range of experts who were "philosophically diverse." Its panel consisted of more than 40 citizens from Virginia, including scientists, economists, environmental advocates, and representatives from the energy, transportation, building, and manufacturing sectors. The Commission also included local government representatives and State lawmakers. He charged this Commission to create a "Climate Change Action Plan" (GCCC 2008) that would do the following:

- 1) Inventory the amount of and contributors to Virginia's greenhouse gas emissions and projections through 2025. (Note: According to the report, "Most of the observed increase in globally averaged temperature since the mid-20th century is very likely due to increase in anthropogenic [green house gas] concentrations. Currently, the three largest sources of greenhouse gas emissions in Virginia are electricity generation, transportation, and non-utility uses of fuel in industrial, commercial, and residential facilities.")
- 2) Evaluate expected impacts of climate change on Virginia's natural resources, the health of its citizens, and the economy, including the industries of agriculture, forestry, tourism, and insurance.
- 3) Identify what Virginia needs to do to prepare for the likely consequences of climate change.
- 4) Identify actions that needed to achieve the goal of a 30 percent reduction in greenhouse gas emissions.
- 5) Identify climate change approaches being pursued by other states, regions, and the Federal government.

The plan explains the Commission's findings about the projected effects of climate change in Virginia on the built environment, natural systems, and human health. To read the entire plan, visit: http://www.deq.virginia.gov/export/sites/default/info/documents/climate/CCC_Final_Report-Final_12152008.pdf (accessed August 2011). For natural systems, they had the following findings:

- Sea level rise is a major concern for coastal Virginia. The Chesapeake Bay Program's Scientific and Technical Advisory Committee projects that sea levels in the Chesapeake Bay region will be 2–5 feet higher by 2100. Specific impacts will vary by location, depending on changes in land elevation.
- Climate change will have a significant impact on Virginia's ecosystems. At varying rates, vegetation ranges are moving from current locations to higher altitudes and latitudes. The effect of this will be that suitable habitat for some species will decline, other species will become extirpated, and others species will become extinct. Climate change also will exacerbate threats already faced by Virginia ecosystems, such as invasive species, pathogens, and pollution.
- The effects of climate change on many of Virginia's ecosystems and species will be better understood as more research becomes available. Research and conservation efforts will need to be increasingly focused on managing resources to maintain healthy, connected, and genetically diverse ecosystems, and plant, wildlife, and fisheries populations.
- Some of the Chesapeake Bay's "foundation species," such as blue crabs, eelgrass, and oysters, could decline or disappear as salinity and temperatures continue to increase and weather patterns continue to fluctuate widely from year to year. Because foundation species support many other species, these impacts would be felt throughout the ecosystem.
- Oxygen levels in the Chesapeake Bay are expected to decrease due to increasing temperatures and increasing storm runoff, which will have a negative impact on species like striped bass, blue crabs, and oysters. Acidification of the bay and Atlantic Ocean is also a concern as waters absorb more carbon dioxide.
- Coastal wetlands, a critical habitat for many of the Chesapeake Bay's plants and animals, are being lost as sea levels rise, and freshwater coastal wetlands are similarly threatened by saltwater intrusion.
- Virginia's agriculture and forestry industries, as well as commercial and sport fishing industries and park land, will be impacted by climate change. More research to determine specific effects is needed. The lack of specific information on the impacts hinders Virginia's ability to adapt and prepare for these changes.
- Virginia's forestlands sequester approximately 23 million metric tons of carbon dioxide per year. Unless current land conversion trends are reversed, however, this number will decline every year, as Virginia loses on average 27,000 acres of forestland annually to development. The loss of agricultural lands, which also can sequester carbon dioxide, depending on the management practices applied, is an additional concern. In 2003, Virginia had 15.8 million acres of forestland, which represents a decline of 180,600 acres since 1992.

Appendix B of the action plan summarizes climate change information presented to the Commission from notable sources. Examples of presentations included:

Author and Affiliation	Subject
Benjamin DeAngelo – EPA	A summary of work from the Intergovernmental Panel on Climate Change (IPCC)
Bill Stanley – The Nature Conservancy	Nature’s role in capturing and storing carbon emissions
Tom Ballou – VDEQ	Greenhouse gas emissions and energy consumption in Virginia and projected emissions in the future through 2025
H.H. Shugart, Ph.D. – University of Virginia – Department of Environmental Sciences	Effects of a warming climate on Virginia’s terrestrial ecosystems and the role of Virginia’s terrestrial ecosystems in context of the global carbon cycle
Doug Inkley, Ph.D. – National Wildlife Federation	Impacts of warming climate on fisheries and wildlife resources in the United States and Virginia
James E. Bauer, Ph.D. – Virginia Institute of Marine Science	Climate Change impacts to the Chesapeake Bay region
Emmett Duffy, Ph.D. – Virginia Institute of Marine Science	Impacts on the Chesapeake Bay and its living resources
Kristie L. Ebi, Ph.D., M.P.H	Climate change impacts on human health
Chris Munson – ICF/U.S. Department of Transportation	Potential impacts of global sea level rise on transportation infrastructure
Nan Humphrey – Transportation Research Board, National Academy of Sciences	Potential impacts of climate change on U.S. Transportation
Patrick Hogan – Pew Center on Global Climate Change	A summary of State and regional actions to address climate change

Virginia’s Strategy for Safeguarding Species of Greatest Conservation Need from the Effects of Climate Change

In 2009, the VDGIF, Virginia Conservation Network, and the National Wildlife Federation released “Virginia’s Strategy for Safeguarding Species of Greatest Conservation Need from the Effects of Climate Change” (VDGIF et al, 2009). This document provides important information on the status and implications of climate change on wildlife and habitats in Virginia. It was created “...to provide initial guidance on actions Virginia’s conservation community can implement immediately to enhance the conservation of wildlife and habitats in the face of climate change while more comprehensive adaptation strategies are developed.” To view the entire document, visit: <http://bewildvirginia.org/climate-change/virginiyas-strategy-for-safeguarding-species-of-greatest-conservation-need-from-the-effects-of-climate-change.pdf> (accessed August 2011).

The strategies in this document build off of the analysis and recommendations made in the Virginia WAP for conserving wildlife and habitat (VDGIF 2005). For example, the Virginia WAP describes more than 900 species that are being impacted by the loss or degradation of their habitats. In coming decades, climate change will exacerbate and intensify many of the existing threats and will likely result in new sets of impacts and stressors. The document’s strategies for addressing climate change impacts include specific actions for conserving species and habitats, developing new data and climate modeling resources, and implementing new outreach efforts related to climate change. The plan also includes a list of concerns identified by the conservation community, actions that can be implemented to make wildlife and habitats more resilient to climate change, research projects needed to inform future planning and management efforts, and outreach efforts required to build the social and political support that will be needed to implement climate adaptation efforts.

During development of this strategic plan, public and partner workshops were held. Participants were asked to identify the most significant challenges currently impacting Virginia’s major rivers and specific wetland types. For the Potomac River, the significant challenges identified were the following:

- Introduction of herbicides, fungicides, and insecticides
- Sediment loading, alterations, and increased turbidity (erosion)
- Channel and shoreline alteration
- Increased nutrient inputs
- Decreased surface permeability within the watershed

In summary, addressing the implications of climate change necessarily requires engagement at all levels, from national, regional, state, and local. Chapter 4 of this CCP identifies objectives and strategies we developed to monitor, address, and adapt to climate change at the refuge-scale.

Regional Air Quality

The air quality in the Washington D.C. metropolitan and surrounding area is experiencing gradual improvement, although excessive ozone and some particulates remain a problem. During the summer, there are occasional air pollution episodes when high-pressure systems stagnate over the area. Ozone and particle pollution have been linked to short-term health concerns, particularly among children, asthmatics, people with heart or lung disease, and older adults. The Virginia Department of Environmental Quality (VDEQ) monitors levels of ozone and particle pollution from several stations in Virginia. For more information, visit www.deq.state.va.us/air/homepage.html.

Ozone may affect the recreational potential of this stretch of river, as sensitive groups may be advised to limit their outdoor activities due to high ozone levels (MWCG, 2006). Ozone levels over the past 10 years have exceeded healthy levels between zero and 21 days per year (VDEQ, 2006). There is not a discernable trend, increasing or decreasing, in unhealthy ozone days over time. The primary factors contributing to unhealthy ozone levels are emissions and the warm and sunny regional climate (AIR Now, 2006). A significant improvement in air quality is unlikely to occur in the near future, as the metropolitan Washington, D.C. area continues to grow and the climate will remain relatively warm and sunny.

Particles found in soot, dust, smoke, and fumes create air pollution in the area. The burning of coal, oil, diesel, and other fuels produces these particles. Vehicles in northern Virginia are a major source of particulate matter (particles and liquid droplets suspended in the air). Motor vehicles emit direct particulate matter from their tailpipes, as well as from normal brake and tire wear. In addition, vehicles cause dust from paved and unpaved roads to be re-entrained, or re-suspended, in the atmosphere. Also, highway and transit construction projects may cause dust. The particles are small enough to enter deep into the lungs and cause health problems.

Air Quality Index

The Air Quality Index (AQI) is an index for reporting daily air quality. It describes the cleanliness of the air in a particular location and the associated health concerns with increasing pollutant levels (table 3.1). The AQI focuses on health effects a person may experience within a few hours or days after breathing polluted air. The EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone (O_3), particle pollution (also known as particulate matter; $PM_{2.5}$ or PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). For each of these pollutants, EPA has established national air quality standards to protect public health.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy for certain sensitive groups of people. As AQI values increase above 150, everyone in the affected area may

Scarlet tanager



Les Brooks

experience health effects. The AQI is divided into six categories as shown in table 3.1.

Table 3.1. Air Quality Index (AQI) Values and Related Health Concerns

AQI Range	Air quality condition: (Level of Health Concern)
0 to 50	<u>Good</u> : (air pollution poses little to no risk)
51 to 100	<u>Moderate</u> : (acceptable; some moderate health concerns for a few people)
101 to 150	<u>Unhealthy for Sensitive Groups</u> : (may cause a health effect for certain groups)
151 to 200	<u>Unhealthy</u> : (may pose health effect for everyone)
201 to 300	<u>Very Unhealthy</u> : (poses a health alert; everyone may experience health effect)
301 to 500	<u>Hazardous</u> : (triggers health warnings of emergency conditions)

County AQI Statistics

In 2007, AQI statistics were calculated for 212 days for Prince William County. On 5 out of these 212 days, the air quality was unhealthy for sensitive groups (table 3.2). On all 212 days, ozone was the major problem pollutant.

In 2007, AQI statistics were calculated for all 365 days for Fairfax County. On 27 out of these 365 days, the air quality was unhealthy for sensitive groups (table 3.2). Ozone and PM2.5 were the major problem pollutants in Fairfax County.

According to the VDEQ Air Division, the refuges are located in an ozone nonattainment and emission control area for nitrogen oxides and volatile organic compounds.

Table 3.2. Air Quality Index Statistics for Prince William and Fairfax Counties for 2007

2007		Number of Days when Air Quality Met Categories			
County	Number of Days AQI Statistics were calculated	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy
Prince William	212	151	56	5	0
Fairfax	365	232	106	27	0

**Note: CO–Carbon monoxide; NO₂–Nitrogen dioxide; O₃–Ozone; SO₂–Sulfur dioxide; PM_{2.5}–Particulate matter smaller than 2.5 micrometers; PM₁₀–Particulate matter smaller than 10 micrometers*

Regional Water Quality

Virginia’s Water Quality Standards

The goals of Virginia’s water quality assessment program are to determine whether water quality standards are met and to design and implement a plan to restore waters with impaired quality.

The VDEQ released the Final 2010 305(b)/ 303(d) Water Quality Assessment Integrated Report (Integrated Report) on February 9, 2011. The Report is a summary of the water quality conditions in Virginia from January 1, 2001, to December 31, 2006. The VDEQ develops and submits this report to the EPA every even-numbered year. The report satisfies the requirements of the U.S. Clean Water Act sections 305(b) and 303(d) and the Virginia Water Quality Monitoring, Information, and Restoration Act.

Water quality standards designate uses for waters. There are six designated uses for surface waters:

- 1) Aquatic life
- 2) Fish consumption
- 3) Shellfish consumption
- 4) Swimming
- 5) Public water supplies (where applicable)
- 6) Wildlife

Additionally, several new subcategories of aquatic life use have been adopted for estuarine waters of the Chesapeake Bay and its tidal tributaries. The standards define the water quality needed to support each of these uses. If a water body contains more contamination than allowed by water quality standards, it will not support one or more of its designated uses. Such waters have “impaired” water quality. In most cases, a cleanup plan (called a “Total Maximum Daily Load” (TMDL)) must be developed and implemented to restore impaired waters.

Impairments in Waters Affecting the Potomac River Refuges

Table 3.3 lists the impairments in tidal waters adjacent to Mason Neck and Featherstone Refuges for which TMDL studies are required to reduce pollutant levels to allow the designated uses. Of particular note are the impairments to aquatic life that may affect aquatic species on both refuges, and the fish consumption advisories that may affect users of Featherstone Refuge if public access is allowed in the future.

Table 3.3. Virginia 2010 303(d) Impaired Waters (Category 5) Needing Total Maximum Daily Load (TMDL) Study

TMDL Watershed Name					
Cause Group ID	Uses Affected	Type of Impairment	Estuary (Square Miles)	Initial List Date	TMDL Dev. Date
Occoquan River					
A25E-04-EBEN	Aquatic Life	Estuarine Bioassessments	0.29	2006	2018
A25E-03-BAC	Recreation	Fecal Coliform	0.08	2004	2016
Neabsco Creek					
A25E-02-BAC	Recreation	E. coli	0.54	2002	2010

Maryland’s Water Quality Standards

The purpose of Maryland’s water quality standards is to protect, maintain, and improve the quality of the State’s surface waters. Maryland’s water quality standards have three main components: designated uses, water quality criteria to protect designated uses, and an anti-degradation policy (MDE 2010).

Designated uses are goals for water quality and are usually an appropriate intended use by humans and/or aquatic life. Each waterbody (stream segment, lake, bay, etc.) is assigned one or more designated uses, such as human recreation, shell-fishing, human water supply, or aquatic life habitat. Although these designated use goals may not be currently meet, each must be attainable for that water body (MDE 2010). For more information on Maryland’s designated uses, visit: <http://www.mde.state.md.us/programs/Water/TMDL/Water%20Quality%20Standards/Pages/programs/waterprograms/tmdl/wqstandards/index.aspx/> (accessed June 2011).

Water quality criteria are generally a numeric criteria that set the minimum water quality standards necessary to meet the designed uses. Maryland publishes criteria for protection of human health, protection of aquatic life and habitat, toxins such as lead, dissolved oxygen levels, turbidity, bacteria, and temperature (MDE 2007). Maryland’s water quality criteria are updated every 3 years and published in the Code of Maryland Regulations (COMAR). They are available online at: <http://www.dsd.state.md.us/comar/comarhtml/26/26.08.02.03-3.htm> (accessed June 2011).

The antidegradation policy is the last component of the Maryland water quality standards (MDE 2007). This policy assures that water quality continues to support designated uses.

Impairments in Waters Affecting the Potomac River Refuges

Table 3.4 lists the impairments for the portions of the Potomac River that occur in Maryland for which TMDL studies are required to reduce pollutant levels to allow the designated uses. Of particular note are the impairments to aquatic life that may affect aquatic species on both refuges.

Table 3.4. Maryland 2008 303(d) Impaired Waters (Category 5) Needing Total Maximum Daily Load (TMDL) Study

Designated Use(s)	Cause of Listing	Source of Pollutant	Priority
Potomac River Lower Tidal			
Aquatic Life and Wildlife	Combination Benthic/Fishes Bioassessments	Unknown	Low
Lower Potomac River Mesohaline			
Open Water–Fish and Shellfish	Nitrogen (total)	Agriculture	High
Season Deep–Channel Refuge Use	Nitrogen (total)	Agriculture	High
Season Deep–Channel Refuge Use	Phosphorus (total)	Agriculture	High
Open Water–Fish and Shellfish	Phosphorus (total)	Agriculture	High
Seasonal Deep Water–Fish and Shellfish	Nitrogen (total)	Agriculture	High
Aquatic Life and Wildlife	Estuarine Bioassessments	Unknown	Low
Lower Potomac River Oligohaline			
Open Water–Fish and Shellfish	Nitrogen (total)	Agriculture	High
Open Water–Fish and Shellfish	Phosphorous (total)	Agriculture	High
Seasonal Shallow Water–Submerged Aquatic Vegetation	Total Suspended Solids	Unknown	Low
Upper Potomac River Tidal Fresh			
Seasonal Shallow Water–Submerged Aquatic Vegetation	Total Suspended Solids	Unknown	Low
Open Water–Fish and Shellfish	Nitrogen (total)	Unknown	High
Open Water–Fish and Shellfish	Phosphorus	Unknown	High

Source: MDE 2008

Socioeconomic Setting

Regional Overview

The population of the Washington, D.C. metropolitan region is approximately 5.35 million residents (2000 Census), and has increased by almost 9 percent over the past decade. Northern Virginia is a sub-area of both Virginia and the Washington, D.C. metropolitan area (map 1.6). Northern Virginia is home to over 2 million residents. Local governments comprising northern Virginia include four counties: Arlington, Fairfax, Loudoun, and Prince William; five independent cities: Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park; and 14 incorporated towns: Clifton, Dumfries, Hamilton, Haymarket, Herndon, Hillsboro, Leesburg, Lovettsville Middleburg, Occoquan, Purcellville, Quantico, Round Hill, and Vienna (NVRC, 2002). Because Mason Neck and Featherstone Refuges are located in the adjacent counties of Fairfax and Prince William respectively, those counties are the most relevant contexts for our discussion in the larger Washington, D.C. metropolitan area.

