# Final Natural Resources Management Plan (NRMP) for NASA Wallops Flight Facility 2022-2027

**Initial Publication: September 23, 2022**

# Record of Review

The following table captures the results of annual Natural Resources Management Plan (NRMP) reviews and administrative updates.

| Review Date | Summary of Change(s) | Reviewer | Notes/Comments |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Contents

# List of Appendices



# List of Tables

# Acronyms

| Acronym | Definition |
|---|---|
| % | percent |
| ac | acres |
| AAOC | Administrative Agreement On Consent |
| AMSL | above mean sea level |
| APHIS | Animal and Plant Health Inspection Service |
| ASWG | Aviation Safety Working Group |
| B | breeding |
| BASH | Bird/Wildlife Aircraft Strike Hazard |
| BCC | Birds of Conservation Concern |
| BCR | Bird Conservation Region |
| BGEPA | Bald and Golden Eagle Protection Act |
| BMP | best management practice |
| BO | Biological Opinion |
| CASI | Climate Adaptation Science Investigators |
| CBFS | Chincoteague Bay Field Station |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CNWR | Chincoteague National Wildlife Refuge |
| CWA | Clean Water Act |
| CZMA | Coastal Zone Management Act |
| CZMP | Coastal Zone Management Program |
| DMR | Discharge Monitoring Report |
| DOD | Department of Defense |
| DPS | distinct population segment |
| ECR | Environmental Compliance and Restoration |
| EFH | Essential Fish Habitat |
| EIS | Environmental Impact Statement |
| EMO | Environmental Management Office |
| EMP | Environmental Management Plan |
| EMS | Environmental Management System |
| EO | Executive Order |
| EPA | Environmental Protection Agency |
| ERD | Environmental Resource Document |
| ERT | Environmental Resources Tool |
| ESC | erosion and sediment control |
| E&SR | Environmental and Safety Review |

| Acronym | Definition |
|---|---|
| FAA | Federal Aviation Administration |
| FC | Federal Candidate |
| FE | Federal Endangered |
| FIRM | Flood Insurance Rate Map |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| FOTW | Federally Owned Treatment Works |
| FT | Federal Threatened |
| FY | fiscal year |
| GCP | General Construction Permit |
| GIS | geographic information system |
| GISS | Goddard Institute for Space Studies |
| GPR | Goddard Procedural Requirement |
| GSFC | Goddard Space Flight Center |
| ha | hectares |
| HUC | Hydrologic Unit Code |
| ICP | Integrated Contingency Plan |
| IUCN | International Union for Conservation of Nature |
| km | kilometer |
| $km^2$ | square kilometer |
| LV | launch vehicle |
| m | meters |
| M | migrating |
| MARS | Mid-Atlantic Regional Spaceport |
| MBTA | Migratory Bird Treaty Act |
| MEMD | Medical and Environmental Management Division |
| mi | miles |
| $mi^2$ | square miles |
| MMPA | Marine Mammal Protection Act |
| MOSI | Management Operations Services and Information |
| NASA | National Aeronautics and Space Administration |
| NEPA | National Environmental Policy Act |
| NESDIS | National Environmental Satellite Data Information Service |
| $nm^2$ | square nautical mile |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NOV | notice of violation |
| NPR | NASA Procedural Requirements |
| NRC | Natural Resources Council |

| Acronym | Definition |
|---|---|
| NRM | Natural Resources Manager |
| NRMP | Natural Resources Management Plan |
| NWI | National Wetlands Inventory |
| NWR | National Wildlife Refuge |
| PEIS | Programmatic Environmental Impact Statement |
| PSD | Protected Services Division |
| PZ | Protection Zone |
| RCRA | Resource Conservation and Recovery Act |
| REPI | Readiness and Environmental Protection Integration |
| SATERN | System for Administration, Training, and Educational Resources for NASA |
| SAV | submerged aquatic vegetation |
| SCSC | Surface Combat Systems Center |
| SDM | Structured Decision Making |
| SE | State Endangered |
| SEED | Stormwater Erosion and Environmental Development |
| SERP | Shoreline Enhancement and Restoration Project |
| SET | Surface Elevation Table |
| SGCN | Species of Greatest Conservation Need |
| SRIPP | Shoreline Restoration and Infrastructure Protection Program |
| ST | State Threatened |
| STEM | science, technology, engineering, and math |
| SWM | stormwater management |
| SWPPP | Stormwater Pollution Prevention Plan |
| T&E | threatened and endangered |
| U.S. | United States |
| U.S.C. | United States Code |
| UAS | unmanned aerial systems |
| USACE | United States Army Corps of Engineers |
| USAF | United States Air Force |
| USDA | United States Department of Agriculture |
| USFWS | United States Fish and Wildlife Service |
| VAC | Virginia Administrative Code |
| VCSFA | Virginia Commercial Space Flight Authority |
| VDCR | Virginia Department of Conservation and Recreation |
| VDEQ | Virginia Department of Environmental Quality |
| VDH | Virginia Department of Health |
| VDWR | Virginia Department of Wildlife Resources |
| VIMS | Virginia Institute of Marine Sciences |

| Acronym | Definition |
|---|---|
| VMRC | Virginia Marine Resources Commission |
| VPDES | Virginia Pollutant Discharge Elimination System |
| VSMP | Virginia Stormwater Management Program |
| W | wintering |
| WCDAS | Wallops Command and Data Acquisition Station |
| WFF | Wallops Flight Facility |
| WHMP | Wildlife Hazard Management Plan |
| WRP | Wallops Research Park |
| WS | Wildlife Services |

# 1. Introduction

This National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's (GSFC's) Wallops Flight Facility (herein referred to as "WFF") Natural Resources Management Plan (NRMP) is a planning document covering the five-year period from 2022 through 2027. This NRMP guides natural resources management at WFF to support operational and mission success while minimizing potential impacts to natural resources and improving their condition where achievable.

## 1.1 NRMP Purpose and Scope

The WFF NRMP provides recommendations, goals, and implementation strategies for the management, protection, enhancement, and multipurpose utilization of WFF's natural resource elements over a five-year planning period. The NRMP serves as a natural resources planning, budgeting, and coordinating tool. It aids in programming future natural resource project requirements and enables the effective management of natural resources at WFF in concert with its mission. The NRMP also provides documentation of the coordination between WFF and the appropriate stakeholders in the development and implementation of its natural resources management program. The NRMP helps ensure that operations and natural resources conservation at WFF are integrated, and consistent, with good stewardship and legal requirements.

This NRMP addresses natural resources management on land and water bodies at or near WFF that are one of the following:

- owned by the United States and administered by NASA alone or in partnership with other federal agencies;
- used by WFF via license, permit, or lease for which WFF has been assigned management responsibility; and/or
- leased lands at WFF and areas occupied by non-NASA entities.

The NRMP's primary concern is natural resources management in the undeveloped, natural areas at WFF, but the plan also applies to natural resource issues in developed areas and recreational areas. The NRMP is meant to serve as a road map for the stewardship of natural resources and to be used by

NASA to properly manage the natural resources that exist at WFF and to comply with relevant environmental laws and regulations during the associated planning period.

## 1.2 Document Organization

This NRMP is organized into the following sections:

*Section 1: Introduction* – This section provides a general discussion of the NRMP and how the plan integrates with overall WFF planning and NASA's Environmental Management System (EMS).

*Section 2: WFF Natural Resources Management Program* – This section describes the purpose and scope of the NRMP with respect to WFF. It provides background information with regard to the WFF mission, any applicable host/tenant relationship(s), and the overall WFF natural resources management program.

*Section 3: Roles and Responsibilities* – This section describes the roles and responsibilities of WFF's environmental management and natural resources management program staff with regard to NRMP implementation and natural resources management. This section also describes the training objectives for WFF personnel; it discusses the training already offered or that would be beneficial to WFF personnel.

*Section 4: Natural Resources Management Program Elements* – This section provides a discussion of the specific natural resources management program elements at WFF. Each program element and/or associated resource is described in terms of the related regulatory environment. This section identifies existing partnerships and resource management collaboration efforts with external stakeholders. Resource or program-specific goals and objectives are also discussed in this section, with information for specific actions and monitoring and measurement requirements identified that support each goal/objective.

*Section 5: Recordkeeping and Reporting* – This section identifies the reporting and recordkeeping requirements associated with WFF's natural resources management program and this NRMP.

*Section 6: Work Plan(s)* – This section provides a summary of all NRMP goals and objectives identified in Section 4 (Natural Resources Management Program Elements) and identifies a priority

and planned implementation schedule by fiscal year (FY) for each. This section provides a "quick reference" for WFF's planned NRMP action implementation.

*Section 7: References* – This standard section lists references used in development of this NRMP.

*Appendices* – The appendices provide WFF-specific supporting information for the NRMP. Such information may include NRMP-related correspondence with internal/external stakeholders and regulatory agencies, figures and tables not included in the main plan, and specific natural resources management action plans.

## 1.3 Planning Integration

Much of NASA's work occurs on federal property at its 13 centers and facilities. Each center is situated amidst unique natural environments that represent many of the nation's ecosystems. Natural Resources Managers (NRMs) across the Agency work to achieve regulatory compliance, protect species, effectively manage habitats, and improve natural resource conditions. NRMs from different centers collaborate regularly to share implementation strategies, identify opportunities, and learn from one another.

At WFF, the natural resources management program is a component of overall environmental management led by the GSFC Medical and Environmental Management Division (MEMD). The MEMD provides regulatory and programmatic environmental management services, expert counsel, and guidance regarding environmental issues with respect to integrated resource planning.

### *1.3.1 Integration with Other Planning Documents*

The development and implementation of this NRMP is integrated with several other WFF management plans and documents, which are incorporated by reference, as appropriate. These plans/documents are listed in Table 1.3.1-1.

**Table 1.3.1-1. Wallops Flight Facility Planning Documents Integral to the NRMP**

| Title | Date | Description | Location |
|---|---|---|---|
| WFF Site Development Plan (NASA, 2022a) | 2022 | This plan considers a planning horizon of 20 years and beyond. It details the desired future condition of the WFF Campus and outlines specific facilities and projects that can be implemented in phases based on budget and needs. It incorporates the approved affordability strategies and develops a planning framework at the campus level. This | WFF internal share drive |

**Table 1.3.1-1. WFF Planning Documents Integral to the NRMP (continued)**

| Title | Date | Description | Location |
|---|---|---|---|
| | | plan has the following priorities: maintain mission capability, envision the WFF Campus of the future, and meet affordability goals. | |
| Wallops Island Protected Species Management Plan (NASA, 2021a) | 2021 | This monitoring plan details a methodology to monitor Endangered Species Act-protected species under the jurisdiction of USFWS within the property boundaries of Wallops Island. Species addressed in this plan include the federally endangered green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), and Kemp's ridley sea turtle (*Lepidochelys kempii*); the federally threatened piping plover (*Charadrius melodus*); the loggerhead sea turtle (*Caretta caretta*); the seabeach amaranth (*Amaranthus pumilus*); the *rufa* subspecies of red knot (*Calidris canutus rufa*); and the northern long-eared bat (*Myotis septentrionalis*). | WFF Public Environmental Management Website |
| Wildlife Hazard Management Plan NASA/GSFC/WFF (NASA, 2021b) | 2021 | This document describes the WS Program's mission to resolve conflicts between wildlife at WFF, human health and safety, natural resources, infrastructure, and the NASA mission. In cooperation with the U.S. Department of Agriculture – Animal and Plant Health Inspection Service – WS Program, WFF has developed this plan to outline steps for monitoring, documenting, and reporting potential wildlife hazards and wildlife strikes at WFF. The plan details the specific protocols for responding to hazardous wildlife situations, including roles and responsibilities of airport personnel. | WFF internal share drive |
| Wallops Island Predator Management Plan (USDA, 2020) | 2020 | This management plan identifies the policies and activities that are implemented at WFF for the protection of native nesting shorebirds, colonial waterbirds, and ducks on Wallops Island, including some species listed as threatened or endangered. | WFF internal share drive |
| USFWS Consolidation of Existing Biological Opinions (BOs) (USFWS, 2019) | 2019 | In accordance with section 7 of the Endangered Species Act (16 U.S.C. 1531–1544, 87 Statute 884), as amended, this document presents the published findings of the USFWS regarding effects to the following federally protected species at WFF: piping plover (*Charadrius melodus) (plover*), red knot (*Calidris canutus rufa*) (knot), and loggerhead sea turtle (*Caretta caretta*) Northwest Atlantic Ocean DPS (loggerhead). | WFF internal share drive |
| Wallops Flight Facility Site-wide Programmatic Environmental Impact Statement (PEIS) (NASA, 2019a) | 2019 | This document presents the potential effects to physical, biological, and socioeconomic resources resulting from various construction and demolition projects, new operational missions, and activities that are needed to ensure continued growth at NASA GSFC's WFF over the next 20 years. | WFF Public Environmental Management Website |
| Final Environmental Assessment (EA) NASA Wallops Flight Facility | 2019 | This document evaluates the environmental consequences of harvesting approximately 1.3 million cubic yards of sand from either the northern end of Wallops Island or an offshore shoal, renourishing the middle and southern areas of Wallops Island and constructing a series of parallel nearshore breakwater structures. | WFF Public Environmental Management Website |

Table 1.3.1-1. WFF Planning Documents Integral to the NRMP (continued)

| Title | Date | Description | Location |
|---|---|---|---|
| Shoreline Enhancement and Restoration Project (SERP) (NASA, 2019b) | | | |
| Environmental Resources Document GSFC WFF (NASA, 2017) | 2017 | This document serves as the primary reference for current environmental conditions at WFF. | WFF Public Environmental Management Website |
| NASA GSFC/WFF Wallops Island Phragmites Control Plan (NASA, 2014) | 2014 | The primary goal of this control plan is to protect NASA's launch infrastructure assets, as well as protect marsh ecosystems and native plant and animal species from invasive species consistent with EO 13112. | WFF Public Environmental Management Website |

**Key:** DPS = distinct population segment; EO = Executive Order; GSFC = Goddard Space Flight Center; NRMP = Natural Resources Management Plan; U.S. = United States; U.S.C. = United States Code; USFWS = United States Fish and Wildlife Service; WFF = Wallops Flight Facility; WS = Wildlife Services.

### *1.3.2 Environmental Management System*

NASA's EMS, codified under NASA Procedural Requirements (NPR) 8553.1, is the Agency's overall approach to managing environmental activities by focusing on improved environmental performance that complies with legislation and regulations. Consistent with NASA's environmental policy (NASA Policy Directive 8500.1), the intended outcomes of an EMS include enhancement of environmental performance, fulfillment of compliance obligations, and achievement of environmental objectives. The EMS allows NASA programs to function in more environmentally friendly ways and improves the success and environmental impact of NASA missions. Each center is required to implement a center-specific EMS that addresses NPR 8553.1. Within the framework of the NASA EMS, this NRMP serves as an operational control that provides guidance and requirements for natural resources management and regulatory compliance.

The WFF EMS Manual (NASA, 2020a) defines the requirements and responsibilities for implementing the EMS at WFF.

This NRMP is a controlled document that describes records retention, identifies WFF-specific natural resources objectives and targets, and establishes monitoring and measurement requirements within the framework of WFF's natural resources management program.

### *1.3.3 NRMP Review and Update*

This NRMP must be reviewed annually and must be revised every five-years as appropriate to incorporate new regulations, science, and information and to assess the performance of management actions (identified in Section 4, Natural Resources Management Program Elements). Significant changes to WFF's mission requirements, its natural resources, or the WFF Site Development Plan would also warrant an NRMP revision.

Periodic reviews of the NRMP evaluate the following: the effectiveness of the plan; the plan's potential impact on NASA's mission; and whether the information within the plan is current, relevant, and reliable. Periodic reviews conducted by WFF personnel and other interested parties will enable project tracking and assessment and will help facilitate adaptive management. These reviews may be accomplished via correspondence or in a meeting of appropriate parties.

The annual periodic review is to verify the following:

- All compliance-driven projects and activities have been budgeted for and implementation is on schedule.
- All required natural resources positions have been filled or are in the process of being filled.
- Natural resources management projects and activities for the upcoming year have been identified and included in Sections 4 (Natural Resources Management Program Elements) and 6 (Work Plan(s)) of the NRMP.
- All required coordination and reporting have occurred.
- The document is current with regard to WFF's mission requirements and natural resources management program information and requirements.
- All relevant regulations and citations are up-to-date.
- Table 1.3.1-1, Table 2.1.1-1, and Table 3.2-1 are up-to-date.

Annual reviews and administrative changes to this NRMP are captured in the Record of Review table located at the front of this document.

At the end of each five-year planning period, the NRMP is reviewed, and a revised/updated plan is prepared for the next planning period. The five-year review includes all aspects of an annual review, including the following:

- evaluation of progress of long-term goals and effectiveness of objectives, with adjustments as necessary;
- identification of new goals and objectives for the subsequent five-year planning period; and
- identification of new issues that may affect the subsequent five-year planning period.

The five-year update is essentially a new plan that requires the same coordination as the initial NRMP development.

# 2. WFF Natural Resources Management Program

## 2.1 WFF Profile/Missions

WFF is composed of three separate land areas in close proximity to each other, located in northern Accomack County on the Eastern Shore of Virginia—the Main Base, Mainland, and Wallops Island. Accomack County is bordered by Northampton County on the south, the state of Maryland on the north, the Atlantic Ocean on the east, and the Chesapeake Bay on the west (Appendix A, Figures, Figure 1).