Northern Virginia's population is expected to increase by about one-third during the next 22 years, with an estimate of more than 3 million by the year 2030 (table 3.5).

Fairfax County

Fairfax County, which includes the Mason Neck Peninsula and Mason Neck Refuge, is the largest county in the Washington, D.C. metropolitan area and has the highest population of any county or city in Virginia. It accounts for about 13 percent of the State's population (USCB American Factfinder, 2007). Fairfax County's population was projected to be 1,077,000 persons as of January 2006, an increase of 31.6 percent over the 1990 census count. This population is expected to continue to increase as indicated in table 3.5.

In terms of both population size and density, Fairfax County ranks among the top two percent of all counties in the nation (FC, 2006a). The county consists of approximately 252,828 acres of land spread across an area of 395 square miles. Residents are primarily employed by private businesses and the Federal government (FC, 2006b). As of the census of 2000, the population density was 2,455 people per square mile. There were 359,411 housing units at an average density of 910 per square mile. The racial makeup of the county is depicted in table 3.6. The average household size was 2.74 and the average family size was 3.20 (USCB American Factfinder, 2007).

Based on U.S. Census Bureau (USCB) figures for 2006 for household median income, Fairfax County was the richest county in the country. The median income in the county was \$100,318 in 2006. This overtook the previous richest county, neighboring Loudoun County, which ranked second with a median income of \$99,371 in 2006. Incomes in Fairfax and Loudoun Counties are both more than double national median income of \$48,451. In addition, poverty levels in each of the area's four counties were well below the national average of 12.3 percent (Francis & Levitz, 2007).

Prince William County

Prince William County, in which Featherstone Refuge is located, is one of the fastest growing counties in Virginia and includes Manassas, Manassas Park, and Manassas City (USCB, 2006). It consists of 222,305 acres of land and 5,120 acres of water, and comprises single-family residential, multi-family residential, agriculture, parks and open space, and government, commercial, and industrial facilities. Employment is high, predominantly in government and government associated services or activities (USCB, 2006).

Prince William County has the third highest population of all Virginia's counties and cities but still has only about a third the population of neighboring Fairfax County—an estimated 360,411 persons in July 2007 (USCB American Factfinder, 2007). This population is also expected to increase as indicated in table 3.5.

As of the census of 2000, there were 280,813 people, 94,570 households, and 72,724 families residing in the county. The population density was 831 people per square mile. There were 98,052 housing units at an average density of 290 per square mile. The racial makeup of the county is depicted in table 3.6. The fastest growing population since 2005 is of Hispanic and Latino origin.



USFWS

Bald eagle on a snag

Of the 94,570 households, 44.20 percent had children under the age of 18 living with them, 61.30 percent were married couples living together, 11.20 percent had a female householder with no husband present, and 23.10 percent were non-families. Of all households, 17.10 percent were made up of individuals, and 3.00 percent had someone living alone who was 65 years of age or older. The average household size was 2.94, and the average family size was 3.32.

In the county, the population distribution included 30.40 percent under the age of 18, 8.80 percent from 18 to 24, 35.20 percent from 25 to 44, 20.80 percent from 45 to 64, and 4.80 percent 65 or older. The median age was 32 years. For every 100 females there were 99.50 males. For every 100 females age 18 and over, there were 97.40 males.

The median income for a household in the county was \$65,960, and the median income for a family was \$71,622. Males had a median income of \$45,595, compared to \$34,286 for females. The per capita income for the county was \$25,641. About 3.30 percent of families and 4.40 percent of the population were below the poverty line, including 5.60 percent of those under age 18 and 4.70 percent of those aged 65 or over (USCB American Factfinder, 2007).

Table 3.5. Regional Population Forecasts

Jurisdiction	2010	2015	2020	2025	2030
Fairfax County	1,132,500	1,211,500	1,276,000	1,303,700	1,330,900
Prince William County	416,000	463,400	489,900	524,900	556,300
Northern Virginia	2,434,700	2,658,500	2,823,800	2,957,700	3,082,200

Source: (Metropolitan Washington Council of Governments, 2006)

Environmental Justice

Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority and Low Income Populations,” requires Federal agencies to identify and address potential disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations (EO 12898, 2/11/1994; <http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf>, [accessed June 2011]). The Presidential Memorandum accompanying this Executive Order further directs Federal agencies to improve opportunities for community input and the accessibility of meetings, documents, and notices (Presidential Memorandum, 2/11/1994; <http://govinfo.library.wnt.edu/npr/library/direct/memos/21a6.html> [accessed June 2011]).

In creating table 3.6 below, we used the definitions provided by the USCB for race, ethnicity, income and poverty.

Table 3.6. Regional Environmental Justice Detailed Characteristics

	Fairfax County, Virginia	Prince William County, Virginia
Race and Ethnicity (from year 2009)		
White persons	73.8%	68.3%
Black Persons	7.1%	20.8%
American Indian and Alaska Native persons	0.4%	0.5%
Asian persons	16.2%	7.4%
Native Hawaiian and Other Pacific Islander	0.1%	0.2%
Persons reporting two or more races	2.4%	2.8%
Persons of Hispanic and Latino origin	14.2%	18.7%
White persons not Hispanic	61.0%	51.6%
Income and Poverty (from year 2000)		
Median household income	\$67,642	\$87,973
Per capita income	\$31,427	\$25,641
Persons below poverty level (from year 2008)	5.6 %	5.3%

Source: United States Census Bureau, 2010

In creating table 3.7 below, we used the following definitions:

- Minority population includes persons who are members of the following groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
- **Low-income population** includes persons living below the poverty line.

Table 3.7. Regional Environmental Justice Summary Characteristics

	Fairfax County, Virginia	Prince William County, Virginia
Minority Population (as percent of total population)	38.0	64.3
Low-income Population (as percent of total population)	5.6	5.3

Source: United States Census Bureau, 2010

Local Socioeconomic Setting of Mason Neck and Featherstone Refuges

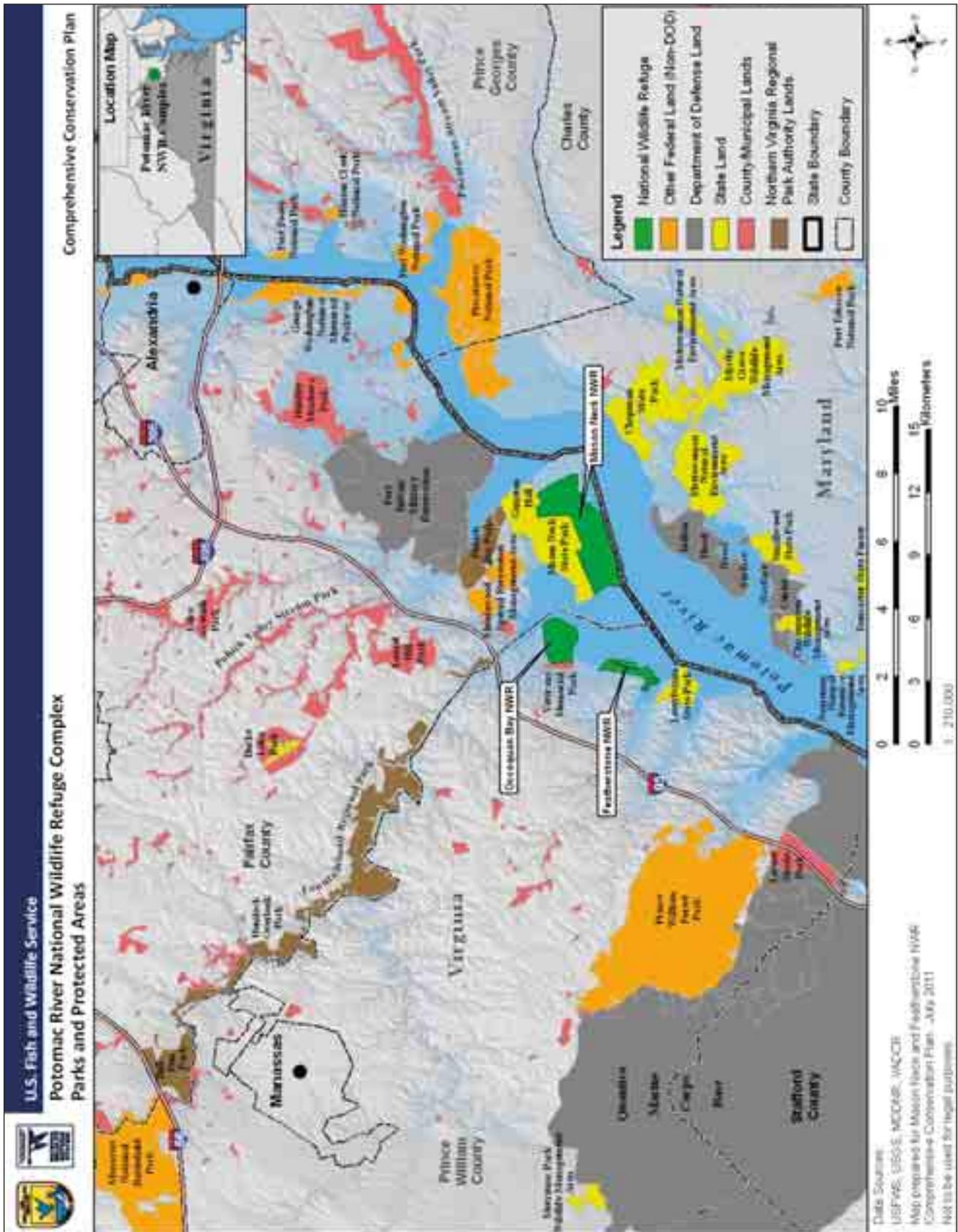
The same factors of burgeoning population and development, and resulting recreation and “green space” demand, influence decisionmaking across the Potomac River Refuge Complex. However, the local socioeconomic settings of Mason Neck Refuge on the Mason Neck Peninsula, and Featherstone Refuge in the Woodbridge section of Prince William County, differ sufficiently to be treated separately in the respective refuge profiles that follow in this chapter.

Regional Parks and Protected Lands

Map 3.1 shows parks and protected areas in the vicinity of the Refuge Complex. The total land area of the map is approximately 576,000 acres. About one-quarter of the area falls under parks and protected lands comprised as follows:

- Federal Agencies, not including Department of Defense—approximately 27,000 acres

Map 3.1. Parks and Protected Areas



- Department of Defense—approximately 73,500 acres
- State Agencies—approximately 13,500 acres
- Northern Virginia Regional Park Authority Land—approximately 6,400 acres
- County/Local Park Land—approximately 21,000 acres

The data are from the Virginia Department of Conservation and Recreation (VDCR) at: http://www.dcr.virginia.gov/land_conservation/tools02a.shtml (accessed June 2011) and the Maryland Department of Natural Resources (MDNR) at: <http://dnrweb.dnr.state.md.us/gis/data/> (accessed June 2011).

VDCR is the lead agency in developing the Statewide Conservation Lands Database to include State, Federal, private, and locally managed lands and conservation easements. VDCR is also responsible for tracking Virginia's progress towards the Chesapeake Bay 2000 Agreement land conservation goal of protecting 20 percent of the Chesapeake Bay watershed.

Special Regional Conservation Areas and Activities

Atlantic Coast Joint Venture—Potomac River Focus Area

The Refuge Complex is located in the Atlantic Flyway along a major tributary of the Chesapeake Bay in the ACJV's Lower Potomac River Focus Area (map 1.5). The Potomac River Focus Area is located in northern Virginia encompassing 416,551 acres. The area as a whole is considerably developed, as would be expected in northern Virginia. The brackish and freshwater tidal wetlands are relatively undeveloped and provide a wide diversity of habitat for many waterfowl species. The Potomac River proper is under the jurisdiction of Maryland and is not included in the focus area. The adjacent marshes are located in Virginia and are included. These marshes are composed of highly brackish *Spartina* spp. marshes near the mouth of the Potomac River to freshwater *Peltandra* spp., *Lotus* spp., and wild rice marshes inland. Historically, hardwood forests dominated areas beyond the river. These forests have given way to row crop agriculture, commercial and industrial farms, horse/hobby farms, loblolly pine (*Pinus taeda*) plantations, and residential and industrial development. In recent historical times, the shallow water areas of the Potomac River have a history of high-density SAV beds which are important habitat for waterfowl, fish, and other aquatic species.

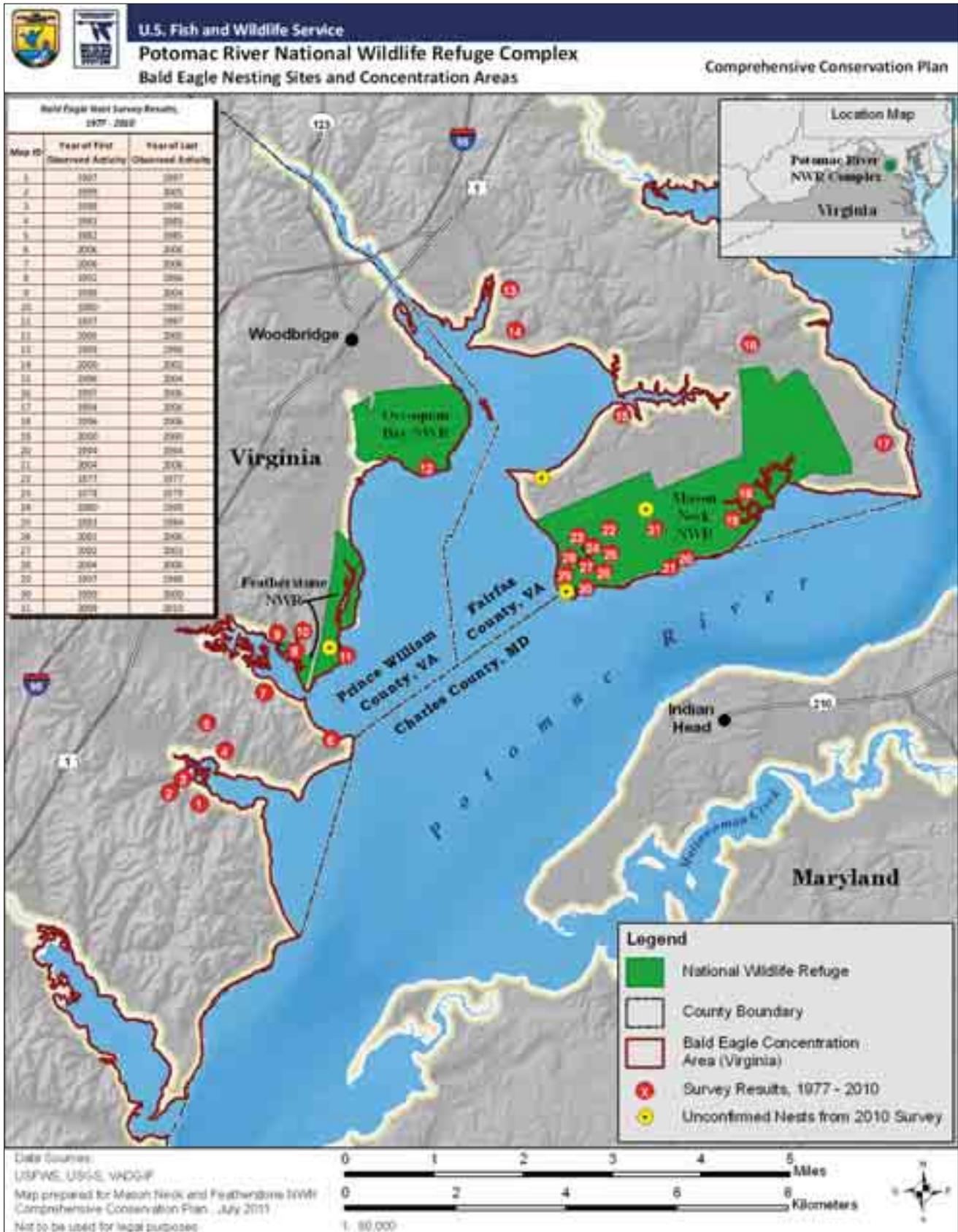
Priority Waterfowl

Fourteen priority waterfowl species use the refuge for wintering and migration habitat: American black duck, mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), greater and lesser scaup (*Aythya* spp.), wood duck (*Aix sponsa*), American wigeon (*Anas americana*), canvasback (*Aythya valisineria*), common goldeneye (*Bucephala clangula*), redhead (*Aythya americana*), bufflehead (*Bucephala albeola*), gadwall (*Anas strepera*), ring-necked duck (*Aythya collaris*), and ruddy duck (*Oxyura jamaicensis*). The dabbling duck species use flooded marshes and the adjacent rivers and lakes for food in the form of invertebrates, plant material, and seeds. Scaup use the adjacent open-water marshes to feed on SAV, and other invertebrates. Several other priority species heavily utilize these same areas for foraging and loafing. Wood ducks abound in the emergent wetlands for brood rearing and staging in the early fall. Table 3.8 outlines waterfowl usage of the Potomac River focus area.