NASA GSFC manages WFF, the oldest active launch range in the continental United States and the only rocket testing and launch range owned and operated by NASA. For over 70 years, WFF has flown thousands of research vehicles in the quest for information on the flight characteristics of airplanes, launch vehicles (LVs), and spacecraft and to increase the knowledge of the Earth's upper atmosphere and the near-space environment. WFF supports aeronautical research and science, technology, engineering, and math (STEM) education programs by providing other NASA centers and other United States (U.S.) government agencies access to resources such as special use (i.e., controlled/restricted) airspace, runways, and launch pads. WFF regularly provides launch support for the emerging commercial launch industry, either directly or through the Mid-Atlantic Regional Spaceport (MARS), a commercial launch site on Wallops Island. WFF facilitates a wide array of U.S. Department of Defense (DOD) research, development, testing, and evaluation and training missions, including target and missile launches and aircraft development. The flight programs and projects conducted by WFF range from small sounding rockets and suborbital rockets, unmanned scientific balloons, unmanned aerial systems (UAS), manned aircraft, and orbital spacecraft to next generation LVs and small- and medium-classed LVs. Many of these programs are conducted from the WFF Research Airport or the WFF Launch Range (NASA, 2019a).

WFFs is a multiuser/multi-tenant facility in a geographic location ideal for supporting satellite tracking and commanding, military operations and training, scientific investigations, technology development and testing, as well as commercial aerospace. The facility's diverse mission set and onsite partners—including the U.S. Navy, National Oceanic and Atmospheric Administration (NOAA), U.S. Coast Guard, and the Virginia Commercial Space Flight Authority's (VCSFA's) (also

known as Virginia Space) MARS—is a model for leveraging and optimizing multi-organizational capabilities and support services.

More information regarding WFF's mission and infrastructure is available in the WFF Site Development Plan (NASA, 2022a).

### *2.1.1 Host/Tenant Relationship: NASA as Landlord*

NASA has several tenants, partners, and customers that use the WFF Research Airport and WFF Launch Range, its facilities, and airspace. While these tenants, partners, and customers are located on or adjacent to WFF, NASA manages the natural resources on WFF (including those resources impacted within connecting waters). The activities of these tenant/partners are described below (Table 2.1.1-1).

**Table 2.1.1-1. WFF Tenants and Partners**

| Tenant/Partner | Mission Description | Potential NRMP Interaction | Agreement Expiry Date |
|---|---|---|---|
| Chincoteague Bay Field Station | The primary objective of CBFS is to promote and encourage learning and research in the marine and environmental sciences. Thirteen academic institutions now comprise the CBFS, which is located adjacent to the WFF Main Base and consists of over 23 ha (57 ac) containing classrooms, wet and dry laboratories, a computer laboratory, residence buildings, faculty and staff residences, a cafeteria, library, recreational facilities, and an administrative building. Licensed captains employed by CBFS frequently operate boats from behind the WFF Visitor Center to transport CBFS students conducting research in the nearby marshes and waterways. CBFS students and faculty also conduct research on Wallops Island. | The CBFS is an adjacent property and partners with NASA on STEM research and studies. Wallops Island is utilized by professors from various institutions for research. This research is shared with WFF and incorporated into natural resources management planning at WFF as applicable. | January 1, 2199 |
| Mid-Atlantic Regional Spaceport operated by the Virginia | The VCSFA holds and maintains the MARS active Launch Site Operator License with the FAA to operate MARS. The license authorizes Virginia Space to operate a launch site at the orbital Launch Complex 0. MARS | MARS is a tenant of WFF. They have two operational areas on the north and south of Wallops Island. | October 31, 2022 |

Table 2.1.1-1. WFF Tenants and Partners (continued)

| Tenant/Partner | Mission Description | Potential NRMP Interaction | Agreement Expiry Date |
|---|---|---|---|
| Commercial Space Flight Authority | provides facilities and services for NASA, DOD, and commercial launches of payloads into space. Activities include launch vehicle and payload preparation, integration and testing, prelaunch operations, launch range integration, and launch and postlaunch operations. | The north operation area includes the UAS airstrip and the port. This area encompasses various natural resources (e.g., wetlands, special status species [federally protected under the Endangered Species Act, MBTA, MMPA, EFH, and BGEPA], and a globally rare habitat [black cherry xeric forest]) as designated by the IUCN.<br><br>The south operation area includes the launch range. The launch range contains various natural resources (e.g., wetlands, special status species [federally protected under the Endangered Species Act, MBTA, MMPA, and EFH], and state-protected species). | |
| NOAA – National Environmental Satellite Data Information Service | The WCDAS, an 11.7-ha (29-ac) facility operated by NOAA-NESDIS, gathers data from environmental satellites. Three of the remotely controlled downlink antennas are located in Fairmont, West Virginia; 6 in Fairbanks, Alaska; and 16 at WFF. | NOAA is a tenant at WFF and has one operational area on the Wallops Main Base. Natural resources within this area include forests and fringe wetlands. | April 28, 2025 |
| U.S. Coast Guard | South of the Main Base entrance, the U.S. Coast Guard maintains 2.8 ha (7 ac) of housing units for personnel assigned to the Chincoteague Station. | The U.S. Coast Guard is a tenant at WFF and has residential housing on the Wallops Main Base. Natural resources are scarce within the housing areas, which are comprised of developed areas and maintained landscaping. | May 18, 2025 |
| U.S. Navy Surface Combat Systems Center | The SCSC is WFF's largest partner. They provide a broad range of support for the conduct of Aegis and Ships Self-Defense System combat system activities. Other technical missions include Lifetime Support Engineering, In-Service Engineering, Systems Level operations, and maintenance training. WFF also provides missile launch support for the U.S. Navy. Drone vehicles launched from Wallops Island are used for target tracking and can be engaged by operational naval forces. | The SCSC is a tenant of WFF. They have an operational area on the mid-island and administrative area and a housing area on the Wallops Main Base.<br><br>In the operational area of Wallops Island, there are wetlands, forested areas, and special status species (protected under the Endangered Species Act, MBTA, and BGEPA). | November 18, 2029 |

Table 2.1.1-1. WFF Tenants and Partners (continued)

| Tenant/Partner | Mission Description | Potential NRMP Interaction | Agreement Expiry Date |
|---|---|---|---|
| | | Natural resources within the administrative area and housing area are limited, as these areas are comprised of developed and maintained landscaping, with the exception of a forested area near the administrative area. | |
| Wallops Research Park | The WRP is approximately 200 ac of land owned by NASA, Accomack County, and CBFS. Upon full build-out, the WRP will consist of a multiuse development dedicated to non-retail commercial and Government space and science research, educational facilities and public recreational areas. | Proposed land use categories within the WRP include research and development/industrial use; aviation use; gateway research and development/industrial use; and county recreational park use. Natural resources within these areas are limited to wetlands, forests, and meadows. No protected species other than migratory birds have been identified in the WRP. | September 30, 2099 |

**Sources:** (NASA, 2019a; NASA, 2022a).

**Key:** ac = acres; BGEPA = Bald and Golden Eagle Protection Act; CBFS = Chincoteague Bay Field Station; DOD = Department of Defense; EFH = Essential Fish Habitat; FAA = Federal Aviation Administration; ha = hectares; IUCN = International Union for Conservation of Nature; MARS = Mid-Atlantic Regional Spaceport; MBTA = Migratory Bird Treaty Act; MMPA = Marine Mammal Protection Act; NESDIS = National Environmental Satellite Data Information Service; NOAA = National Oceanic and Atmospheric Administration; NRMP = Natural Resources Management Plan; SCSC = Surface Combat Systems Center; STEM = science, technology, engineering, and math; UAS = unmanned aerial systems; U.S. = United States; VCSFA = Virginia Commercial Space Flight Authority; WCDAS = Wallops Command and Data Acquisition Station; WFF = Wallops Flight Facility; WRP = Wallops Research Park.

Tenant responsibilities with respect to environmental and natural resources management include, but are not limited to, compliance with all aspects of this NRMP as outlined in associated host-tenant agreements or memoranda of understanding/memoranda of agreement.

## 2.2 Natural Resources Management Program-Level Goals and Objectives

The primary goal of WFF's natural resources management program is to ensure responsible stewardship of natural resources to support the success of NASA's mission and for the benefit of future generations. This NRMP does not evaluate NASA's mission nor does it replace any environmental requirements or documentation that are specific to a given mission. Goals and objectives will be adjusted over time using an adaptive management approach as NASA's mission and the ecological conditions at WFF change. The general objectives of the natural resources management program include the following:

- Comply with federal, state, and local laws and regulations that pertain to the management of natural resources at WFF.
- Implement the NRMP within the framework of NASA policies and regulations.
- Manage natural resources at WFF within the spirit of good environmental stewardship of public lands entrusted to the care of a federal agency.
- Promote interagency partnerships and public involvement.
- Assess habitat quality to understand current conditions, develop management strategies, and maintain and/or improve impacted natural communities.
- Monitor protected species to understand trends in population, as feasible.