Other Priority Bird Species

This focus area supports nearly 25 percent of the coastal population of bald eagle in Virginia (map 3.2). Waterfront development and increased urbanization is the

Map 3.2. Bald Eagle Nesting Sites and Concentration Areas



most important limiting factor on the distribution and future population trends of bald eagle and many other species in this area. Small, narrow fragments of bottomland and swamp forest border Potomac River tributaries but represent a relatively minor component of this area compared to other focus areas in coastal Virginia. However, these forested wetlands provide habitat for migratory birds of conservation concern such as Acadian flycatcher, yellow-throated vireo, northern parula (*Parula americana*), and prothonotary warbler. Small, isolated populations of Swainson's warbler and worm-eating warbler may be found in forested wetlands with dense understory vegetation. Tidal marshes are irregularly distributed along the shores of the Potomac River but are extensive along some of the associated creeks and tributaries. These habitats are important for Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), American bittern (*Botaurus lentiginosus*), and least bittern (*Ixobrychus exilis*). Marshes in the lower salinity zones and upper reaches of the Potomac River also support king rail. Historical records indicate that the coastal plain swamp sparrow (*Melospiza georgiana nigrescens*) inhabited these areas as well. However, their complete distribution among the marshes in this focus area is unknown.

Table 3.8. Waterfowl Species using the Potomac River Focus Area

Species	Breeding	Migration	Wintering
Mallard	X	X	X
Black Duck	X	X	X
Wood Duck	X	X	
Hooded Merganser	X	X	
Greater Scaup		X	X
Lesser Scaup		X	X
Redhead		X	X
Canvasback		X	X
American Wigeon		X	X
Green-winged Teal		X	X
Blue-winged Teal		X	
Ring-necked Duck		X	X
Tundra Swan		X	X
AP Canada Goose		X	X
Gadwall		X	X
Ruddy Duck		X	X
Bufflehead		X	X
Red-breasted Merganser		X	X

Migratory Bird Conservation Concerns and Needs

The ACJV has identified many threats to migratory birds. Additional development of riparian and forested areas remains a major concern for forest-dependent migratory birds. Increasing stormwater runoff, increased siltation, and chemicals associated with urbanization continue to degrade water quality. Increasing boat traffic may affect habitat quality for waterfowl by creating disturbances in resting, foraging, and nesting areas, and may push them into less favorable sites.

Continued acquisition and protection of land in a series of conservation corridors will help this area retain its importance for migratory birds. Previously converted crop fields and farmed wetland pasture that are restored to wetland habitat provide excellent waterfowl habitat and receive high use in these areas. Continued restoration of these sites will help wintering and staging waterfowl populations. The preservation of bottomland hardwood forest for nesting wood duck and other forest-dependent cavity nesting migratory birds is also important.

Regional Bald Eagle Monitoring

The Service formed the Chesapeake Bay Bald Eagle Recovery Team in 1977 (Abbott, 1977). This team was tasked with developing a plan for the recovery of the bay population. As part of this process, state wildlife agencies assumed the responsibility for population monitoring. As the State agency responsible for wildlife management, VDGIF is responsible for bald eagle monitoring and management in Virginia.

The primary focus area for the Virginia bald eagle breeding survey includes the tidal reaches of bay tributaries and the lower Delmarva Peninsula (map 3.2). All bay tributaries in Virginia are systematically surveyed to determine the extent of tidal influence on each of them. These drainages encompass nearly all historic records of breeding eagles in Virginia and continue to support the vast majority of the population. Map 3.2 also depicts nest survey results through 2010. Several nests from the 2010 survey are still unconfirmed but will be verified in 2011.

The Virginia bald eagle survey measures breeding activity and productivity via a standard two-flight approach (Fraser et al., 1983). All bald eagle nests detected are plotted on 7.5 minute topographic maps and given a unique alpha-numeric code. Each nest is examined to determine its condition and activity status. A breeding territory is considered to be “occupied” if a pair of birds is observed in association with the nest and there is evidence of recent nest maintenance (e.g. well-formed cup, fresh lining, and structural maintenance). Nests are considered to be “active” if a bird is observed in an incubating posture or if eggs or young are detected in the nest (Postupalsky, 1974). The second survey flight is conducted from late April through mid-May to check active nests for productivity.

Lower Potomac River— Important Bird Area

Description

The Lower Potomac River IBA is located in Fairfax, Stafford, King George, and Prince William Counties (map 1.5). The IBA area covers 281,024 acres, at elevations ranging from 0 to 282 feet above sea level. We mention in chapter 1 that we referenced Audubon’s IBA program goals in developing this CCP. We also describe in chapter 1 the Lower Potomac River IBA’s significance to birds.



Wood duck

USFWS

The tidal fresh/oligohaline reach of the Potomac River included in the IBA extends from Mathias Point to just above Fort Belvoir. The river is wide along this stretch with several large tributaries. Tributaries contain considerable emergent and forested wetlands. Surrounding uplands support extensive tracts of hardwoods that are increasingly giving way to residential development. The area lies within the extreme inner coastal plain and has a great deal of topographic relief that has led to the development of a diversity of upland habitats. Due to its close proximity to the Nation’s capital, the area includes many historic properties and landmarks.

Protection

Due to its size, history, and proximity to Washington, D.C., the tidal fresh reach of the Potomac River in this IBA contains many tracts of land dedicated to conservation, education, military training, and recreation. Both the Service and the U.S. Department of Defense hold lands that are strategically important for conservation. Virginia also maintains several tracts of land that are State parks or natural area preserves. The NVRPA and individual counties own other lands for recreational access.

Conservation and Threats

Audubon's IBA program identifies the dominant threat to the avifauna within this area as habitat loss from urban expansion extending down the river from Washington, D.C. Jurisdictions within the area are experiencing some of the fastest human growth rates in the nation. This growth is causing the rapid loss of habitat for many species. All of the upland habitats are in immediate danger from development. The increase in the human population has led to an increase in the demand for access to the waterway for recreational boating. Increase in boating activity and associated disturbance is the greatest threat to the bald eagle concentration area. In recent years, increases in disturbance along important shorelines appear to be limiting bald eagle use of the area during peak times of the year. In the future, rapid development of private lands will elevate the importance of government and conservation lands for the management of sensitive species. Maintaining continuity in the mission of these lands as it pertains to population protection will be important (Audubon VA, 2006).

Virginia Natural Heritage Program Conservation Sites

The VDCR's Natural Heritage Program (VNHP) maintains a Biotics Data System of occurrences natural heritage resources throughout Virginia. Areas where important natural heritage resources occur are called "conservation sites." These conservation sites represent areas for possible conservation action due to the presence of natural heritage resources, such as rare plants, animals, or natural communities. Conservation sites are also ranked by biodiversity significance based on the rarity, quality, and amount of natural heritage

Mason Neck Refuge Conservation Sites

Mason Neck Refuge is located in the Mason Neck—Sycamore Point Conservation Site (moderate biodiversity significance ranking). This site supports two important natural heritage resources: bald eagles and tidal freshwater marsh. Two other conservation sites are in the vicinity of the refuge. The Mason Neck State Park—Kane Creek Headquarters Conservation site (moderate biodiversity significance ranking) and the High Point NE Conservation Site (general biodiversity significance ranking) both support the following natural heritage resources: bald eagles and colonial wading bird colonies.

Featherstone Refuge Conservation Sites

Featherstone Refuge is located within the Neabsco Creek Conservation Site (general biodiversity significance ranking) that supports bald eagles. The refuge is also in the vicinity of the Powell Creek Conservation site (high biodiversity significance ranking), which supports both bald eagles and tidal freshwater marsh.

Potomac River Refuge Complex Administration**Refuge Complex Staff**

The Refuge Complex staff manages and carries out duties related to Mason Neck, Featherstone, and Occoquan Bay Refuges. The full-time staff currently consists of a refuge manager, an assistant refuge manager, an administrative assistant, a visitor services specialist, a maintenance worker, and a law enforcement officer.

Refuge Complex Budget

Neither Mason Neck nor Featherstone Refuge receives specific funding—all funding is at the Refuge Complex level to support staff and projects on all three refuges. Federal budgets are complex, with funding sources which often have restrictions on where and how the funding can be used. The basic budget consists of funding for operations and maintenance which are defined in more detail below. A station may also receive a variety of additional funds for specific purposes. This funding can be for replacement of equipment, construction projects, major repairs to facilities, support of a specific activity such as burning, or to fund or support a specific project. While this type of funding can represent a significant portion of a station’s overall budget, it is a one-time, project-specific allocation. As such, a station budget appears to have huge differences from year to year, which can be difficult to interpret without explanation. Table 3.9 shows the annual operations and maintenance budget of the Potomac River Refuge Complex from 2002 to 2009. Some of the additional project funds are also listed for reference.

Operations

This funding covers all operational costs including salaries, utilities, fuel, supplies, rent, training, travel, etc. The amount of funding left after all of the above operational costs are covered is the amount of money a station has to spend at its discretion. This “discretionary” money is used to accomplish projects, cover unanticipated expenses such as fuel increases, major repairs to equipment, clean up and repairs after major storms, employee overtime, etc. If a station does not have enough funding to cover the unanticipated cost or complete a project, it must be deferred until the next fiscal year. Over the past 3 years the “discretionary” funds in the budget has averaged \$18,500. Only basic operations funds are included in table 3.9.

Maintenance

This funding is provided for a station to cover annual maintenance of buildings and equipment, and to cover minor repairs. In addition to annual maintenance funds, a station may receive funds targeted for replacement of equipment, major repairs to a facility, or for the rental of specialized equipment that the refuge would need to complete a project such as a forklift. These funds can be a significant part of the maintenance budget but are one time funding that varies from year to year. Only annual maintenance funds are included in table 3.9.

Table 3.9. Potomac River Refuge Complex Annual Budget from 2002-2009

Year	Operations	Maintenance	Additional Targeted Funds
2002	\$415,100	\$16,900	\$97,000 Great Marsh Trail improvements
2003	\$409,900	\$16,900	\$147,000 Visitor enhancement projects
2004	\$466,500	\$15,500	\$93,000 Radio system replacement
2005	\$483,500	\$15,200	\$15,000 Equipment rental funds
2006	\$560,800	\$15,500	\$16,000 Equipment rental funds
2007	\$556,614	\$15,500	\$61,655 Roof replacement, equipment
2008	\$689,525	\$15,500	\$211,982 Dump truck, equipment rental
2009	\$715,348	\$15,500	\$11,673 Equipment rental, challenge cost share, environmental compliance

Administrative Facilities

Headquarters Office

The office for the Refuge Complex is located in Woodbridge, Virginia, about 9 miles from Mason Neck Refuge, and 1 mile from Occoquan Bay and Featherstone Refuges. The office is in a small rental space in a strip mall (USFWS, 2005a). The

Service is planning to build a new visitor contact station/headquarters facility at a site on Occoquan Bay Refuge. That project was addressed in separate NEPA documentation and approved in 2009. Contact refuge headquarters for additional information.

Maintenance Facility

The primary maintenance facility for the Refuge Complex is located on Mason Neck Refuge. This facility consists of several small buildings and storage sheds within a fenced compound. The compound is also used for vehicle and equipment storage.

The Friends of Potomac River Refuges

The Friends of Potomac River Refuges (Friends Group) is an organization which supports the Refuge Complex goals. The purpose of this non-profit group is to promote conservation, awareness, and appreciation of the wildlife and habitats of the Refuge Complex, and to provide assistance to refuge programs. The group hosts special events and programs related to the Refuge Complex. For more information regarding the Friends Group, you can visit their Web site at: <http://www.fopr.org/> (accessed June 2011).

Activities of the Friends Group include the following:

- Designing and constructing interpretive signs for self-guided nature trails
- Developing a draft interpretive plan for Occoquan Bay Refuge
- Funding, designing, and erecting eight interpretive panels through a grant from Gateways
- Purchasing nets and storage shed for bird banding station, which has banded more than 3,000 birds
- Advocating for Federal funds for facilities, staff, and programs
- Demolishing and removing 60 feet of unsafe bridge at Mason Neck Refuge
- Conducting dozens of interpretive programs highlighting the flora and fauna of the refuges
- Surveying plants, insects, birds, and mammals on the refuges
- Co-sponsoring a forum on the Virginia Wildlife Action Plan
- Partnering with Virginia Dominion Power to construct public use facilities at Occoquan Bay Refuge.
- Participating in local and international events:
 - ✱ Elizabeth Hartwell Environmental Education Eagle Festival at Mason Neck State Park
 - ✱ Exxon Mobil shoreline cleanup
 - ✱ Youth fishing event
 - ✱ Photo contest
 - ✱ International Migratory Bird Day
- Partnering with refuge staff to present an annual Fall Wildlife Festival

Mason Neck Refuge Environment

Refuge Establishment and History

Refuge Size and Location

The 2,277-acre Mason Neck Refuge is located on the Mason Neck Peninsula in Lorton, Virginia. It is on the western shore of the Potomac River and approximately 18 miles south of Washington, D.C. The refuge is bounded by the Potomac River to the south and west, Mason Neck State Park and Gunston Hall Plantation (a State-owned historic site) to the north, and private housing developments to the east (Friends, 2009).

The Mason Neck Peninsula is surrounded by Gunston and Pohick Coves on the north, the Potomac River on the east, and Occoquan and Belmont Bays on the south. Mason Neck forms the southernmost section of Fairfax County in northern Virginia, and comprises an area of approximately 9,000 acres, two-thirds of which is preserved as parkland by regional, State, and Federal authorities (MNCA, 2004). Mason Neck is named for colonial patriot and founding father George Mason, whose estate, *Gunston Hall*, is preserved near the base of the peninsula (WAMU, 2008).

Establishing Authority and Purpose

When a major development was proposed for the Mason Neck Peninsula in the 1960s, local residents, working with The Nature Conservancy to protect the area and the bald eagles that frequented there, brought their concerns to the attention of local, State, and Federal agencies. In response to these concerns, the Service purchased 845 acres of land from The Nature Conservancy and officially established Mason Neck Refuge on February 1, 1969 (MNCA, 2004). Additional lands were subsequently acquired by the Service, and another 789 acres were incorporated into the refuge in 1982 under a 60-year lease from the NVRPA (map 3.3).