## 2.3 Partnerships and Collaboration

The diversity of natural resources encountered at WFF creates the need for a variety of expertise and assistance in developing and implementing sound management practices. Partnerships with state and federal agencies, as well as local conservation and academic institutions, makes such expertise available to WFF personnel. Added benefits of inviting volunteers and conservation groups to assist with natural resources projects are good community relationships are fostered and volunteers are allowed to become invested in the area's natural resources.

The following is a list of groups and agencies that have formed or could form significant partnerships with WFF.

- The U.S. Fish and Wildlife Service (USFWS) is a primary stakeholder in the development and review of this NRMP and provides assistance in matters that concern the conservation, protection, and management of federally listed fish and wildlife species. The USFWS also manages the adjacent Chincoteague National Wildlife Refuge (CNWR) and Wallops Island National Wildlife Refuge (NWR) to conserve, restore, and protect fish, wildlife, and plants.
- The Virginia Department of Wildlife Resources (VDWR) is also a stakeholder in the development and review of this NRMP and provides assistance in matters that concern the conservation, protection, and management of state-listed fish and wildlife species.

- The Virginia Department of Forestry can provide technical assistance and plant materials for the establishment and maintenance of trees on the installation.
- The Department of Conservation and Recreation, Division of Natural Heritage provides information and guidance related to rare, threatened, and endangered species and supports invasive species control.
- The Chincoteague Bay Field Station (CBFS) is committed to excellence in education and research in the marine and environmental sciences for undergraduate, graduate, precollege, and continuing education students. Wallops Island is utilized by CBFS professors for research and hands-on education. This research is shared with WFF and incorporated into natural resources management planning at WFF, as applicable.
- The College of William and Mary Center for Conservation Biology has partnered with WFF in many peregrine falcon studies, provides WFF with the results of its annual raptor nesting surveys, and consults with WFF on potential project impacts on faunal species.
- The U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, and the Virginia Tech Department of Fisheries and Wildlife Conservation conduct acoustic surveys for bats throughout NASA's WFF.
- Virginia Tech conducts shoreline ecological research on Wallops Island.
- The Virginia Aquarium partners with WFF if an injured or deceased marine animal is found along the shoreline. WFF employs a monitoring plan that entails the marine mammal and sea turtle stranding program protocols managed at WFF in cooperation with the Virginia Aquarium (NASA, 2021a).
- The U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) provides aviation safety support through the following programs: wildlife hazard management, Bird/Wildlife Aircraft Strike Hazard (BASH), and bald eagle nest monitoring (at the Main Base). Additionally, the USDA APHIS provides nuisance wildlife control and predator management services for nesting threatened and endangered (T&E) shorebirds.
- The National Park Service runs and maintains the adjacent Assateague Island National Seashore.

- NASA and its partners purchase wetland mitigation credits from the Virginia Aquatic Trust Fund through The Nature Conservancy.
- The Virginia Institute of Marine Sciences (VIMS) provides hydrodynamic models of sediment flow around Wallops Island.

# 3. Roles and Responsibilities

Fundamentally, NASA's natural resources management is decentralized, with primary management responsibilities residing with each center's/facility's Environmental Management Office (EMO). An NRM is assigned by each center's/facility's EMO. Together, the NRMs make up the Natural Resources Council (NRC). Agencywide, the NRC serves as an advisory and information-sharing body to the NASA Environmental Management Division. The NRC supports the development of natural resources conservation policy and leadership strategy, drives consensus of priorities across Operational and Mission Directorates, and recommends initiatives to improve NASA's stewardship of the nation's natural resources. The NRC supports NASA's compliance with federal natural resource laws, such as the Endangered Species Act, by developing best practices, recommendations, and guidance. NRMs from different centers can collaborate through NASA's Natural Resources Management Program SharePoint: https://nasa.sharepoint.com/sites/EME-NRM. While each center manages its own resources independently, through collaboration across the Agency, NASA is able to continue pursuing its space and aeronautics mission while managing natural resources to protect the environment.

## 3.1 WFF Natural Resources Management Program Staffing and Implementation

The WFF MEMD has primary day-to-day responsibility for natural resources management. Environmental staff are responsible for WFF environmental compliance, management, and sustainability programs. These responsibilities include coordinating and integrating all environmental programs, interpreting environmental regulations, acting as the formal point of contact with all environmental regulatory agencies, assisting in the development and review of environmental permits, remediating contaminated sites, authorizing cease and desist for any polluting activities, and compliance monitoring and surveillance. The WFF natural resources management program staff consists of civil service environmental specialists and engineers, along with onsite and offsite contractor support. Additionally, the USDA APHIS supports the program for nuisance wildlife management.

## 3.2 Training

The NASA EMS requires that all employees are made aware of the NASA environmental policy and its applicability to their work. Appropriate training is required at each level and function of the organization. NPR 8853.1 specifically requires that employees be aware of the following:

- adverse environmental impacts and beneficial environmental impacts associated with their work;
- benefits of improved environmental performance;
- requirements of the EMS applicable to their work; and
- consequences associated with their deviation from these requirements.

The System for Administration, Training, and Educational Resources for NASA (SATERN) is the Agency's Learning Management System that provides web-based access to training and career development resources. Training requirements can be met via SATERN, other government agencies (e.g., the USFWS), or through other third-party training vendors.

Table 3.2-1 presents the list of possible training program recommendations for natural resources personnel at WFF. These recommendations include general environmental awareness trainings and/or specific trainings that are tailored to staff function and responsibilities based on WFF resources.

**Table 3.2-1. WFF Training Programs**

| Training Program | Required | Recommended | Frequency |
|---|---|---|---|
| Advanced Environmental Management | | WFF Natural Resources Manager | One time |
| Basic Environmental Law | | WFF Natural Resources Manager | One time and as applicable trainings become available |
| BASH | | WFF Natural Resources Manager and Natural Resources Staff | One time and as applicable trainings become available |
| CZMA/Chesapeake Bay Act/Coastal Consistency Determinations | | WFF Natural Resources Manager | One time |

**Table 3.2-1. WFF Training Programs (continued)**

| Training Program | Required | Recommended | Frequency |
|---|---|---|---|
| Endangered Species Act Section 7/T&E Species Management | | WFF Natural Resources Manager and Natural Resources Staff | One time and as applicable trainings become available |
| General Environmental/EMS Awareness | WFF Employees | | All personnel upon hire, triennially thereafter |
| GIS | | WFF Natural Resources Manager and Natural Resources Staff | As applicable trainings become available |
| Invasive Species Control | | WFF Natural Resources Manager and Natural Resources Staff | One time and as applicable trainings become available |
| Marine Mammal and Turtle Stranding Workshop | | WFF Natural Resources Manager and Natural Resources Staff | Annually |
| NEPA | | WFF Natural Resources Manager | One time and as applicable trainings become available |
| Natural Resources Compliance | | WFF Natural Resources Manager and Natural Resources Staff | As applicable trainings become available |
| Structured Decision Making (USFWS National Conservation Training Center) | | WFF Natural Resources Manager | One time, and as applicable trainings become available |
| VDWR Workshops | | WFF Natural Resources Manager | As applicable trainings become available |
| Wallops Island Protected Species Training | Protective Services | WFF Employees | Annually |
| Wetland Awareness | | WFF Natural Resources Manager and Natural Resources Staff | One time, and as applicable trainings become available |
| Wetlands Delineation and Practicum | | WFF Natural Resources Manager and Natural Resources Staff | *Frequency determined by the issuing agency* |
| Wetlands Regulations | | WFF Natural Resources Manager and Natural Resources Staff | One time and as applicable trainings become available |

**Key:** BASH = Bird/Wildlife Aircraft Strike Hazard; CZMA = Coastal Zone Management Act; EMS = Environmental Management System; GIS = geographic information system; NEPA = National Environmental Policy Act; T&E = threatened and endangered; USFWS = United States Fish and Wildlife Service; VDWR = Virginia Department of Wildlife Resources; WFF = Wallops Flight Facility.

# 4. Natural Resources Management Program Elements

## 4.1 Introduction

This section discusses the primary WFF natural resources management program elements and how they are implemented at WFF. In addition, this section briefly describes the current conditions for each resource within the program elements, the regulatory drivers for related management requirements, the associated resource management goals and objectives, the actions identified for meeting those goals and objectives, and the monitoring and measurement requirements for assessing the progress of each goal and objective.