Establishing Purposes and Authorities

Mason Neck Refuge has several official purposes:

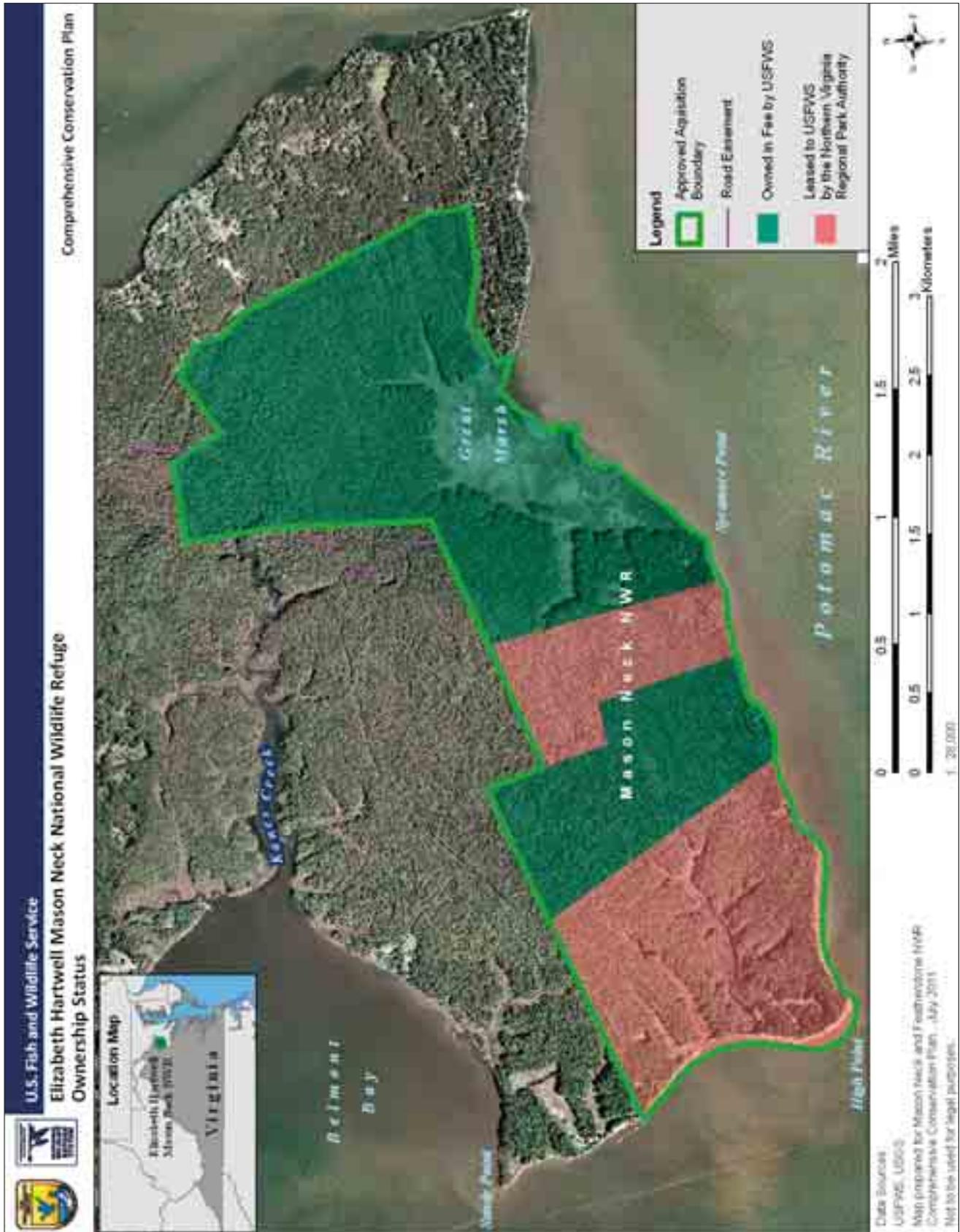
- Lands acquired under the Endangered Species Act were “... to conserve (A) fish or wildlife which are listed as endangered species or threatened species Or (B) plants ...” (16 U.S.C. § 1534).
- Lands acquired under the Refuge Recreation Act were found to be “... suitable for—(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ...” 16 U.S.C. § 460k-1 “... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ...” (16 U.S.C. § 460[k]–460[k] [4]).
- Lands acquired under the Act Authorizing the Transfer of Certain Property for Wildlife, or other purposes were established for their “... particular value in carrying out the national migratory bird management program.” (16 U.S.C. § 667b).
- Lands acquired under the Migratory Bird Conservation Act were “... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” (16 U.S.C. § 715d).

Administrative Changes since Refuge Establishment

Creating a Refuge Complex

Until 1974, Mason Neck Refuge was a subunit of Blackwater Refuge, located in Cambridge, Maryland. In 1974, it became an independent unit with a manager

Map 3.3. Mason Neck Refuge Ownership Status



and two nearby subunits of its own—Marumscow Refuge (which later became Occoquan Bay Refuge) and Featherstone Refuge (USFWS, 2005a). With the establishment of Occoquan Bay Refuge in 1998, which combined land previously acquired as Marumscow Refuge with newly acquired military surplus lands, Mason Neck, Featherstone, and Occoquan Bay Refuges were administratively reorganized into the current Potomac River Refuge Complex. Their proximity to each other and their growing management complexity warranted this new administrative status.

Refuge Name Change to “Elizabeth Hartwell Mason Neck” Refuge

In 2005, the name of the refuge was officially changed to Elizabeth Hartwell Mason Neck National Wildlife Refuge in honor of Elizabeth Hartwell, a long-time conservationist with significant contributions to protecting the natural landscape on the Mason Neck Peninsula and elsewhere in the region. Ms. Hartwell, a resident of Mason Neck, spearheaded the movement to protect habitat on the peninsula. Through her efforts, The Nature Conservancy ultimately purchased much of the land on the peninsula for later resale to local, State, and Federal governments. Ms. Hartwell also petitioned Congress for the initial \$3 million appropriation to purchase land for the refuge. While part of the broader regional preservation movement, she is often referred to as the single most important person responsible for creation of the refuge and the Mason Neck State Park.

Public Access

Access to Mason Neck Refuge for five out of the six priority wildlife-dependent public uses (wildlife observation, photography, environmental education, interpretation, and hunting) currently occurs via foot access. Two trails, the Joseph V. Gartland, Jr. Great Marsh Trail (Great Marsh Trail) and the Woodmarsh Trail, provide access to forest habitat and viewpoints along Great Marsh. The High Point Trail is used solely to provide safe access for pedestrians through the refuge to Mason Neck State Park. The High Point Trail is the only trail on the refuge that allows bicycles, rollerblades, and other modes of recreational non-motorized pedestrian travel. High Point Trail and Great Marsh Trail are accessible and allow mobility-impaired visitors access to the natural beauty of the refuge. Parking to access the refuge can be found at the trailheads of Great Marsh and Woodmarsh Trails. See the section on “Visitor Services” for more details on the refuge’s priority public use programs.

Some areas of the refuge are closed to public access, or to certain activities, because of concerns with disturbing wildlife or impacting sensitive habitat. For example, a significant area of the refuge is closed to migratory bird hunting by Director’s Order. In 1969, the Director of the Bureau of Sport Fisheries and Wildlife, which was what the Service was called at that time, closed Great Marsh to migratory bird hunting to protect bald eagles (34 FR 15627; Oct 9, 1969). This concern with disturbance to wildlife and sensitive habitats, coupled with concerns about accelerating shoreline erosion, are the reasons we also do not allow fishing on the refuge. The most current information on refuge closures can be obtained at Refuge Complex headquarters.

Community Demographics and Planning

Mason Neck Peninsula Demographics

Because of its location, recent history of land management decisionmaking, and aggressive opposition to development, the Mason Neck Peninsula community contrasts sharply with Fairfax County overall. While the county population density is 2,455 per square mile, Mason Neck population density is 93 per square mile. The peninsula also has a median household income \$8,600 higher than the county median and housing values \$60,000 higher than the county average based on 2000 census figures (USCB, 2007).

Other Public Lands of the Mason Neck Peninsula

Since 1949, the Virginia Division of Historic Resources (VDHR) has protected the Gunston Hall Plantation site. Around the time of refuge establishment, the VDCR purchased the land to establish Mason Neck State Park adjacent to the refuge and the NVRPA bought the Pohick Bay Regional Park. NVRPA also purchased the Potomac Shoreline regional parks, which they subsequently leased to the Service. Together the Service, BLM, and these other agencies have acquired more than 6,400 acres on the peninsula (USFWS, 2004).

A series of events threatened Mason Neck peninsula in the late 1960s and early 1970s. After plans for a proposed beltway through the area were dropped in 1967, an airport, a natural gas pipeline, a landfill, and a sewer line were proposed for the area. These proposals met strong opposition from groups such as the Mason Neck Conservation Committee. Plans for the projects were dropped because of the potential negative impact each had on Mason Neck Refuge and Mason Neck State Park. Mason Neck State Park opened to the public in April 1985 (VDCR, 2006a).

The refuge, along with Mason Neck State Park, the Pohick Bay Regional Park, the Gunston Hall Plantation, and the BLM, cooperate in the management of their combined lands on the Mason Neck Peninsula with each agency focusing on their strengths of natural resource management, recreation, interpretation, and preservation. This cooperation provides a wide variety of recreational activities while protecting natural resources and avoiding duplication of facilities and programs (USFWS, 2004).

Mason Neck State Park

Mason Neck State Park (1,804 acres) is directly adjacent to Mason Neck Refuge along the refuge's northern boundary. The park attracts migrating and non-migrating species of birds, including tundra swans and a variety of waterfowl. Like Mason Neck Refuge, bald eagles also inhabit the park. The park also features several hundred acres of hardwood forests consisting of oaks, holly, hickory, and other species. Several wetland areas important to area wildlife are also found within the park.

Hiking, biking, and self-guided trails wind through the park. Elevated walkways allow visitors to explore some of the marsh areas in the park. Fresh and brackish water fishing are available from car-top boat launch facilities. The park rents kayaks and canoes to explore Belmont Bay or Kane's Creek. Deer hunting is conducted in coordination with Mason Neck Refuge. The Elizabeth Hartwell Environmental Education Center in the park features exhibits on the plant and animal life of the area, area history and the agencies of the Mason Neck Cooperative Management Area, hands-on activities, a resource library, volunteer exhibit, and roving interpretive displays. This center also provides an opportunity for teachers to conduct environmental studies in natural settings. The facility has a variety of research materials, a mobile wet lab, and a variety of sampling equipment.

The park supports many activities: pond study, birdwatching, canoe trips, fishing clinics, an active volunteer program, night hikes, teacher workshops, hands-on experiential educational opportunities, evening programs, and butterfly gardens. (VDCR, 2006a).

Gunston Hall Plantation

Gunston Hall Plantation is a 550-acre National Historic Landmark located about a mile northeast of Mason Neck Refuge. Gunston Hall is the plantation estate of George Mason, who was the first author of the Virginia Declaration of Rights



Tim Williams

Eastern bluebird

and instrumental in the framing of the U.S. Government. The site includes the main house (completed in 1759), gardens, a variety of outbuildings, as well as a graveyard. The outbuildings include a kitchen, dairy, smokehouse, and laundry. Guided tours of the main house, as well as self-guided tours of the outbuildings and grounds, give a glimpse into how the Mason family and their servants and slaves lived during the mid to late 18th century. Several archaeological studies are currently ongoing, with a strong focus on the historical gardens.

The onsite Gunston Hall Library and Archives serves as a resource to scholars interested in George Mason and the plantation. Gunston Hall occasionally hosts lectures, festivals, and other special events. Additionally, student and teacher programs aim to expose schoolchildren to the history of the plantation. For more information on the site visit: <http://www.gunstonhall.org> (Gunston Hall, 2006; [accessed June 2011]).

Bureau of Land Management–Meadowood Special Recreation Management Area

The 800-acre Meadowood Special Recreation Management Area (SRMA), administered by the BLM, is located along Gunston Road in Lorton, Virginia, northwest of Mason Neck Refuge. Meadowood SRMA consists of wooded acreage, open pastures, and support buildings. Support buildings on the property include a stable, indoor riding arena, and blacksmith shed. There are also three former residences on the property which have recently been converted into office space, temporary quarters, and an environmental education and interpretive center. The farm roads that traverse the property are planned to be used as recreational trails. The Meadowood Farm was privately owned until the BLM acquired it on October 18, 2001, under the authority of the 2001 Washington, D.C. Appropriations Act. Section 165 of this act authorized a complex set of land transactions facilitated by Fairfax County. These resulted in the acquisition of Meadowood Farm by BLM in exchange for federally owned land in the former Lorton Correctional Complex (BLM, 2004).

Management of the Meadowood SRMA focuses on three core programs: recreation, environmental education, and wild horses and burros. The goals and objectives of these programs and activities are balanced with the goals and objectives of the natural and cultural resource management programs. Boarding of private horses is allowed, as well as horse-related programs that the BLM determines are appropriate. Wildlife, vegetation, and riparian/wetland management focuses on species diversity, quality, protection, and enhancement in balance with visitor-use activities (BLM, 2004).

Pohick Bay Regional Park

Pohick Bay Regional Park is a 1,002-acre scenic shoreline park managed by the NVRPA. The park, located in the upper area of the Mason Neck Peninsula, features a large campground (160 acres), 18-hole golf course (460 acres), and a recreational facilities area (382 acres) featuring a large swimming pool, miniature and disk golf courses, 4 miles of equestrian trails, nature trails, and picnic shelters. The park also provides visitors with rental paddle boats, jon boats, sailboats, canoes, and kayaks (NVRPA, 1999).

Refuge Administration

Refuge Revenue Sharing Payments

The Refuge Revenue Sharing Act of 1935 (16 U.S.C 715s), as amended, authorizes revenues and direct appropriations to be deposited into a special fund, the National Wildlife Refuge Fund (NWRF). This fund is used for payments to counties in which lands are acquired in fee title ownership or reserved from the public domain (reserved land) and managed by the Service. These revenues are derived from the sale, transfer, or exchange of

- 1) products (e.g., timber and gravel);
- 2) other privileges (e.g., right-of-way and grazing permits); and/or
- 3) leases for public accommodations or facilities (e.g., oil and gas exploration and development) incidental to, and not in conflict with, refuge purposes.

The act authorizes payments for Service-managed fee lands based on a formula contained in the act that reflects, among other things, the amount of refuge land and its appraised value. Congress ultimately determines each year whether full payment, or a percentage of that full payment, will be made.

Mason Neck Refuge's revenue-sharing payments to Fairfax County from 2003 to 2009 are listed in table 3.10. Revenue-sharing checks are sent by the Service electronically to Fairfax County on an annual basis.

Table 3.10. Refuge Revenue Sharing Payments to Fairfax County, Virginia from 2003-2009

Fiscal Year	Revenue-Sharing Payments
2009	\$51,147
2008	\$65,923
2007	\$68,175
2006	\$73,661
2005	\$65,224
2004	\$73,741
2003	\$61,814

Other Current Refuge Plans

In 1989, we prepared an EA to evaluate strategies to control the overpopulation of white-tailed deer that damage refuge habitat. High deer densities in the eastern deciduous forest cause heavy browsing that impacts forest communities, particularly the understory, ground cover, and recruitment of seedlings. Sensitive woody species subjected to heavy browsing will disappear as deer density increases and become replaced by plant species less palatable to deer. This process eventually alters the plant diversity and physical structure of the habitat, which in turn affects the populations and diversity of other species of wildlife. White-tailed deer management can not only improve the health of the deer population itself by eliminating overcrowding and competition for scarcer food resources, but will also improve the health and diversity of the plant and animal community as a whole (USFWS, 2005b). The EA resulted in the development of a refuge hunt plan and the refuge began a managed deer hunt in 1989. In 1993, Mason Neck State Park joined with the refuge to form a single hunting management unit.

In the years since the initiation of the hunt, species such as American holly (*Ilex opaca*), American beech (*Fagus grandifolia*), paw-paw (*Asimina* spp.), rhododendron (*Rhododendron* spp.), and eastern red cedar (*Juniperus virginiana*) have rebounded. These species have formed a noticeable mid- and understory layer on some parts of the refuge. However, white-tailed deer overpopulation continues to impact refuge habitats, as evidenced by lack of understory and tree regeneration, even though past hunts have reduced the refuge's deer population. We will continue to manage and monitor the deer

population and their impacts to protect refuge habitats from further damage (USFWS, 2005b).

Special Use Permits

The refuge issues special use permits for various activities such as research, wildlife surveys and censuses, and environmental education. Each request is considered on a case-by-case basis and decisions are based on the following criteria: type, purpose, and appropriateness of activity; whether the activity supports refuge goals; and what kind of impact the activity will have on other users. Prior to issuing a special use permit, the refuge manager evaluates the use's appropriateness and compatibility with the refuge purposes.

Partners

Since the 1960s, the conservation community has learned the importance of building strong partnerships between public agencies and private groups. As noted earlier, Mason Neck Refuge is part of the Mason Neck Cooperative Management Area, which includes BLM-Meadowood, Pohick Bay Regional Park, Mason Neck State Park, and Gunston Hall. The refuge coordinates with those agencies to address and resolve common management issues. VDGIF is also a key partner with the refuge and the other land managers when there are issues or opportunities affecting wildlife or habitat.

Other partnerships encompass a wide array of community organizations and individuals, including but not limited to the following:

- Friends of the Potomac River Refuges
- Audubon Society of Northern Virginia
- Boy Scouts of America
- Girl Scouts of America
- Chesapeake Bay Gateways Network
- The Hartwell Foundation

Volunteer Program

Since its establishment in 1969, refuge staff have continuously provided opportunities for volunteers to be involved in research, maintenance, and education. Volunteers contribute hundreds of hours of service each year to provide critical assistance in the maintenance of roads and trails, management of white-tailed deer, and monitoring of populations of bald eagles and great blue heron. In addition, volunteers have completed a variety of projects such as cleaning and painting kiosks, inventory of museum property, mounting of plants for the herbarium collection, and updating databases. The Refuge Complex's visitor services specialist is responsible for the oversight of all volunteer training and activities.

Refuge Terrain and Habitats

Topography

Inspection of the USGS topographic map (map 3.4) shows that the largest portion of Mason Neck Refuge is upland with relatively gentle relief between 30 and 40 feet above sea level. The shoreline terrain on the banks of the Potomac River consists of narrow beaches just above tidal level. Immediately inland of the beach are 20 to 40 feet high bluffs. At the major drainage outlets of the Great Marsh and Little Marsh, the land shows the dendritic pattern of deeply eroding notches of streams and marsh-vegetated low tidal flats.

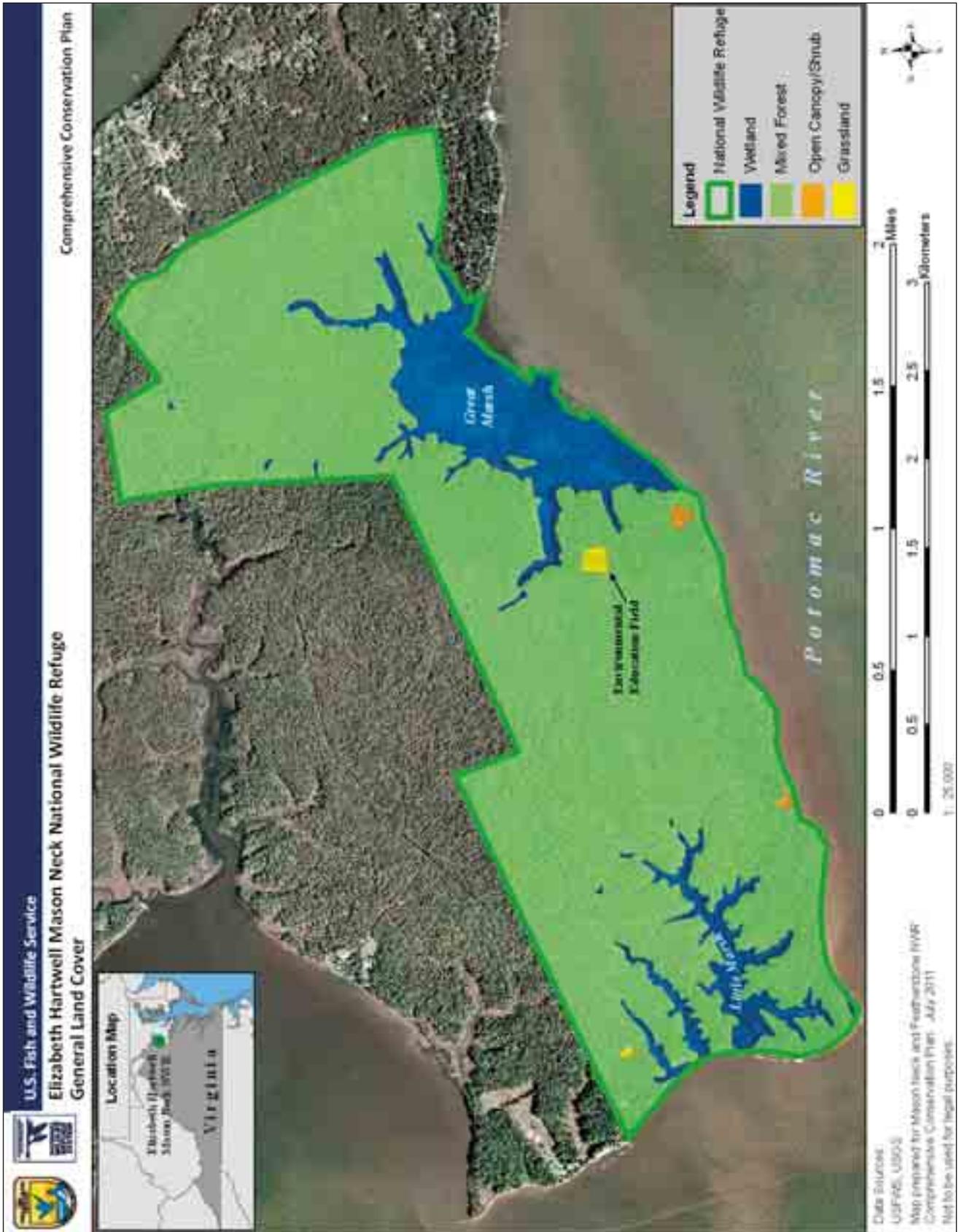
Land Cover

Geographic Information System (GIS)-based land cover information from the Service and the USGS is shown on map 3.5. As illustrated on the map, the predominant land cover types on the refuge are mixed forest and wetlands, with

Map 3.4. Mason Neck Refuge Topography



Map 3.5. Mason Neck Refuge General Land Cover



very minor amounts of grasslands and open canopy/shrub cover. The refuge is comprised of 1,883 acres of mixed deciduous upland forest, 364 acres of palustrine and riverine wetlands, 15 acres of grasslands, 10 acres of brush, and 5 acres of administrative buildings, parking and roads (USFWS, 2005a).

Soils and Shoreline

The predominant soil association on the refuge is the Matapeake-Mattapex-Woodstown. It consists of sandy silt loams with more erodible soils along the cliffs (TPL, 2006). Specific soil series at Mason Neck Refuge are depicted on map 3.6 and their characteristics described in table 3.11 based on profiles from the Fairfax County Soil and Water Conservation District below (FC, 2009; USDA-NRCS, 2008).

Between High Point (the southwest point of refuge land at the junction of the Potomac River and Occoquan Bay) and Sandy Point (where Occoquan and Belmont Bays meet) is a 2-mile stretch of west-facing shoreline experiencing erosion. Four minor drainage systems enter Occoquan Bay along this stretch, with Little Marsh the southern-most and Short Marsh the northern-most. Both High and Sandy Points can be seen from the site, as well as Occoquan Bay

Refuge across the bay. This exposed stretch of bluffs and creek mouths is what is most subject to heavy erosion. Miller (1983) studied erosion processes, rates, and sedimentation of the tidal Potomac River. One of his study locations occurred across High Point Creek on the bluff opposite Little Marsh Creek. At this location, Miller found that the mean recession rate was approximately 14 inches per year (Miller, 1983). This translates into over 115 feet of shoreline lost in the last 100 years; with even a greater proportional loss at the Little Marsh Creek site.

In 2001, the Federal Highway Administration (FHWA) and Virginia Department of Transportation (VDOT) requested and received authorization for construction mitigation activities associated with the Woodrow Wilson Bridge Replacement Project, including constructing three, 250-foot



Lelaina Marin/USFWS

Breakwater structures off Mason Neck Refuge's shoreline

breakwaters near Mason Neck Refuge. These are spaced 50 feet apart which filled in to create 22,500 square feet of State jurisdiction bottomland adjacent to the refuge, and another two, 300-foot breakwaters, spaced 50 feet apart which filled in to create 18,000 square feet of State bottomlands adjacent to Mason Neck State Park (VAMRC, 2000).

The breakwaters were completed in October 2002 and have stemmed major erosion along the refuge's western shoreline. The substrate is accreting behind the breakwaters and the shoreline is actually expanding there. Erosion by wind and runoff is still occurring along the top of the bluff where numbers of mature trees are undermined and lost. In 2002, limited SAV monitoring at these sites occurred. However, since 2002, a steady increase in abundance of SAV has been noticed. The species composition varies but consists of mostly brittle waternymph (*Najas minor*) and *Hydrilla* spp. with a good percentage of *Vallisneria* spp. and *Myriophyllum* spp. mixed in.

Map 3.6. Mason Neck Refuge Soils

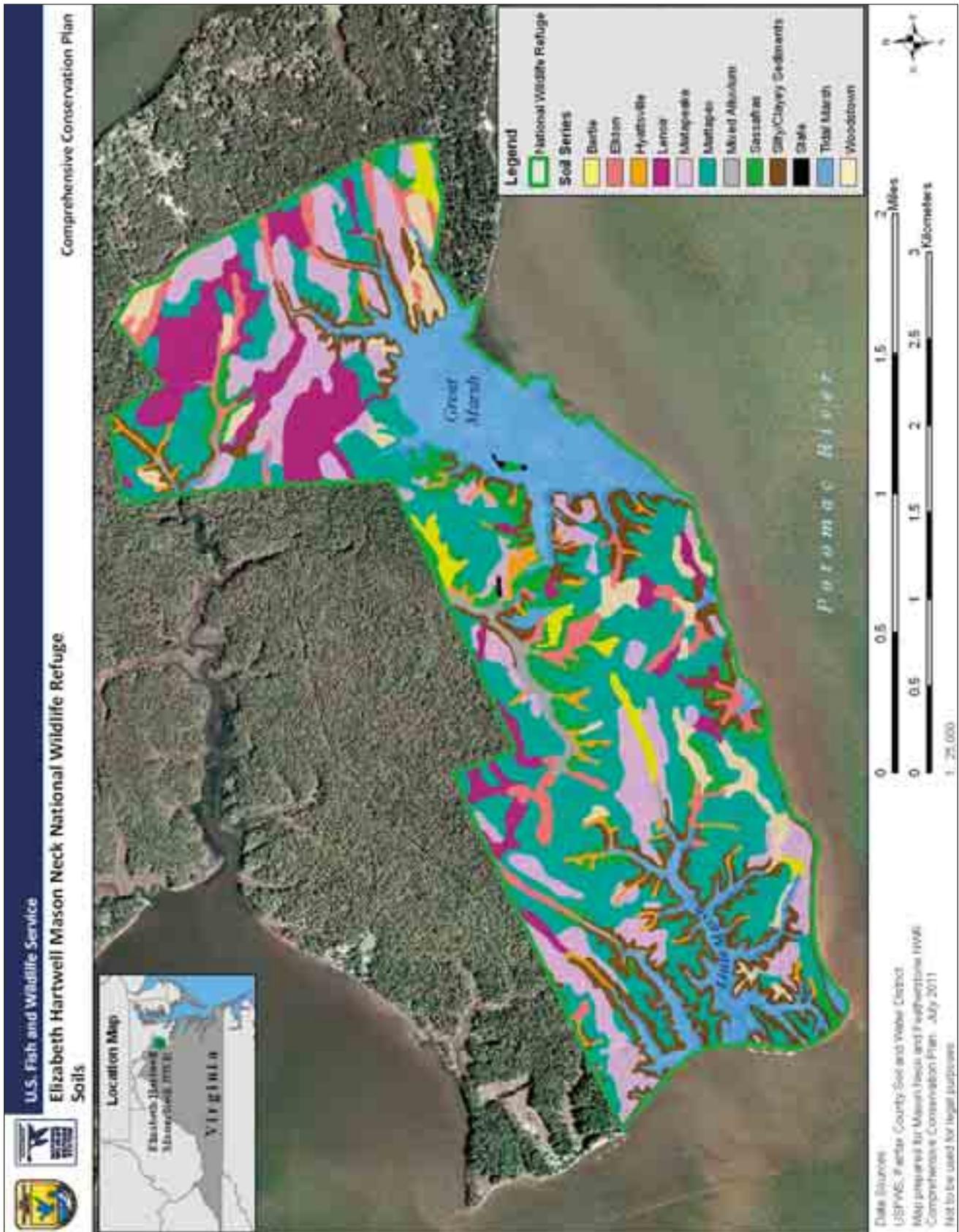


Table 3.11. Characteristics of the Soils of Mason Neck Refuge (Source: FC, 2009; USDA-NRCS, 2008)

Soil Type	Characteristics
Bertie	Predominantly fine, sandy loam sediments on relatively flat landscapes in the Coastal Plain. Very strongly acidic to moderately acidic. The seasonal high water table is 1.5 to 2.5 feet below the surface. Depth to hard bedrock is greater than 50 feet. Somewhat poorly drained with slow surface runoff and moderate permeability. Moderate erosion potential. Mostly used for agriculture, but where wooded, supports loblolly pine, sweetgum, yellow poplar, water oak, southern red oak, red maple. Understory plants typically include American holly, flowering dogwood, sassafras, greenbriar, giant cane, and inkberry.
Elkton	This wet soil occurs on nearly level landscapes in the lower Coastal Plain. Low areas of this soil, near larger streams, are within the floodplain. Fine-silty surface overlies silty and clayey subsoils. Organic strata may be encountered in some areas. Extremely to strongly acidic. Poorly drained with slow to ponded surface runoff. Erosion potential is low. The seasonal high water table is near the surface. Depth to bedrock is greater than 200 feet. Mostly wooded with native vegetation including red maple, sweetgum, willow oak, blackgum, and loblolly pine. Understory plants typically include greenbriar, American holly, waxmyrtle, and sweet bay.
Hyattsville	This soil occurs in drainageways and toe slopes, derived from Coastal Plain sediments eroded from upper slopes. Soil materials include clay, silt, sand, and gravel. The seasonal high water table is 1 to 2 feet below the surface. Depth to bedrock ranges from 10 to 200 feet or more. Low erosion potential.
Matapeake	This soil occurs on uplands in sand, silt, and clay sediments of the lower Coastal Plain. Sandy clay loam, clay loam, and silty clay loam soils are typical. A dense silty clay loam layer may be present two to three feet below the surface in some areas. Extremely to strongly acidic. Well-drained with medium surface runoff and moderate to moderately slow permeability. Erosion potential is moderate. Depth to bedrock is typically greater than 200 feet. Almost exclusively used for agriculture, native vegetation dominated by oaks, some cutover areas have loblolly, Virginia, or shortleaf pine.
Mattapex	This soil occurs on uplands in sand, silt, and clay sediments of the lower Coastal Plain. Sandy clay loam, clay loam, and silty clay loam soils are typical. A dense layer occurs 2.5 to 3 feet below the surface. A "perched" seasonal high water table is found above the dense layer, one to two feet below the surface. Extremely to strongly acidic. Moderately well-drained with moderate to moderately slow permeability. Erosion potential is moderate. Depth to hard bedrock is typically greater than 200 feet. Where wooded dominate vegetation is white oak, scarlet oak, loblolly pine, red maple, yellow poplar, sweet gum with understory of sassafras, dogwood, greenbriar, and American holly.
Mixed Alluvial	This channel-dissected soil complex occurs in floodplains and drainageways, and is susceptible to flooding ¹ . Soil materials range from soft organic silts and clays to dense gravel-sand-silt-clay alluvium. The seasonal high water table varies from 0 to 2.5 feet below the surface. Depth to hard bedrock ranges from 3 to 30 feet. Stream bank erosion within these soils may result in undercutting of embankments. Erosion potential is low.
Sassafras	This soil occurs on hilltops and sideslopes in sandy and clayey Coastal Plain sediments. The upper 5 feet consists of predominantly sandy and sandy clay loam materials. Well drained with slow to medium surface runoff and moderate to moderately slow permeability. Erosion potential is moderate. Depth to hard bedrock is greater than 200 feet. Mainly used for agriculture, where forested native vegetation is mixed upland hardwoods with some shortleaf and Virginia pine.
Silty/ Clayey Sediments	Occurs primarily along steep hillsides and adjacent to drainageways in the Coastal Plain. It consists predominantly of silty and clayey strata. Soil properties are variable within this unit and low bearing strata and perched seasonal high water tables may be present. This unit may contain deposits of marine clay. Erosion potential is high.
Tidal Marsh	Tidal marsh areas occur along the Potomac River and are periodically inundated by flood waters under tidal influence. The soils consist of organic-rich, highly stratified sandy, silty, and clayey sediments. Underlying soil is usually soft. Floodwaters from tidal inundation are typically shallow. Erosion potential is low.
Woodstown	This soil occurs in sandy sediments on nearly level landscapes in the lower Coastal Plain. Soil materials are primarily sandy loams to sandy clay loams, with a dense subsurface. The seasonal high water table is 1.5 to 2.5 feet below the surface. Extremely to strongly acidic. Moderately well drained with slow to medium surface runoff and moderate permeability. Erosion potential is low. Depth to hard bedrock ranges from 50 to more than 300 feet. Mostly used for agriculture; where wooded native vegetation is oak and hardwoods with some Virginia and loblolly pine.

Soil Type	Characteristics
State	This sandy to silty soil occurs on high stream terraces in the Coastal Plain. Flooding may occur following storm events. The seasonal high water table is four to six feet below the surface. Extremely to strongly acidic. Well drained with negligible to moderate surface runoff and moderate permeability. Shrink-swell potential is low. Erosion potential is high. Depth to hard bedrock is 8 to 20 feet. Mostly used for agriculture, where wooded dominate vegetation is white oak, red oak, American beech, elm, sycamore, American holly, sweetgum, yellow poplar, and loblolly, Virginia, and shortleaf pine.
Lenoir	This soil occurs in loamy and clayey sediments on nearly level landscapes in the lower Coastal Plain. A silty surface overlies a slowly permeable clayey subsoil which has a moderate shrink-swell potential. The seasonal high water table is 0.5 to 1.5 feet below the surface. Somewhat poorly drained with slow surface runoff and slow permeability. Erosion potential is moderate. Depth to bedrock is typically greater than 200 feet. Where wooded, dominant vegetation is loblolly pine, longleaf pine, blackgum, and yellow poplar. Understory typically includes inkberry, sourwood, honeysuckle, flowering dogwood, American holly, wax myrtle, blueberry, poison ivy, redbay, and greenbriar.

Wetland Habitats

Tidal Wetlands

Mason Neck Refuge’s freshwater tidal wetlands include the 207-acre Great Marsh and the 50-acre Little Marsh. Little Marsh is formed by the impoundment of High Point Creek. Map 3.7 depicts the National Wetlands Inventory wetland types.