Environmental planning provides a process to identify environmental impacts, issues, and requirements associated with a project and to incorporate them into project planning and decision-making. GSFC has created the Management Operations Services and Information (MOSI) Environmental and Safety Review (E&SR) online system to ensure compliance with multiple federal, state, and local environmental and safety regulations. Early in the planning stages of a project, the project manager starts the environmental review by submitting the project in MOSI E&SR. The various resource leads, including the NRM, review the project in MOSI E&SR to identify and track potential environmental issues and compliance requirements. The online E&SR contains links to geographic information system (GIS) maps to show sensitive areas, such as wetlands, cultural resource areas, and land use control areas. Refer to Figure 2 and Figure 3 in Appendix A (Figures) for examples of the E&SR-generated maps used for various natural resource planning projects.

More detailed information regarding the locations and descriptions for each resource is provided within the NASA Environmental Resource Document (ERD) (NASA, 2017), located at https://code200-external.gsfc.nasa.gov/sites/code250wff/files/inline-files/2017_WFF_REDACTED_ERD.pdf. The management activities implemented at WFF are subject to the availability of funding and to changes in WFF's mission.

### *4.1.1 Resources Not Addressed*

The following resources are not included in this NRMP because they are either not present at WFF or WFF has no management concerns/authority regarding these resources.

**Table 4.1.1-1. Resources Not Addressed**

| Resource | Reason not Addressed |
|---|---|
| Wildland Fire Management | There is little potential for wildfire at the Main Base or the Mainland. Wallops Island has some potential for wildfire under drought conditions, particularly in the open burn and launch pad operational area; however, wildland fire and general fire concerns (associated with structural fires and fires associated with aircraft accidents or fuel spills) are managed by the WFF Fire Department. |
| Forestry | Normal forestry activities include timber harvesting and construction and maintenance of forest roads in accordance with BMPs if the activity is part of an established operation. Commercial forestry is not an objective of forest management at WFF; the primary issues concerning the forested areas at WFF are the spread of invasive plant species and land clearing for development and mission support. These issues are addressed in Section 4.7 (Invasive Species/Pesticides Management). |

**Key:** BMP = best management practice; WFF = Wallops Flight Facility.

# 4.2 Wetland and Floodplain Management

## *4.2.1 Program/Resource Description*

WFF resource distributions can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

### *Wetlands*

Wetlands at WFF are presented in Figure 4, Figure 5, and Figure 6 in Appendix A (Figures). Based on the USFWS National Wetlands Inventory (NWI) wetland mapper, wetland classifications were assigned using the USFWS system—Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al., 1979). Under the USFWS system, wetlands are divided into five major systems: 1) marine, 2) estuarine, 3) riverine, 4) lacustrine, and 5) palustrine. A total of 1,550 hectares (3,940 acres) of wetlands have been delineated at WFF—1.6 percent are classified as marine, 83.6 percent as estuarine, and 14.8 percent as palustrine. No lacustrine or riverine wetlands have been identified.

As part of the site-wide Programmatic Environmental Impact Statement (PEIS), the *Report on the Historical Impacts and Protection of Wetlands at NASA WFF* was developed to evaluate the historical wetland impacts at WFF between 1938 and 2017 (presented in Appendix H of the site-wide PEIS) (NASA, 2019a). This report presented an extensive analysis of historical impacts to wetlands at WFF

and the surrounding areas. The geographic boundary of the analysis was the two 12-digit Hydrologic Unit Codes (HUCs) (020403030504 and 020403040101) that encompass the Wallops Main Base, Mainland, and Wallops Island, as well as adjacent areas. Together, the two HUCs total 20,539 hectares (50,753 acres). Between pre-NASA development in 1938 and construction of the UAS airstrip and shoreline renourishment activities in 2014, an approximate total of 550 hectares (1,355 acres) of wetlands were cumulatively impacted within the NASA boundaries. A total of 70 percent of the impacts (383 hectares [946 acres]) that occurred on WFF happened between 1938 and 1974. The primary causes for historical wetland impacts within the NASA boundaries included development of the WFF buildings, runways, launch pads, the causeway bridge, infrastructure, and dredging the access channels. Additionally, every three to five years, the recurring beach renourishment will temporarily impact the same area of approximately 60 hectares (150 acres) of marine subtidal and intertidal unconsolidated bottoms (NASA, 2019a).

### *Floodplains*

Flood Insurance Rate Map (FIRM) Community Panel 5100C (2015 data) shows that the 100-year and 500-year floodplains are along portions of the perimeter of the Main Base to the northwest, north, and northeast. Large areas of tidal marsh are located to the east along Little Mosquito Creek and Jenneys Gut. The same FIRM Community Panels indicate that the 100-year and 500-year floodplains include much of the area identified as Wallops Mainland; however, these areas are primarily tidal marsh along Hog Creek, Oyster Bay, and Bogues Bay. The developed portions of Wallops Mainland are not mapped as flood zones. Wallops Island is located entirely within the 100-year floodplain (NASA, 2019a).

### *Current Management Practices*

Projects and activities often encounter wetlands and the floodplains, and WFF actively manages these resources. This program element is primarily focused on ensuring projects/activities avoid impacting wetlands and floodplains, if feasible. Potential impacts are typically identified during the National Environmental Policy Act process and then managed by the WFF natural resources management program. Wetland delineations and any requisite permitting are conducted on a project-specific basis.

### 4.2.2 Regulatory Environment

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*Executive Order (EO) 11990, Protection of Wetlands* – EO 11990 directs federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

*Section 404 of the Clean Water Act* (CWA) – This act regulates the discharge of dredged or fill material into waters of the United States, including wetlands. The basic premise of the Section 404 program is that no discharge of dredged or fill material may be permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. Permit applicants must show that they have, to the greatest extent practicable, taken steps to avoid wetland impacts, minimized potential impacts to wetlands, and provided compensation for any remaining unavoidable impacts through appropriate mitigation.

*EO 11988, Floodplain Management* – EO 11988 directs federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

### 4.2.3 Management Goals and Objectives

#### Goal A1: Proactively manage facility wetlands.

WFF natural resources management program staff will maintain an accurate inventory of wetlands via the USFWS NWI Wetland Mapper and through planning-level surveys (such as wetland delineations and preconstruction wetlands site visits).

#### Objective(s)

A1.1) Maintain an accurate inventory of wetlands for use by WFF personnel.

A1.2) Program offices to fund jurisdictional wetland delineations as needed for specific projects.

A1.3) Upload survey data and wetland boundaries to the GIS/Environmental Resources Tool. This action occurs as surveys are completed.

A1.4) Develop long-term wetlands compensation strategy (refer to the Environmental Management Plan).

### Monitoring and Measurement

WFF currently maintains an environmental sensitivity GIS mapping portal that includes a facility-wide wetlands inventory. Progress of each objective will be measured by the amount of WFF acreage covered by planning-level wetland surveys and/or delineated at WFF each year. The goal will be achieved once all wetlands are identified on WFF, and data has been placed in an online database available to WFF personnel. It will be necessary to periodically confirm the data in the wetland inventory remains accurate.

### Goal A2: Ensure no net loss of wetland functions.

The purpose of this goal is to avoid or minimize impacts to wetlands and floodplains to the greatest extent practicable, to mitigate any unavoidable impacts in accordance with state and federal regulations and to enhance wetland habitats, where feasible.

WFF natural resources management program staff performed an inventory of wetlands functionality during preparation of the 2019 site-wide PEIS (see Appendix H of (NASA, 2019a)). WFF natural resources management program staff will maintain an accurate inventory of wetland functionality via decadal wetland functionality assessments.

### Objective(s)

A2.1) Maintain an accurate inventory of wetland functionality by performing a wetland functionality assessment (Tiner, 2005) every ten years, with the next assessment performed by 2027.

A.2.2) Determine wetland functionality for proposed projects that would impact wetlands.

A.2.3) Program office would fund and mitigate for wetland function, as well as acreage, to ensure no net loss of wetland functionality.

### Monitoring and Measurement

WFF currently maintains a wetland functionality assessment that is reviewed every ten years. Wetland data is placed in an online database available to WFF personnel. Progress of each objective will be measured by the net change of acreage of wetland functionality at WFF each year. The goal will be achieved once all identified wetlands on WFF have been assigned a functionality value.

### Goal A3: Avoid any instance of unpermitted fill or dredge within a wetland area.

Under Section 404 of the CWA, discharge of dredge and fill material into waters of the United States, including adjacent wetlands, is prohibited unless a jurisdictional determination is made, and a permit is issued by the U.S. Army Corps of Engineers (USACE). Waters of the United States are broadly defined as territorial seas; tidal and non-tidal waters, including adjacent wetlands; and all other waters including tributaries to interstate waters or navigable waters of the United States and intermittent streams. Exemptions to Section 404 regulations are provided for prior converted cropland (wetlands that were converted to farmland before 1986), as long as it has been farmed within the past five years; for maintenance of ditches, dams, causeways, and other existing transportation structures; and for normal forestry.