Great Marsh has several meandering creek mouths and is dominated by wild rice, spatterdock, and other open marsh species favored by a constant freshwater tidal exchange (USFWS, 2005a).

High Point Creek is narrow and protected by forested promontories, except at the narrow impounded (large dike) mouth with little exchange of water beyond storm surges and runoff. Little Marsh impoundment is drawn down to the greatest extent possible in early summer to provide better foraging opportunities for young eagles and great blue heron (USFWS, 2005a).

Nontidal Waters

Streams such as Raccoon Creek provide excellent wetland habitat for species such as painted turtles (*Chrysemys picta*), red-bellied turtles (*Pseudemys rubriventria*), beaver, and mink (*Mustela vison*) (USFWS, 2004).

Upland Habitats

A survey in 1986 of Mason Neck Refuge identified a wide variety of plants throughout the diverse habitats of the refuge. Table A.5 in appendix A lists the plant species found during the survey.

Forest

Upland hardwood forest (1,883 acres) is the predominant vegetation type on the refuge and peninsula. Thirty-six species of trees have been recorded on the refuge. The dominant deciduous species in the upland forest are oak (*Quercus* spp.)—primarily chestnut oak (*Quercus prinus*), white oak (*Quercus alba*), and red oak (*Quercus rubra*) (USFWS 2004). Other overstory species include mockernut hickory (*Carya alba*), shagbark hickory (*Carya ovata*), yellow poplar (*Liriodendron tulipifera*), sycamore (*Platanus occidentalis*), American beech, and red maple (*Acer rubrum*). The dominant understory species include American holly, flowering dogwood (*Cornus florida*), and sweetgum (*Liquidambar styraciflua*) (USFWS, 1993).

Virginia pine (*Pinus virginiana*) is the most common coniferous species and is widely scattered throughout the deciduous upland forest where it sometimes

occurs in small patches and is usually found along the wetland edges. Other conifers include loblolly pine, eastern red cedar, and shortleaf pine (*Pinus echinata*).

In 2009, VDF completed a Forest Health and Condition Inventory and Assessment of Mason Neck Refuge. Overall, they determined that the refuge's hardwood forest was unhealthy, suffering from a lack of regeneration, missing an understory of shrubs and herbaceous plants, and was considerably "overstocked." They attributed the lack of hardwood regeneration, shrub layer, and herbaceous plants to overbrowsing from high deer populations. The VDF report included recommendations for improving forest health and habitat quality for bald eagles and forest interior dependent birds. The report is available from refuge headquarters.

Grassland

Only about 15 acres of grasslands or open field remain on the refuge and they are not a priority for management. During colonial times and up to the early 1900s, numerous acres were used for agriculture (crops and dairy) and logging. Natural succession has converted the grasslands into hardwood forests leaving a monotypic habitat of mixed hardwoods with small patches of conifers. Most of the refuge has not been logged in the last 40 to 50 years and some areas on the refuge have stands of 100-year and older trees (USFWS, 2005a). We mow approximately 10 acres of the grassland fields on a rotational basis for wildlife viewing opportunities and to manage invasive plants and weeds. In addition, approximately 2 acres of the field associated with the environmental education site are mowed annually as part of a 3-year rotational strip mowing program designed for educational interpretation and habitat diversity (USFWS, 2005a).

Threatened or Endangered Plants

The small whorled pogonia (*Isotria medeoloides*) is a federally listed threatened plant species. Although it has been found south and north of the refuge, it has not yet been found on the refuge. Habitat for this plant may be present on the refuge, but the deer population is likely having an impact on any suitable areas (USFWS, 1993). To date, the recovery team has not recommended special efforts to locate this plant on the refuge.

Sensitive joint-vetch (*Aeschynomene virginica*), a federally listed and State-listed threatened plant, has the potential to occur in freshwater tidal marshes on or in the vicinity of the refuge. Although it has not been identified on the refuge, sensitive joint-vetch can occur in freshwater to brackish wetlands, primarily marshes in the intertidal zone of large rivers (VDCR, 2010).

Two other State rare plant species may occur in the vicinity of the refuge, but have also not been identified on the refuge. Parker's pipewort (*Eriocaulon pakeri*) occurs in intertidal zones and river bulrush (*Schoenoplectus fluviatilis*) inhabits fresh tidal marshes (VDCR, 2010).

Invasive Plants

Executive Order 13122–Invasive Species (issued February 3, 1999) authorizes and directs the Service to protect native wildlife and their habitats on national wildlife refuges from damage from invasive and injurious species. In 2004, the refuge surveyed for invasive plants along 24 transects across the refuge. Table A.5 in appendix A lists the plant species found. The refuge currently has two invasive plants of primary concern: Japanese stiltgrass and mile-a-minute. Their descriptions are below. Other invasive plants of concern on the refuge are tree-of-heaven, Japanese honeysuckle, Japanese barberry, and beefsteak plant.

Japanese stiltgrass

Japanese stiltgrass is an annual plant that has a sprawling habit and grows slowly through the summer months, ultimately reaching heights of 2 to 3.5 feet. It threatens native plants and natural habitats in open to shady, and moist to dry locations. Stiltgrass spreads to form extensive patches, displacing native species that are not able to compete with it. Where white-tail deer are abundant, as they are on Mason Neck Refuge, they may facilitate stiltgrass invasion by feeding on native plant species and avoiding stiltgrass (NPS, 2008). Japanese stiltgrass can spread rapidly following a disturbance such as flooding or mowing. Within 3 to 5 years it can form dense monotypic stands which crowd out native herbaceous vegetation. Although Japanese stiltgrass does not produce prolific amounts of seed (a single produces 100 to 1000 seeds), the seeds remain viable in the soil for 3 to 5 years. It is also well adapted to low light levels and is able to grow and produce seeds in five percent of full sunlight.

Mile-a-minute

Mile-a-minute weed is an herbaceous, annual, trailing vine that is widely distributed on the refuge and is a high priority for management. Mile-a-minute weed generally colonizes open and disturbed areas along the edges of woods, wetlands, stream banks, roadsides, and uncultivated open fields. It will tolerate shade for a part of the day, but needs a high percentage (63-100 percent) of available light. Mile-a-minute attaches to other plants with recurved barbs and climbs over other plants to reach areas of high light intensity. This invasive species spreads rapidly and is difficult to manage once established. It is a rapidly growing vine which allows it to overtake native vegetation by smothering seedlings and outcompeting adult plants for space, nutrients, and sunlight. This is particularly a concern in the refuge's wet meadows which may support rare wetland plants (VDCR, 2003).

Refuge Wildlife

The mature upland hardwoods, freshwater marshes, and small grassland areas which comprise the refuge habitat host over 211 species of birds, 31 species of mammals, and over 40 species of reptiles and amphibians (USFWS, 2005a). One of the State's largest colonies of great blue heron in the Mid-Atlantic region is located in the Little Marsh impoundment area (USFWS, 2004). Lists of the wildlife species on the refuge are provided in appendix A. This section discusses species of greatest conservation need found at the refuge that we consider as focal species for refuge management.

Threatened or Endangered Animals

There are no known occurrences of any federally listed animal species on the refuge. However, should one become known, we would make it a priority to protect and aid in its recovery. Two State threatened birds, the peregrine falcon (*Falco peregrinus*) and loggerhead shrike (*Lanius ludovicianus*), are known on the refuge but are rare sightings. The tables in appendix A highlight sensitive species including State rare and endangered species, as well as other species of concern.

Birds

Of the 211 species of birds that occur on Mason Neck Refuge (USFWS, 1995; also see appendix A), 114 species are listed as species of conservation concern by one or more of the following authorities in various plans:

- Service's Region 5 Birds of Conservation Concern List (17 species)
- ACJV, BCR 30 plan (70 species)
- PIF Area 44 Plan (50 species)
- Virginia WAP (70 species)

Approximately 56 species of conservation concern are known to breed on the refuge.

Bald Eagle

The refuge was established for the primary objective of protecting essential nesting, feeding, and roosting habitat for bald eagles (USFWS, 2005a). Records of bald eagle use date back to the 1700s, showing multiple nest sites and summer roosts hosting concentrations of 50 or more birds. During the 1960s, populations dwindled locally, as they did nationally, due to increased pesticide use and habitat destruction (USFWS, 2009). With greater awareness, better protection nationally and regionally of the birds and their habitat, and reduction in pollution, the eagle population has made a recovery (USFWS, 2005a).

Three active eagle nest sites exist on the refuge. Other areas frequented by eagles in the vicinity of the refuge are the roost and a nest site on Kanes Creek in the neighboring State park, a nest and roost on the north border of the refuge and Gunston Hall, a nest site between Gunston Manor and Hallowing Point communities, and a nest site on undeveloped land on the north portion of the peninsula. Historically, eagles abandoned the nest near the heron rookery and moved out along the shore between Anchorage Road and High Point. Though active for 3 years, we suspect the proximity resulted in competition between the herons and the High Point Creek bald eagle. In 2002, the occupied bald eagle breeding site was abandoned and has not been occupied since (USFWS, 2005a). The inset table in map 3.2 highlights the nesting territories and productivity of bald eagles on Mason Neck Refuge from 1990 to 2010.

The year 2005 marked the completion of 6 years of bald eagle surveys along the shoreline of the Potomac River between Fort Washington, Maryland and Aquia Creek, Virginia. The field study was designed to examine the distribution and abundance of the bald eagles and to assess potential human impacts or the effects that activities might have on their distribution and relative abundance. In general, there was a three-fold increase in the overall number of eagles observed along the shoreline, with an average of 20 birds observed in 2000 to an average of 64 birds observed in 2005. The relationship between their distribution and the availability of perching and foraging habitat along the river suggests that the eagles are avoiding developed areas along the river (USFWS, 2005a).



Bill Wallen

Breakwater off Mason Neck Refuge

Waterfowl

Waterfowl that breed at the refuge include the American black duck, a highest priority species in BCR 30. The refuge also supports hooded merganser (*Lophodytes cucullatus*) and wood

duck, which are both considered of moderate priority by BCR 30. Although Mason Neck Refuge is out of the mainstream of the Atlantic Flyway, the refuge, as part of a series of small marshes along the Potomac River, provides migrating and wintering habitat for over 20 different waterfowl species. The AP Canada goose (BCR 30 highest priority) and the tundra swan (BCR 30 high priority) are common migrants at the refuge.

Each year at Mason Neck Refuge, approximately 75 ducks are banded at Great Marsh by the VDGIF. The majority of banded ducks are wood ducks, approximately 5 to 10 are usually teal, and 3 to 5 are mallards. Aerial surveys around the refuge area have not been conducted in the past seven years because of flight area restrictions.

Raptors

Fifteen species of raptors (table A.1, appendix A) have been known to breed on or visit the refuge. In addition to bald eagles, nesting has been documented for BCR 30 ranked high priority broad-winged hawk (*Buteo platypterus*), the VDGIF ranked American kestrel (*Falco sparverius*; Tier II), and VDGIF ranked red-shouldered hawk (*Buteo lineatus*; Tier V). VDGIF ranked owls of conservation concern found nesting on the refuge include the barred owl *Strix varia*; Tier II) and barn owl (*Tyto alba*; Tier V). Definitions of tier levels are explained in appendix A.

Shorebirds, Gulls, Terns, and Allied Species

Great Marsh and the refuge's Potomac River shoreline provide only marginal habitat for shorebirds because of the steep banks. The refuge is also located out of the main migration corridor. A total of 19 species of shorebirds, gulls, and terns have been reported at Mason Neck Refuge. In the winter, ring-billed (*Larus delawarensis*), herring (*Larus argentatus*), and great black-backed gulls (*Larus marinus*), and the PIF 44 (Tier V) and State-listed (Tier IV) Forster's tern (*Sterna forsteri*) comprise the bulk of this community. Small populations of migrating shorebirds, including the wintering greater yellowlegs (*Tringa melanoleuca*) (BCR 30 high-priority), and common snipe (*Gallinago gallinago*) (BCR 30 moderate-priority), are also observed.

Marsh- and Waterbirds

The refuge hosts 14 species of marsh and waterbirds during the spring and summer. Most abundant are the great blue heron, green heron (*Butorides virescens*), and great egret (*Ardea alba*) that use the small marshes and Potomac River shoreline for feeding, nesting, and roosting. Extensive marsh bird surveys were last conducted at Mason Neck and Occoquan Bay Refuges in June and July of 1999.

Two species of colonial waterbirds—the great blue heron and great egret—breed on the refuge. The number of great blue heron, in particular, contributes to this being one of the largest rookeries in the Mid-Atlantic region. Both are PIF 44 listed as Tier V birds of conservation concern. The population size of the heron rookery in the southwest corner of the refuge grew from 30 nests in 1979 to over 1,679 nests at its peak in 2003, during which time the reproductive potential for the heron has varied considerably and may be related to weather-related factors. The estimated average size of the rookery at Mason Neck Refuge during the period 1992 to 2004 was 1,386 nests, with a range between 1,026 to 1,679 nests, based on a total census of nests during the fall or winter. The rookery has been comprised primarily of great blue heron with some great egret nests. The number of great egret nests has typically ranged from only 15 to 25. These birds have consistently located in the southwest corner of the rookery site (Witt, 2006). More recently, the entire rookery has decreased markedly in size to fewer than 800 nests (Witt, personal communication, 2008). The portion of the refuge on which the heron and egret rookery is located is closed to the public.

Migratory Songbirds

The refuge supports a wide diversity of songbirds. A complete list can be viewed at: <http://www.fws.gov/masonneck/wildlife.html> (accessed June 2011). Several of these are birds are listed of “Highest” conservation concern in the BCR 30 plan, including blue-winged warbler (*Vermivora cyanoptera*), prairie warbler (*Dendroica discolor*), and wood thrush. There are also 14 songbird species of “high” concern in BCR 30 that breed on the refuge. Those are listed in appendix A. Several others known to breed on the refuge are listed as FIDS of conservation concern in the Chesapeake Bay area, including red-eyed vireo (*Vireo olivaceus*), Louisiana waterthrush, hooded warbler (*Wilsonia citrine*), and ovenbird (*Seiurus aurocapilla*).

The Institute for Bird Populations (IBP) from Port Reyes Station, California has continued operating two Monitoring Avian Productivity and Survivorship (MAPS) stations on Mason Neck Refuge, which were started in 1995. The refuge was included in a partnership with nearby Fort Belvoir to monitor nesting bird activity as part of the MAPS Program. The refuge's stations are Mason Neck-1, located on Sycamore Road near Old Barn Road, and Mason Neck-2, on Little Marsh Road northwest of the High Point eagle nest. Volunteers, trained by IBP, operate the stations and conduct an average of eight banding sessions between May and August each summer. At the site, birds are captured with mist-nets, identified, sexed, and measured. The 2005 field season resulted in 38 birds being newly banded with 11 recaptured from previous years at Mason Neck-1 site; and 54 birds being newly banded with 6 recaptured from previous years at Mason Neck-2 site.

Game Birds

The game bird species that occur on the refuge are wild turkey (*Meleagris gallopavo*), mourning dove (*Zenaida macroura*), northern bobwhite quail (*Colinus virginianus*), ruffed grouse (*Bonasa umbellus*), and woodcock (*Scolopax minor*). Mourning doves are abundant on the refuge yearround, while woodcock are commonly seen in the spring. Both bobwhite quail and ruffed grouse are rare on the refuge.

Reptiles and Amphibians

The refuge's vernal pools, creeks, tidal marshes, and woodlands offer a diverse array of habitats for reptiles and amphibians. There are 54 species of reptiles and amphibians known or suspected to occur on the refuge. Table A.2 in appendix A lists those species known or suspected to occur on the refuge.

Reptiles

Eight turtle species and four lizard species are either known or suspected to occur on the refuge (Klimkiewicz, 1972a). Of the eight turtle species, two are considered species of greatest conservation need in Virginia: eastern box turtle (*Terrapene carolina*; Tier III) and spotted turtle (*Clemmys guttata*; Tier III) (VDGIF, 2005).

Two researchers from local schools have conducted studies on the snake community of Mason Neck Refuge. A 2001 doctoral thesis was completed by Terry R. Creque of George Mason University (Creque, 2001), and a 2001-2003 study of eastern worm snakes (*Carphophis amoenus*) was completed by John Orr of J.E.B. Stuart High School in Fairfax, VA (Orr, 2006). The 2 studies found a total of 12 species of snakes on the refuge and 6 more species are suspected to occur on the refuge. Of the 16 snake species, 2 are considered species of concern by the State of Virginia: common (or eastern) ribbon snake (*Thamnophis sauritus*; Tier IV) and eastern hognose snake (*Heterodon platirhinos*; Tier IV) (VDGIF, 2005).

Amphibians

Nine salamander species are either known or suspected to occur on the refuge (Klimkiewicz, 1972b). To determine what frog and toad species occur on the refuge, anuran call count surveys were conducted each year from 2000 to 2002. These surveys found 15 species of frogs and toads on the refuge and were also used to find out what habitat sites are important to breeding frog and toad populations.