### Objective(s)

A.3.1) WFF natural resources staff will be notified through the online E&SR process of new projects that have the potential to impact wetlands.

A.3.2) WFF natural resources staff will work with the project proponent to delineate wetlands, submit and obtain joint permits, and conduct any required monitoring and/or mitigation. Project proponent is responsible for funding this objective.

### Monitoring and Measurement

WFF currently maintains an online E&SR portal that includes natural resources review of new projects. Progress of each objective will be measured by the number of E&SR checklists with natural resources reviews. The goal will be achieved on a project-by-project basis when wetland impacts are identified, and all necessary permits, monitoring, and mitigation are complete.

### Goal A4: Monitor wetland response to sea level rise.

Sea level rise is occurring along the Atlantic Ocean coastal zone, and the effects of sea level rise on areas surrounding NASA WFF needs to be considered. Refer to Section 4.9 (Coastal Resource Management) for a detailed discussion on shoreline restoration and sea level rise.

Scientists from NASA's Goddard Institute for Space Studies (GISS) will continue to use local data to refine global climate model outputs, making the projections WFF-specific (NASA, 2019a). Outputs of the GISS models project rising average sea levels for the Wallops area over the next 80 years. NOAA publishes sea-level trend data at various tide locations along the coast (NOAA, 2021).

The nearest station with sea-level trend data is in Wachapreague, Virginia, which is approximately 32 kilometers (km) (20 miles) south of WFF. The linear trend of the sea-level rise data since 1978 at this station indicates an average of 5.48 millimeters per year rise, or an estimated 0.55-meter (1.8-foot) rise in 100 years. Alternatively, the USACE applied data from three coastal locations (Maryland, Delaware, and Virginia) to project sea level rise over a 50-year period at Wallops Island between 2010 and 2060. The results showed a range from 0.17 to 0.69 meters (0.56 to 2.25 feet) for the analysis period.

#### Objective(s)

A4.1) NASA will monitor sea level changes at WFF through the available data sources.

A4.2) WFF will participate in USFWS Surface Elevation Table (SET) data collection and monitoring on Wallops Island.

#### Monitoring and Measurement

This goal will be met via the USFWS analysis of SET trend data versus GISS modeling every five years, beginning in 2025.

## 4.3 Surface Water and Groundwater Resource Management

### *4.3.1 Program/Resource Description*

WFF resource locations can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

This discussion focuses on surface waters (e.g., rivers, streams, ponds, lakes) and groundwater resources (e.g., aquafers, reservoirs) managed by WFF.

#### *Surface and Subsurface Waters*

Numerous tidal inlets, marshes, bays, and creeks are found in and around all three installation areas of WFF. A section of the Virginia Inside Passage, a federally maintained navigation channel, separates Wallops Island and Wallops Mainland. The Atlantic Ocean lies to the east of Wallops Island. Surface waters in the vicinity of WFF are primarily saline to brackish and are influenced by the tides and surface runoff (NASA, 2019a).

Little Mosquito Creek primarily forms the northern border of the Main Base, while an unnamed tributary of Little Mosquito Creek forms the western border. Additional unnamed tributaries to Little Mosquito Creek flow through areas in the western and northern portions of the Main Base. Little Mosquito Creek discharges directly to the Chincoteague Bay, which flows into the Atlantic Ocean.

The Main Base drains primarily into Little Mosquito Creek to the west and north and borders Simoneaston Bay tidal marsh to the east. The southeastern portion of the Main Base includes stormwater swales and ditches that drain to Watts Bay. The surface water on the Mainland drains to and includes portions of Bogues Bay to the north, Cat Creek to the east, and Hog Creek to the south. Surface water on Wallops Island flows through numerous tidal tributaries that subsequently flow to the Atlantic Ocean. The northern boundary of Wallops Island is formed by the Chincoteague Inlet, and its western side is bounded by a series of water bodies that include (from north to south) Ballast Narrows, Bogues Bay, Cat Creek, and Hog Creek, which separate the Island from the Mainland. No natural perennial streams or open water ponds exist on the Island. There are permanent water bodies on north Wallops Island in depressions remaining from past dune/swale structures. Intermittent

water bodies may form after storms or in response to other physical forces such as tides (NASA, 2019a).

### *Current Management Practices*

The Virginia Stormwater Management Program (VSMP) requires that construction and land development activities incorporate measures to protect aquatic resources from the effects of increased volume, frequency, and peak rate of stormwater runoff and from increased nonpoint source pollution carried by stormwater runoff. The VSMP also requires that land-disturbing activities of 0.4 hectares (1 acre) or greater develop a Stormwater Pollution Prevention Plan (SWPPP) and acquire a permit from the Virginia Department of Environmental Quality (VDEQ) prior to construction.

As such, WFF maintains a SWPPP (NASA, 2021c) to ensure that its operations have minimal impact on stormwater quality. Scheduled samplings of stormwater drainage areas are performed in accordance with the Virginia Pollutant Discharge Elimination System (VPDES) water quality monitoring requirements. Sample results are submitted to VDEQ in a monthly Discharge Monitoring Report (DMR). WFF monitors groundwater usage compared to historic withdrawal and monitors groundwater, the Federally Owned Treatment Works (FOTW), stormwater outfalls, and launch pad deluge collection for contamination. Dredge material discharge, whether to the temporary holding areas, beach disposal area, or possible thin-layer deposition, is also monitored to ensure that state water quality criteria are not exceeded.

The VDEQ designated the surface waters in the vicinity of WFF as Class I–Open Ocean and Class II–Estuarine Waters. Surface waters in Virginia are subject to the water quality criteria specified in 9 Virginia Administrative Code (VAC) 25-260-50. This set of criteria establishes limits for minimum dissolved oxygen concentrations, pH, and maximum temperature for the different surface water classifications. In addition, surface waters must meet the criteria specified in 9 VAC 26-260-140. This set of criteria provides numerical limits for various potentially toxic parameters. For the Class I and II waters in the vicinity of WFF, the saltwater numerical criterion is applied. Both sets of standards are used by the Commonwealth of Virginia to protect and maintain surface water quality (NASA, 2021d). The surface waters of Little Mosquito Creek were listed on Virginia's 303(d) Water Quality

Assessment Report as an impaired water body in 2016. Little Cat Creek was also listed in the 2016 report and is located just east of Wallops Island (NASA, 2019a).

### *4.3.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

9 *VAC 25-870* – This code is administered by the VDEQ and requires that construction and land development activities incorporate measures to protect aquatic resources from the effects of increased volume, frequency, and peak rate of stormwater runoff and from increased nonpoint source pollution carried by stormwater runoff.

*9 VAC 25-260-50 and 9 VAC 26-260-140* – Surface waters in Virginia are subject to water quality criteria that establishes limits for minimum dissolved oxygen concentrations, pH, and maximum temperature for the different surface water classifications. In addition, surface waters must meet the criteria that provides numerical limits for various potentially toxic parameters.

*CWA* – This act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

*VPDES* – As authorized by the CWA, and delegated to VDEQ, the VPDES Permit Program controls water pollution by regulating point sources that discharge pollutants into waters of the Commonwealth. Point sources are discrete conveyances such as pipes or man-made ditches. Examples of pollutants include, but are not limited to, rock, sand, and dirt, as well as agricultural, industrial, and municipal waste discharged into Virginia waters.

*Safe Drinking Water Act* – This act identifies actions to protect drinking water and its sources—rivers, lakes, reservoirs, springs, and ground water.

*Wild and Scenic Rivers Act* – This act preserves certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. This act also safeguards the special character of these rivers, while recognizing the potential for their appropriate use and development.

*Soil and Water Resources Conservation Act* – This act provides the USDA broad strategic assessment and planning authority for the conservation, protection, and enhancement of soil, water, and related natural resources.

*Fish and Wildlife Coordination Act* – This act requires that the Regional Administrator, before issuing a permit proposing or authorizing the impoundment (with certain exemptions), diversion, or other control or modification of any body of water, consult with the Department of the Interior USFWS and the appropriate state agency (e.g., VDWR) exercising jurisdiction over wildlife resources to conserve those resources.

### *4.3.3 Management Goals and Objectives*

#### Goal B1: Prevent contamination to surface water and groundwater on or adjacent to WFF.

#### Objective(s)

B1.1) Prepare and implement appropriate permits and plans to prevent pollution to surface water and groundwater, such as the VPDES permit, SWPPP, sediment and erosion control plan, and Integrated Contingency Plan (ICP).

B1.2) Annually train staff in the implementation of permits and plans to prevent pollution to surface water and groundwater.

B1.3) Maintain accurate Environmental Compliance and Restoration (ECR) studies, inventories, and remediation for impacted surface and groundwater.