Mammals

Currently, 31 species of mammals are known to inhabit the refuge (USFWS, 2005a). Common mammal species include gray squirrel (*Sciurus carolinensis*),

red fox (*Vulpes vulpes*), eastern cottontail rabbit (*Sylvilagus floridanus*), and white-tailed deer. The mammals that have been observed on Mason Neck Refuge are listed in appendix A, table A.3 (Jones and Klimkiewicz, 1975).

White-tailed Deer

White-tailed deer are one of the most visible species on Mason Neck Refuge. The refuge's large deer population reflects overall high population levels throughout northern Virginia. Extensive development in the area has reduced the amount of habitat available for wildlife which taxes remaining habitats more heavily. White-tailed deer populations at high levels may negatively impact habitat quality and other wildlife species. Deer are particularly prone to habitat alteration due to their high reproductive potential (Rooney and Waller, 2003). Through their foraging habits and preferences, they can change plant composition and structure with subsequent impacts on other wildlife such as songbirds (McShea and Rappole, 2000). These impacts are magnified when other factors, such as mild weather, availability of alternative food sources, and reduced annual mortality allow populations to quickly increase in numbers (USFWS, 2007b). In addition to a general decrease in habitat quality, high deer densities can also decrease overall deer population health as evidenced by decreased body weights, increased occurrence of deformities, increased levels of internal and external parasitism, decreased body fat deposits, and disease transmission (USFWS, 2007b).

Mason Neck's deer population appears to be having impacts on the refuge's forests. In 2009, the VDF determined that the refuge's hardwood forest was unhealthy, suffering from a lack of regeneration, missing an understory of shrubs and herbaceous plants, and was considerably "overstocked." The lack of hardwood regeneration, shrub layer, and herbaceous plants is likely due to overbrowsing from high deer populations (VDF, 2009). We are particularly concerned about the lack of recruitment of canopy trees, which are important habitat for bald eagles.

The refuge began a deer management program in 1989 to control and reduce deer numbers and to improve the quality of the forest habitat which had been severely degraded. This was clearly evidenced by distinct browse lines and lack of understory vegetation. The refuge currently uses deer health data such as weight, fat deposits, antler growth, and bone marrow fat content as indicators of herd health. Harvest data indicate that the population is stable and that habitat is improving, however densities are still above desired levels and deer are still nutritionally stressed.

Interjurisdictional and Other Fish Species

The tidal Potomac River and tributaries support a diversity of interjurisdictional fish species that depend in part on the larger tributaries (including the Occoquan River and Occoquan Bay) and the smaller streams and marshes along the Virginia shoreline for habitat. Interjurisdictional fish of interest to the Service and considered species of concern by VDGIF (2005) include the shortnose sturgeon (*Acipenser brevirostrum*; Tier I), Atlantic sturgeon (Tier II), alewife (Tier IV), American shad (Tier IV), and American eel (Tier IV). Other fish of greatest conservation need in the Coastal Plain-Potomac EDU include the bridle shiner (*Notropis bifrenatus*; Tier I), and yellow lance (*Elliptio lanceolata*; Tier III), least brook lamprey (*Lampetra aepyptera*; Tier IV), ironcolor shiner (*Notropis chalybaeus*; Tier IV), and logperch (*Percina caprodes*; Tier IV). Table A.4 in appendix A lists the fish species of conservation concern in the refuge area.

Cultural Resources

Mason Neck Refuge contains an important and unusually diverse archaeological and historical record, which offers evidence of thousands of years of settlement by Native Americans, and of later occupations by Euro-Americans and African-

Americans. Twenty-five known Native American sites occur on the refuge and represent occupations that began as early as 9,000 years ago, and continued into the mid-seventeenth century. There are also 15 known historical archaeological sites, which offer insights into Euro-American settlement that occurred after the seventeenth century. Unfortunately, the refuge's archaeological resources are seriously threatened by shoreline erosion and a recent reconnaissance study assessed the impacts of this erosion (Johnson, 2005). Appendix F presents a detailed discussion of the cultural resources of Mason Neck Refuge.

Visitor Services

Mason Neck Refuge provides a variety of opportunities for the public to participate in wildlife-dependent recreational activities. The Refuge Improvement Act identifies six wildlife dependent public uses that are a priority on refuges and directs us to give them enhanced consideration during CCP development. Five of the six priority uses have been found compatible on this refuge in designated areas, including: wildlife observation, nature photography, hunting, interpretation, and environmental education. Recreational fishing is not offered on the refuge because no opportunities are present in areas open to public access. For example, virtually all of the refuge shoreline is closed to public access due to concerns with wildlife disturbance, impacts to sensitive habitat areas, or accelerating shoreline erosion. Our public use program areas of emphasis for Mason Neck Refuge are wildlife observation, photography, and interpretation.

Visitation

In 2009, our total annual visitation was 19,172 visitors. The majority (approximately 75 percent) of our visitors engage in wildlife observation and photography.

Wildlife Observation and Photography

The three trails on the refuge facilitate wildlife observation and photography. A brief description of the trails follows.



*Joseph V. Gartlan, Jr.
Great Marsh Trailhead
on Mason Neck Refuge*

Joseph V. Gartlan, Jr. Great Marsh Trail

The Great Marsh Trail is a paved, 3/4-mile, accessible trail that follows a forested ridge along a natural peninsula and terminates at an observation platform at Great Marsh (USFWS, 2004). The large observation platform features an accessible Mark-1 telescope for viewing wildlife. Interpretive sites on the Great Marsh Trail are located at a kiosk near the parking lot and a wayside interpretive panel at the observation platform. Information about the refuge, Joseph V. Gartlan, Jr., Great Marsh, plants, and wildlife can be found at these sites.

Woodmarsh Trail

The 3-mile Woodmarsh Trail loops through a hardwood forest, carpets of ferns, over small streams, and along a marsh (USFWS, 2004). Interpretive sites on Woodmarsh Trail are located at a kiosk at the parking lot, an interpretive panel at the beginning of the trail, and a kiosk at the end of the trail adjacent to Sycamore Road. These sites provide information about the refuge, white-tailed deer, bald eagles, other refuge wildlife, invasive plants, rules and regulations, and a trail map (USFWS, 2005). Portions of the trail are closed from December through July due to bald eagle nesting activity.

High Point Trail

The High Point Trail was dedicated at the Elizabeth Hartwell Mason Neck Earth Day celebration in April of 2005 (USFWS, 2005a). It is a multi-purpose, Americans with Disabilities Act (ADA)-compliant trail which parallels High Point Road from Gunston Road through the refuge to the Mason Neck State

Park Visitor Center. Only 1/2-mile of the 3-mile trail occurs on the refuge. The trail was developed to provide a safe alternative to pedestrians that were using High Point Road to access the State Park. This is the only trail on the refuge that allows bicycling and other non-motorized pedestrian uses, along with foot traffic.

Environmental Education

According to Service policy (605 FW 6), environmental education is a curriculum-based process designed to teach citizens and visitors of all ages about the history and importance of conservation and the significance of natural resources.

In general, environmental education programs may incorporate some of the following: onsite, offsite, and distance learning materials, activities, programs, and products based on a course of study designed for specific audiences.

Over the past few years, the role of refuge staff in environmental educational activities has shifted from an active role to one of a facilitator. In addition, diminishing school budgets have resulted in a decrease in the number of schools utilizing the refuge. However, we continue to encourage educators to use the refuge with their primary and secondary students to participate in hands on activities in which they learn basic biological principles and are taught about the Chesapeake Bay watershed. High school and college level teachers and faculty have also led students on more advanced studies.

Environmental education facilities on the refuge include an education pavilion and loop trail located off Sycamore Road, which is maintained when staff and funding allows. This area is not open to the general public and is managed via a special use permit. Other educational programs also occur elsewhere on the refuge. For example, Thomas Jefferson High School has used the refuge to conduct advanced science projects. Four times a year, students survey specific vernal pool sites for salamanders and test new computer monitoring devices. In another study, students collect and analyze deer pellets. The coordinator of the project has been very excited about the advanced science work completed by the students and the opportunity to use the refuge. A new program, led by Virginia Polytechnic Institute (Virginia Tech), began in 2007 and has students from Freedom High School collecting dendrochronology (tree-ring) information.

Interpretation

The Service defines interpretation as “[a] communication process that forges emotional and intellectual connections between the audience and resource” (603 FW 7). Interpretation is the means by which the refuge presents historical and cultural information and explains concepts of ecology and methods of resource management to the public. The Service’s guiding principles for its interpretive programs include the following:

- Developing a sense of resource stewardship
- Minimizing conflicts between visitors engaged in wildlife-dependent recreation
- Promoting an understanding and appreciation for the individual refuge, the Refuge System, and America’s natural and cultural resources

Interpretation facilities on the refuge include three kiosks with interpretive panels as noted above. Two are located at the trail heads of Great Marsh and Woodmarsh Trails. An additional kiosk is located further down Woodmarsh Trail, close to Sycamore Road. Each kiosk contains a map panel to physically orient the visitor and additional panels covering topics such as viewable wildlife, bald eagles, invasive and exotic plant and animal species, and white-tailed deer.

All interpretive panels on the Great Marsh Trail were updated in 2001. One panel provides information on Joseph V. Gartlan, Jr., what visitors are likely to see along the trail, and refuge regulations. Another provides information on Great Marsh with photographs of plants and wildlife commonly seen at the marsh. New panels at the Woodmarsh Trail parking lot include a trail map and an aluminum trailhead map and information panel. Six panels at the Sycamore Road kiosk include panels on white-tailed deer, bald eagles, other wildlife in the area, and invasive plants, as well as a trail map.

Interpretive tours are given by staff on special occasions, including festivals and other community events. Refuge brochures on a variety of topics are also available to facilitate self-guided interpretation.

Hunting

A white-tailed deer management program was initiated in 1989 (USFWS, 2005b) to reduce the population of deer on the refuge and thereby protect and restore understory vegetation on both the refuge and adjacent State park. A large, unmanaged population of deer had created a noticeable browse line due to the lack of available food. In partnership with the State park and VDGIF, the refuge holds an annual hunt in November and December as part of its deer management program. Hunters selected through an application and lottery process are required to attend an orientation session to learn the rules, restrictions, and management goals of the hunt. Table 3.12 summaries harvest information from 1998 to 2009.

From a biological perspective, white-tailed deer hunting is a viable management tool needed to reduce the deer population on the refuge and Mason Neck State Park. From a recreational perspective, these hunts serve to continue the legacy and heritage of hunting in the region. We will continue to offer an annual hunt due to the quick and continual repopulation of this area by deer.

Table 3.12. Annual Mason Neck Refuge Deer Harvest Results (1998-2009)

Year	Number of Does Harvested	Number of Bucks Harvested total	(antlered/button)*	Totals
1998	44	53	(38/15)	95
1999	34	60	(34/26)	93
2000	53	56	(33/22)	109
2001	48	44	(27/17)	92
2002	41	31	(23/8)	72
2003	48	67	(46/21)	115
2004	39	60	(54/6)	99
2005	39	50	(37/13)	89
2006	60	61	(47/14)	121
2007	44	67	(40/27)	111
2008	55	53	(37/16)	108
2009	30	40	(30/10)	70

**Male deer under 1 year of age are considered "button bucks."*

Featherstone Refuge Environment

Refuge Establishment and History

Refuge Size and Location

Featherstone Refuge consists of 325 acres of woodland and freshwater tidal marsh. It lies along the northern shore and mouth of Neabsco Creek and north around Featherstone Point along Occoquan Bay. It is located approximately 4 miles southwest of Mason Neck Refuge, and 22 miles from Washington, D.C. in Prince William County, Virginia. Refuge Complex staff are responsible for its management.

Establishment Authority and Purpose

Featherstone Refuge was established with the purpose to protect the features of a contiguous wetlands area. Public Law 91-499, approved October 22, 1970 (84 Stat 1095), authorized the Secretary of Interior to acquire, by purchase or exchange, portions of a tract of land in Prince William County, Virginia from the District of Columbia. The law required that both the Secretary and the District mutually agree the lands were wetlands and areas necessary to protect surrounding natural features of such wetlands (<http://www.fws.gov/laws/lawsdigest/nwracts.html#Featherstone>; [accessed June 2011]).

History of Refuge Land Acquisition

It was not until 1979 that the Service acquired land to establish Featherstone Refuge from the District of Columbia. The refuge then consisted of 164 acres of land along Farm Creek in eastern Prince William County. An additional 161 acres of land were acquired for the refuge with a donation from Prince William County in 1992. Elizabeth Hartwell, a noted conservationist in the region, was also instrumental in the establishment of Featherstone Refuge, along with Mason Neck Refuge and Mason Neck State Park.

Public Access

There has been no authorized public access to Featherstone Refuge since its establishment. However, in chapter 4 under goal 2 for Featherstone Refuge, we describe new opportunities that will be offered upon CCP approval. Official administrative access is by two rights-of-way, neither of which is accessible to vehicles, and which only provide access to the refuge boundary, not its interior. Refuge staff use the VRE commuter rail station landing built next to the refuge as one way to gain quick access across the tracks to the refuge.

Illegal trespass is a common problem on the refuge but has been dramatically reduced with the addition of a full-time refuge law enforcement officer. Violations recorded include illegal hunting, fishing, camping, and dumping of trash.

Community Demographics and Planning

Featherstone Refuge is located on Occoquan Bay in the eastern-most portion of the town of Woodbridge, Virginia which is a U.S. census-designated place (CDP). According to the U.S. Census Bureau, the Woodbridge CDP has a total area of 10.8 square miles, of which 10.5 square miles (97 percent) is land and 0.3 square miles (3 percent) is water. Woodbridge is geographically located about 22 miles from Washington, D.C.

Population Statistics

As of the census of 2000, there were 31,941 people, 10,687 households, and 7,769 families residing in the Woodbridge CDP. The population density was 3,047.8 people per square mile. There were 11,026 housing units at an average density of 1,052.1 per square mile. The racial makeup of the CDP was 56.34 percent White, 23.45 percent African American, 0.55 percent Native American, 4.90 percent Asian, 0.17 percent Pacific Islander, 9.62 percent from other races, and

4.96 percent from two or more races. Hispanic or Latino of any race were 19.07 percent of the population. There were 10,687 households out of which 41.5 percent had children under the age of 18 living with them, 52.3 percent were married couples living together, 14.2 percent had a female householder with no husband present, and 27.3 percent were non-families. Of all households, 20.4 percent were made up of individuals, and 3.9 percent had someone living alone who was 65 years of age or older. The average household size was 2.96 and the average family size was 3.40.

The median income for a household in the CDP was \$50,525, and the median income for a family was \$52,362. Males had a median income of \$35,538 versus \$28,587 for females. The per capita income for the CDP was \$19,810. About 4.6 percent of families and 5.5 percent of the population were below the poverty line, including 7.7 percent of those under age 18 and 5.9 percent of those age 65 or over.

Potomac Heritage National Scenic Trail

The PNHST is a developing network of locally managed trails and routes between the mouth of the Potomac River and the Allegheny Highlands in the upper Ohio River Basin (NPS, 2009). The PHNST network is one part of the National Trails System created by the National Trails System Act of 1968. The Department completed a feasibility study for the PHNST in 1974 and Congress passed legislation designating the PHNST in March 1983 (Public Law 98-11), establishing a foundation for development of the PHNST network of approximately 704 miles of trails in Virginia, Pennsylvania, Maryland, and Washington, D.C.

To date, approximately 830 miles of existing and planned trails have been recognized as segments of the PHNST network (NPS, 2009; <http://www.nps.gov/pohe> [accessed June 2011]). The trail network is not yet continuous, but many trails and segments have been completed. For example, people can now hike 375 miles from Washington, D.C. to Seward, Pennsylvania (Lillard & Talone, 2006) using the Chesapeake and Ohio Canal Towpath, Great Allegheny Passage, and Laurel Highlands Hiking Trail. Existing and planned routes in northern Virginia total approximately 100 miles, and bicycling routes in southern Maryland and on the Northern Neck of Virginia total over 225 miles.

Existing, planned, and proposed segments of the PHNST through Prince William County parallel the Potomac River shoreline, including a segment within Featherstone Refuge (see map 4.3). The proposed route near the refuge would use an existing pedestrian crossover at the VRE station, pass east of the railroad tracks, continue north along an abandoned railroad right-of-way within the refuge, and connect with Featherstone Drive on the north end of the refuge. The segment of PHNST proposed within the refuge is contingent upon the availability of parking spaces at the VRE station and use of the pedestrian crossover.

Refuge Administration

Refuge Revenue Sharing Payments

Featherstone Refuge's revenue sharing payments to Prince William County from 2003 to 2009 are listed in table 3.13. Revenue sharing checks are sent by the Service electronically to Prince William County on an annual basis.

For more information on refuge revenue-sharing payments, see our discussion under "Refuge Administration" for Mason Neck Refuge.

Table 3.13. Refuge Revenue Sharing Payments to Prince William County, Virginia from 2003-2009

Fiscal Year	Refuge Revenue Sharing Payments
2009	\$633
2008	\$816
2007	\$844
2006	\$911
2005	\$807
2004	\$912
2003	\$949

Special Use Permits

The refuge issues special use permits for various activities such as research, surveys and censuses, and environmental education. Each request is considered on a case-by-case basis and decisions are based on the following criteria: type, purpose, and appropriateness of activity; whether the activity supports refuge goals; and what kind of impact will the activity have on other users. Prior to issuing a special use permit, the refuge manager evaluates the use's appropriateness and compatibility with other refuge purposes.

Partners

The refuge coordinates with Prince William County and the Immigration and Naturalization Service for certain law enforcement actions and with VDGIF for fish and wildlife issues.

The Friends group, along with the Prince William Soil and Water Conservation District, provides volunteers for specific maintenance projects and clean-ups.

Refuge Terrain and Habitats**Topography**

The refuge's topography is almost entirely flat with patches of bottomland hardwoods and tidal marsh (map 3.8) The majority of the refuge is wetlands with relief lower than 10 feet above sea level.

Land Cover

The refuge currently consists of 325 acres, including 80 acres of upland mature mixed-deciduous forest, 220 acres of palustrine wetlands, and 25 acres of open water (map 3.9). The shoreline along the banks of the Potomac River consists of narrow beaches. The Richmond, Fredericksburg, and Potomac Railroad parallels the western boundary of the refuge from north to south with built up elevations of 80 feet. An abandoned railroad grade also crosses the refuge. Farm Creek passes through the northeastern portion of the refuge before draining into Occoquan Bay and the Potomac River.

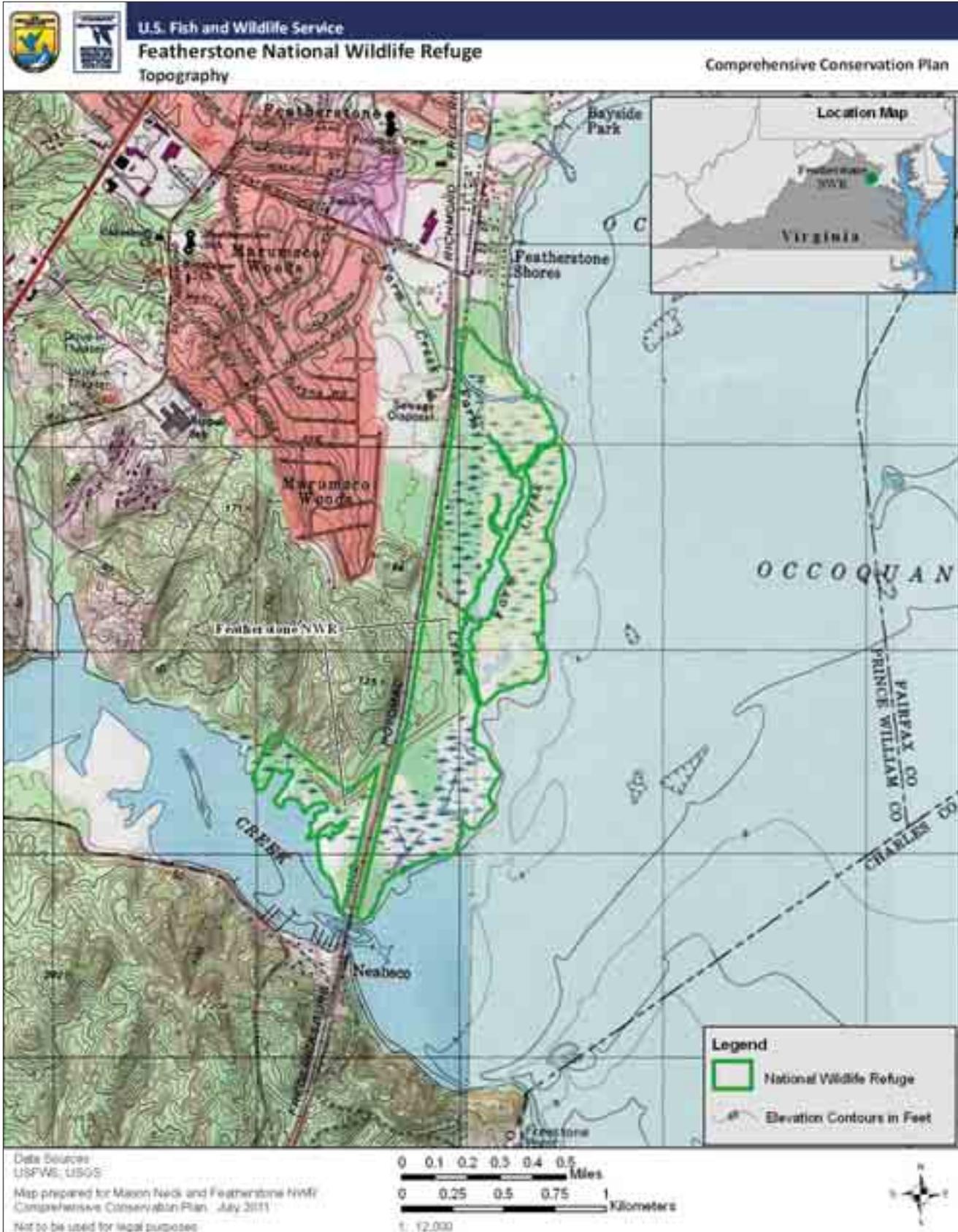
Soils

The soils of Featherstone Refuge are shown on map 3.10 and described in table 3.14.

Shoreline Erosion

Similar to Mason Neck Refuge, shoreline erosion is also an issue at Featherstone Refuge. Over the years, refuge staff have observed active shoreline erosion at Featherstone Refuge; however, no formal measuring or monitoring has occurred.

Map 3.8. Featherstone Refuge Topography



Map 3.9. Featherstone Refuge General Land Cover



Map 3.10. Featherstone Refuge Soils



Table 3.14. Characteristics of the Soils of Featherstone Refuge (Source: NRCS 2006)

Soil Type	Characteristics
Codorus soils	Occur on level slopes of floodplains and formed in alluvial materials containing medium to large quantities of mica derived from schist, gneiss, phyllite, and other metamorphic rocks. About 20 percent are wooded, mostly mixed hardwoods.
Dumfries soils	Occur on narrow ridges and side slopes in the northern part of the Atlantic Coastal Plain. These soils developed in sandy feldspathic sediments in highly dissected Coastal Plain terraces. Most of this soil is in hardwood and mixed hardwood and pine forest. Few areas are used for pasture, residential, and commercial development.
Elsinboro soils	Formed in unconsolidated, old alluvium, derived from crystalline rock that contains high amounts of mica. Permeability is moderate in the solum. The potential for surface runoff is negligible to medium. Native vegetation consists of maple, oaks, poplar, hickory, and beech.
Featherstone soils	Occur on level floodplains in the Coastal Plain. They do not flood daily but are subject to high seasonal tides and storm tides. The water table is at the surface 6-8 months each year and most areas are subject to ponding. They are very poorly drained; very slow to ponded runoff; moderate permeability. It is dominated by woody species with few larger trees of red maple and sweetgum. Cattails, skunk cabbage, and reeds make up much of the vegetation. Many areas are partially covered with debris.
Hatboro soils	Occur on nearly level flood plains. They formed in alluvium largely from schist, gneiss, and other metamorphic and crystalline rocks. They are poorly drained. Permeability is moderate. Index surface runoff class is high or very high. These soils are subject to periodic stream overflow, which usually occurs during the winter and spring months. Woodland areas are in mixed hardwoods.
Kelly soils	Formed in residuum weathered from gray to brown hornfel and granulite. Somewhat poorly drained. The potential for surface runoff is low to medium. Permeability is slow or very slow. In undisturbed areas, the depth to the top of the seasonal high water table ranges from 10 to 20 inches for some time in most years. About 40 percent of the area is in native forest of oaks, hickory, ash, and Virginia pine.
Lunt soils	Occur on gently sloping to moderately steep Coastal Plain uplands. They formed in fluviomarine Coastal Plain sediments. Most of the Lunt soils are used for urban development, idle land or woodland. The dominant species in the wooded areas are pines, oaks, hickory, gum, and poplar
Marr soils	Formed in a regolith of unconsolidated very fine and fine sandy loams. Most of the present woodlands consist of mixed hardwoods, dominated by oaks. Some areas have moderate to heavy stands of Virginia pine, and in places shortleaf pine.
Marumsco soils	Occur on level to gently sloping low Coastal Plain terraces. These soils developed in stratified marine sediments of sand, silt, and clay that contain a relatively high content of feldspar. Most of the acreage is in hardwood and pine forest. Some areas are used for urban development.
Quantico soils	Occur on medium to broad drainage divides of the older coastal plain terraces. These soils developed in stratified fluvio-marine sediments that have a high content of feldspathic sands. Largest acreage is in hardwood and pine forest. Many areas are used for residential and commercial developments. Small acreage is used for crops. Native vegetation consists of northern red oak, Virginia pine, red maple, yellow-poplar, and sweet gum.
Sycoline soils	Occur on upland sideslopes. The soils developed from hornfel and granulite. Moderately well to somewhat poorly drained; slow to rapid runoff; moderately slow permeability in upper solum, very slow permeability in lower solum.

Wetlands Habitat

Tidal freshwater marshes are a diverse group of herbaceous wetlands occurring along the upper tidal reaches of coastal plain rivers and tributaries which are flooded daily. These marshes tend to occur in the uppermost estuary zones, where a large volume of freshwater from upstream can effectively dilute the inflow of saltwater from tidal influence. Tidal freshwater marshes provide habitat for several rare plant species, including the potential for the federally listed sensitive joint-vetch, and important breeding habitat for many birds species, including the least bittern and Virginia rail. Common plant species occurring in the marshes include wild rice (*Zizania aquatica* var. *aquatica*), arrow-arum (*Peltandra virginica*), dotted smartweed (*Polygonum punctatum* var. *punctatum*), and pickerelweed (*Pontederia cordata*). Sea level rise is increasing

Emergent tidal wetlands of Featherstone Refuge.



USFWS

salinity and, along with the introduction of invasive plant species, is threatening native species and shifting the vegetative composition of tidal freshwater marshes (VDCR, 2006b; http://www.dcr.virginia.gov/natural_heritage/ncEIA.shtml; [accessed June 2011]).

A large portion of the Featherstone Refuge is tidally influenced freshwater wetlands. Portions of “Hidden Lake,” the main section of Farm Creek running through the refuge, were at one time diked. This dike was likely used for fisheries management in the late 1800s or early 1900s, but has greatly deteriorated. Currently, only a few pilings are left in the water, as well as a short earthen section that no longer serves as a barrier (USFWS, 2005a).

The forested wetlands on the refuge are comprised of red maple, sweetgum, yellow poplar, and water willow (*Andrographis* spp.). Emergent marsh is located mainly on the southern section of the property (USFWS, 2005a).

Table 3.15 below describes in more detail the Featherstone Refuge National Wetlands Inventory types which are illustrated in map 3.11.

Table 3.15. Featherstone Refuge Wetland Types

Wetland Type	Characteristics
Forested	Characterized by woody vegetation that is 6 m tall or taller.
Scrub/Shrub	Includes areas dominated by woody vegetation less than 6 m tall.
Emergent	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.
Riverine	The riverine system includes all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water or which forms a connecting link between the two bodies of standing water.
Deciduous	Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that are shed during the cold or dry season.
Persistent	Dominated by species that normally remain standing at least until the beginning of the next growing season.
Seasonally Flooded	Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years.

Upland Habitats

The refuge’s upland forests features mature oaks, yellow poplars, and red maples at or near climax stage with Virginia and loblolly pine. These large bottomland hardwoods provide habitat for woodland warblers and nest cavities for pileated (*Dryocopus pileatus*) and red bellied woodpeckers (*Melanerpes carolinus*), barred owls, and prothonotary warblers. Areas bordering Neabsco Creek consist of steep slopes with an understory of mountain laurel (*Kalmia latifolia*).

Endangered or Threatened Plants

Federally threatened and endangered plant species that occur in Prince William County or adjacent counties include: harperella (*Ptilimnium nodosum*; endangered, occurs in adjacent county), sensitive joint-vetch (threatened, occurs in adjacent county), and small whorled pogonia (threatened, occurs in Prince William County). None are documented on the refuge.

Map 3.11. Featherstone Refuge National Wetlands Inventory



Two other State rare plant species may occur in the vicinity of the refuge, although they have not been identified on the refuge. Parker's pipewort occurs in intertidal zones and river bulrush inhabits fresh tidal marshes (VDCR, 2010). Table A.10 in appendix A lists plant species of concern for the refuge area.

Invasive Plants

The invasive plant Phragmites (*Phragmites australis*) is not yet a major problem in Featherstone Refuge's wetlands, but it could pose a future threat. Phragmites has become a destructive weed in Virginia, quickly displacing desirable plants species such as wild rice, cattails, and native wetland orchids. Invasive stands of this species eliminates diverse wetland plant communities, and provide little food or shelter for wildlife (VDCR, 2010). Other invasive plants of concern include mile-a-minute and Japanese stiltgrass in the upland forests.

Refuge Wildlife

Endangered or Threatened Animals

There are no known occurrences of any federally listed animal species on Featherstone Refuge. The federally endangered dwarf wedgemussel (*Alasmidonta heterodon*) may occur in Prince William County, but it is not known to occur on, or in the vicinity of, the refuge.

Birds

Table A.6. in appendix A lists bird species of conservation concern that are either known or suspected to occur on Featherstone Refuge. The table includes both the species compiled by Jim Waggoner, a local birder, based on his observations and what we suspect may occur based on refuge habitats and sightings in other nearby areas.

Bald Eagle

Bald eagles are often observed using the refuge, primarily for foraging. The shoreline provides important feeding and perching habitat. Since the early 1990s, a pair of bald eagles have nested on or near the refuge, although they have not always produced young (USFWS, 2005a). Map 3.2 displays the bald eagle nesting sites in the vicinity of the refuge.

Waterfowl

Featherstone Refuge provides important wintering and nesting habitat for waterfowl, wading birds, and shorebirds. Wintering and migrating waterfowl of conservation concern include American black duck, mallard, blue-winged teal (*Anas discors*), wood duck, hooded merganser, green-winged teal (*Anas crecca*), gadwall, and lesser scaup (USFWS, 2005a).

Raptors

Osprey (*Pandion haliaetus*), red-tailed hawks (*Buteo jamaicensis*), red-shouldered hawks northern harrier (*Circus cyaneus*), American kestrel, and Cooper's hawks (*Accipiter cooperii*) have been recorded on the refuge (USFWS, 2005a).

Shorebirds, Gulls, Terns, and Allied Species

Featherstone Refuge does not provide quality nesting or foraging habitat for shorebird, gulls, terns, and allied species due to the dense vegetation on the refuge. Also, mudflats exposed at low tide are high in fine sediments and are anaerobic, producing little vegetation or macroinvertebrates to attract birds (USFWS, 2005a).

Marsh- and Waterbirds

The dense and diverse marsh vegetation attracts many wading birds including great blue heron, great egret, and double-crested cormorants (*Phalacrocorax auritus*) (USFWS, 2005a).

Game Birds

There are no known game birds on the refuge and there is no public hunting of any kind allowed on the refuge. None of the birds listed as game birds by the VDGIF are likely to occur on the refuge considering the extensive wetlands and limited upland habitat.

Reptiles and Amphibians

There have been no recent surveys or studies of reptiles or amphibians conducted on Featherstone Refuge; however many of the reptile and amphibian species found in Prince William County are likely to occur on the refuge. Table A.7 in appendix A lists the amphibians and reptiles known or suspected to occur on the refuge.

Mammals

Common mammals observed on Featherstone Refuge include white-tailed deer, red fox, gray squirrel, and beaver (USFWS, 2005a). There have been no recent mammal surveys or studies conducted on the refuge; however, many of the mammals found in Prince William County are likely to occur on the refuge. Table A.8 in appendix A lists the mammal species known or suspected to occur on the refuge.

Interjurisdictional and Other Fish Species

The tidal Potomac River and tributaries support a diversity of interjurisdictional fish species that depend in part on the larger tributaries (including the Occoquan River and Neabsco Creek), the smaller streams that include Farm Creek, and the marshes along the Virginia shoreline for habitat. Interjurisdictional fish of interest to the Service and considered species of concern by VDGIF (2005), include the shortnose sturgeon (Tier I), Atlantic sturgeon (Tier II), alewife (Tier IV), American shad (Tier IV), and American eel (Tier IV). Table A.9 in appendix A lists the fish species of conservation concern known or suspected in the refuge area.

Cultural Resources

Presently, there is one known historical site and two archaeological sites on the refuge, including a Native American site of undetermined age. Although no professional surveys or site testing have been conducted at Featherstone Refuge, there is a high likelihood that other sites are present. Appendix F describes the cultural resources of Featherstone Refuge.

*Featherstone Refuge
shoreline*



Bill Wallen