B1.4) Conduct monitoring required by permit(s) (e.g., FOTW DMRs, deluge monitoring at Pad 0-A, and surface water monitoring in case of a launch anomaly).

B1.5) Research and implement innovative natural stormwater management (SWM) strategies (e.g., tree boxes, bioretention basins).

#### Monitoring and Measurement

This goal and associated objectives are achieved through annual staff trainings, accurate and timely submittals of monthly reports, incident reporting, and the monitoring of the number of notices of violation (NOVs); regulators may issue an NOV when permit terms and conditions are not met. WFF

also tracks the number of launches that require deluge monitoring or surface water monitoring. The goal and objective B.1.5. will be met if innovative natural SWM strategies are implemented.

## 4.4 Soil and Geology Resource Management

### *4.4.1 Program/Resource Description*

Locations of WFF resource can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

Situated within the Atlantic Coastal Plain Physiographic Province, WFF is underlain by approximately 2,100 meters (7,000 feet) of sediment overlying crystalline basement rock. The sedimentary section, ranging in age from Cretaceous to Quaternary, consists of a thick sequence of terrestrial, continental deposits overlain by a much thinner sequence of marine sediments. The two uppermost stratigraphic deposits at WFF are the Yorktown Formation and the Columbia Group, which is not subdivided into formations. The Yorktown Formation is the uppermost unit in the Chesapeake Group and generally consists of fine-to-coarse, glauconite quartz sand. The overlying Columbia Group is generally unconsolidated deposits of clay, silt, sand, and gravel (NASA, 2017).

Coastal Plain soils of the Eastern Shore are generally very level, and many types are classified by the USDA as prime farmland. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. Prime and unique farmlands in Accomack County are classified as the following soil types:

- Bojac fine sandy loam soils;
- Bojac loamy sand soils;
- Munden fine sandy soil;
- Munden loamy sand;
- Dragston fine sandy loam, if adequately drained; and
- Nimmo fine sandy loam, well-drained.

The predominant soil types at WFF are shown in Table 4.4.1-1. The dominant soils are high in sand content, resulting in a highly leached condition, an acidic pH, and a low natural fertility (NASA, 2019a).

**Table 4.4.1-1. Predominant Soil Types at WFF**

| Location | Soil Type | Typical Slopes | Description |
|---|---|---|---|
| Main Base – inland areas | Bojac fine sandy loam | 0–2% | Nearly level, very deep, well-drained soils. Suitable for agriculture. |
| Main Base – perimeter areas | Molena loamy sand | 6–35% | Very deep and somewhat excessively drained. The severe erosion potential and low availability of water make it unsuitable for cultivation. |
| Wallops Mainland –western portion | Bojac loamy sand | 2–6% | Gently sloping, very deep, well-drained; can be used for cultivation; sloping and erodibility limit its productivity. |
| Wallops Mainland –middle portion | Magotha fine sandy loam | 0–2% | Nearly level, very deep, poorly drained hydric soils. This soil provides a suitable wildlife habitat. |
| Wallops Mainland – eastern and Wallops Island western portions | Chincoteague silt loam | 0–1% | Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat. |
| Wallops Island –eastern portion | Chincoteague silt loam | 0–1% | Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat. |
| Wallops Island – east of Chincoteague silt loam | Udorthents and Udipsamments | 0–35% | Nearly level to steep, very deep, and range from well-drained to somewhat poorly drained. |
| Wallops Island –southern end | Fisherman Assateague fine sands complex | 0–35% | Nearly level to steep, very deep, moderately well-drained, to excessively drained. This soil provides wildlife habitat and recreation. |
| Wallops Island – depressions and areas associated with dunes and salt marshes | Fisherman Comacca fine sands complex | 0–6% | Very poorly to moderately well-drained. |
| Wallops Island – central and western portions in depressions and on flats associated with dunes and marshes | Comacca fine sand | 0–2% | Nearly level, very deep, very poorly drained. The soil provides wildlife habitat and recreation. |
| Wallops Island –eastern portion | Assateague fine sand | 2–35% | Gently to steeply sloping, very deep, excessively drained. This soil is rarely flooded and provides wildlife habitat and recreation. |
| Wallops Island – eastern portion | Beaches | 1–5% | Moderately sloping and provides wildlife habitat. |

**Source:** (NASA, 2019a)
**Key:** % = percent; WFF = Wallops Flight Facility.

WFF is located on the Atlantic Coastal Plain of Virginia and occupies an area with elevations ranging from sea level to approximately 12 meters (40 feet) above sea level. Buildings are located on flat or gently sloping grades (0 to 2 percent). The WFF perimeters have occasional incised streambeds or

embankments on the tidal fringe. Most of the site is not highly erodible; however, its proximity to wetlands and its elaborate storm drainage system (a direct conduit to surface waters) elevate the risk of stormwater pollution from land-disturbing activities.

## *Current Management Practices*

### Sediment and Erosion Control

The WFF SWPPP includes practices to monitor soil, surface water, sediment, and groundwater at WFF. Scheduled sampling of stormwater discharges is performed to meet VPDES monitoring requirements. The Environmental Office conducts, at a minimum, quarterly visual inspections of the permitted stormwater outfalls, quarterly inspections of high-risk areas, and annual visual inspections of all stormwater drop inlets. The results of these inspections are compiled into the annual Comprehensive Site Compliance Evaluation report. Copies of the monthly DMRs are submitted electronically to VDEQ by WFF.

Current best management practices (BMPs) employed for SWM and erosion and sediment control (ESC) include installing silt fences, utilizing stone construction vehicle entrances, maintaining vegetative buffer strips, and quickly reseeding bare soils. All plans and applicable BMPs are consistent with the Virginia ESC Program, which is administered by the VDEQ. Furthermore, any activities that impact at least 0.40 hectares (1 acre) require coverage under a VSMP General Construction Permit (GCP) (NASA, 2021c).

In addition to the SWPPP, WFF has incorporated Annual Standards and Specifications for ESC and SWM that are integral components of WFF's design, construction, maintenance, and management of the facility and its operations (NASA, 2020b). The NASA WFF Annual Standards and Specifications for ESC and SWM has been developed to provide detailed information regarding WFF's compliance with all regulatory requirements. These standards and specifications outline the process for a successful and compliant project. The WFF Stormwater Erosion and Environmental Development (SEED) Team manages the Annual Standards and Specifications Program for WFF. On behalf of the VDEQ, the SEED Team reviews all designs and inspects all land disturbances undertaken by WFF, either by its internal workforce or contracted to external entities, where such activities are regulated

by ESC and SWM regulations. The following implementation measures are enforced for all new projects at WFF:

- If the land disturbance is over 930 square miles ($mi^2$) (10,000 square feet), a site-specific ESC Plan that is compliant with the Virginia ESC Regulations (9VAC25-840) is required.
- This plan must be approved by NASA WFF SEED prior to commencing any land-disturbing work.
- Land disturbances above 0.40 hectares (1 acre) will also require a Construction General Permit issued by the Commonwealth, along with an approved SWM plan.

NASA WFF Annual Standards and Specifications for ESC and SWM are annually submitted to VDEQ for review and approval. NASA WFF shall continue to ensure that project specific-plans are developed and implemented in accordance with these Annual Standards and Specifications.

### *4.4.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*Virginia SWM Act Section 62.1-44.15:24* – This act requires a contract between the VSMP authority and the owner or permittee that specifies methods that shall be implemented to comply with the requirements of the VSMP; such contract may be executed by the VSMP authority in lieu of a SWM plan.

*9VAC25-870-63, Water Quality Design Criteria Requirements* – In order to protect the quality of state waters and to control the discharge of stormwater pollutants from regulated activities, design criteria and statewide standards for SWM shall be applied to the site.

*9 VAC 25-870-65, Water Quality Compliance* – Compliance with the water quality design criteria set out in subdivisions A 1 and A 2 of 9VAC25-870-63 shall be determined by utilizing the Virginia Runoff Reduction Method or another equivalent methodology that is approved by the State Water Control Board.

*9 VAC 25- 880/VAR10, General VPDES Permit for Discharges of Stormwater from Construction Activities* – Any operator whose registration statement is accepted by the State Water Control Board

receives a general permit and shall comply with the requirements contained therein and be subject to all requirements of 9VAC25-870.

*9 VAC 25-840, Erosion and Sediment Control Law* – This law sets the minimum standards, techniques, and methods for ESC to resources such as, but not limited to, the following: soil stabilization, stock pile and borrow areas, vegetative cover, sediment traps and basins, storage capacity, subsurface runoff, storm sewer inlets, stormwater conveyance channels or pipes, natural receiving channels or previously constructed man-made channels, outfalls, bed and banks of a watercourse, underground utility lines, construction vehicle access, etc.

*Soil and Water Resources Conservation Act* – This act provides the USDA broad strategic assessment and planning authority for the conservation, protection, and enhancement of soil, water, and related natural resources.

*Farmland Protection Policy Act* – This act serves to minimize the impact programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. It assures that, to the extent possible, federal programs are administered to be compatible with state, local units of government, and private programs and policies to protect farmland. Farmland includes prime farmland, unique farmland, and land of statewide or local importance.

### *4.4.3 Management Goals and Objectives*

#### Goal C1: Prevent contamination to soils and geology on or adjacent to WFF.

#### Objective(s)

C1.1) Prepare and implement appropriate permits and plans to prevent pollution to soils such as the VPDES permit, SWPPP, sediment and erosion control plan, GCPs, and ICP.

C1.2) Annually train staff in the implementation of permits and plans to prevent pollution.

C1.3) Maintain accurate ECR studies, inventories, and remediation for impacted soil.

C1.4) Annually submit NASA WFF Annual Standards and Specifications to VDEQ. Utilize the MOSI E&SR to ensure that the SEED Team reviews all ground-disturbing activities.

### Monitoring and Measurement

Monitoring and measurement will be achieved by training staff annually, accurate and timely submittal of incident reports, and tracking the number of NOVs.

## 4.5 Fish and Wildlife Management

### *4.5.1 Program/Resource Description*

WFF resource distributions can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

Fish and Wildlife management at WFF includes both terrestrial and aquatic fauna of the region. Wildlife, except for those identified as special status species (see Section 4.8, Special Status Species Management), are discussed below.

#### *Terrestrial Wildlife*

The terrestrial wildlife category includes mammals, reptiles, amphibians, invertebrates, and birds (including native bird species protected under the Migratory Bird Treaty Act [MBTA]). Virtually all native birds are protected under the MBTA. The MBTA was designed to protect migratory birds and Birds of Conservation Concern (BCC), including their eggs, nests, and feathers. BCC birds are species that, without additional conservation measures, are likely to become candidates for listing under the Endangered Species Act. If an agency determines that implementation of a Proposed Action may result in a significant adverse effect on a population of a migratory bird species or BCC, they must confer and cooperate with the USFWS to develop appropriate and reasonable conservation measures to minimize or mitigate identified significant adverse effects. The USFWS recommends that BCC lists be reviewed in accordance with EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, so that proactive management and conservation actions may be implemented.

A variety of terrestrial wildlife species occur within the habitat or vegetation types found at WFF. Representative mammal, reptile, bird, and invertebrate species found within the vegetation communities at WFF are discussed below.

### *Mammals*

The only large mammal that occurs at WFF is the white-tailed deer (*Odocoileus virginianus*). Other mammals found on WFF property include the red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), eastern grey squirrel (*Sciurus carolinesis*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), river otter (*Lontra canadensis*), and eastern cottontail (*Sylvilagus floridanus*) (NASA, 2017).

### *Reptiles and Amphibians*

Reptiles and amphibians found at WFF include Fowler's toad (*Anaxyrus fowleri*), green treefrog (*Hyla cinerea*), eastern ratsnake (*Pantherophis alleghaniensis*), eastern hognose snake (*Heterodon platirhinos*), fence lizard (*Sceloporus undulates*), eastern box turtle (*Terrapeneaurue*), and northern diamond-backed terrapin (*Terrapene carolina carolina*). Green treefrogs are often found in freshwater depressions on Wallops Island, and Fowler's toads are found under stands of bayberry. Eastern ratsnakes, hognose snakes, and box turtles are often found in scrub-shrub habitat, and the diamondback terrapin utilizes saltmarsh, tidal flats, and lagoons (NASA, 2017).

### *Birds*

WFF is home to a wide variety of bird species. In fact, much of WFF is located within the boundaries of the Barrier Island Lagoon System Important Bird Area (Audubon, 2021) and the path of the coastal route of the Atlantic Flyway, a regular avenue of travel for migrating land and water birds that winter on the waters and marshes south of Delaware Bay. The barrier islands, including Wallops, Assateague, Chincoteague, and Assawoman Islands, are particularly important for migratory birds including BCC. Some species use these islands as a stopover point, while others use the islands and surrounding habitats as an overwintering area. The bay (west) side of the islands tends to contain the highest concentrations of migratory and BCC birds. In addition to its Important Bird Area status, the area has also been designated as a United Nations Educational, Scientific and Cultural Organization Biosphere Reserve and a Western Hemisphere Shorebird Reserve Site.

In 2022, a CNWR biologist compared the BCC 2021 list; the Bird Conservation Region 30 (New England/Mid-Atlantic Coast) Priority Species (2021) list; Potential Resources of Concern list at Chincoteague and Wallops Island NWRs; CNWR bird brochure; and eBird sightings (Holcomb,

2022). Table 4.5.1-1 is based upon CNWR's comparison and lists the BCC species known to inhabit the areas around the WFF Main Base, Mainland, and Wallops Island.

**Table 4.5.1-1. Bird Conservation Region 30 Priority Species**

| Highest Priority | High Priority | Moderate Priority |
|---|---|---|
| American Black Duck (B/W/M) | American Golden Plover (M) | American Avocet (M) |
| American Oystercatcher (B) | Baltimore Oriole (B) | American Bittern (B/W/M) |
| American Woodcock (B/W/M) | Black Scoter (W/M) | American Wigeon (W/M) |
| Atlantic Brant (W/M) | Black-and-white Warbler (B) | Bald Eagle (B/W/M) |
| Black Rail (B) | Black-bellied Plover (W/M) | Black Skimmer (B) |
| Blue-winged Warbler (B) | Broad-winged Hawk (B) | Black-crowned Night Heron (B/W) |
| Canada Goose – Atl. Pop. (W/M) | Brown Thrasher (B) | Brown-headed Nuthatch (B/W) |
| Gull-billed Tern (B) | Buff-breasted Sandpiper (M) | Cerulean Warbler (B) |
| Piping Plover (B/M) | Bufflehead (B/W/M) | Common Goldeneye (B/W/M) |
| Prairie Warbler (B) | Canada Goose - North Atlantic (W/M) | Common Snipe (B/W/M) |
| Red Knot (M) | Canvasback (W/M) | Common Tern (B/M) |
| Red-throated Loon (W/M) | Chimney Swift (B) | Gadwall (B/W/M) |
| Roseate Tern (B/M) | Clapper Rail (B) | Golden-winged Warbler (B) |
| Ruddy Turnstone (M) | Dunlin (W/M) | Grasshopper Sparrow (B) |
| Saltmarsh Sharp-tailed Sparrow (B/W/M) | Eastern Kingbird (B) | Gray Catbird (B) |
| Sanderling (W/M) | Eastern Towhee (B/W/M) | Green-winged Teal (B/W/M) |
| Seaside Sparrow (B/W/M) | Field Sparrow (B/M) | Harlequin Duck (W/M) |
| Whimbrel (M) | Forster's Tern (B/M) | Henslow's Sparrow (B) |
| Wood Thrush (B) | Glossy Ibis (B) | Hooded Merganser (B/W/M) |
| | Great Crested Flycatcher (B) | Killdeer (B/W/M) |
| | Greater Scaup (W/M) | King Rail (B/W) |
| | Greater Shearwater (M) | Least Bittern (B) |
| | Greater Yellowlegs (W/M) | Least Sandpiper (M) |
| | Horned Grebe (W/M) | Lesser Yellowlegs (W/M) |
| | Hudsonian Godwit (M) | Little Blue Heron (B/W) |
| | Kentucky Warbler (B) | Loggerhead Shrike (B) |
| | Least Tern (B/M) | Nelson's Sharp-tailed Sparrow (B/M) |
| | Lesser Scaup (W/M) | Northern Pintail (W/M) |
| | Long-tailed Duck (W/M) | Red-necked Phalarope (M) |
| | Louisiana Waterthrush (B) | Red-breasted Merganser (W/M) |
| | Mallard (B/W/M) | Red-headed Woodpecker (B/W/M) |
| | Marbled Godwit (M) | *Royal Tern (B)* |
| | Marsh Wren (M) | Ruddy Duck (W/M) |

**Table 4.5.1-1. Bird Conservation Region 30 Priority Species (continued)**

| Highest Priority | High Priority | Moderate Priority |
|---|---|---|
| | Northern Bobwhite (B/W) | Sedge Wren (B/W/M) |
| | Northern Flicker (B/W/M) | Semipalmated Plover (M) |
| | Northern Gannet (W/M) | Short-eared Owl (W/M) |
| | Prothonotary Warbler (B) | Snowy Egret (B/W) |
| | Purple Sandpiper (W/M) | *Sora (B/M)* |
| | Scarlet Tanager (B) | Spotted Sandpiper (B/M) |
| | Semipalmated Sandpiper (M) | Swainson's Warbler (B) |
| | Short-billed Dowitcher (M) | Tricolored Heron (B) |
| | Solitary Sandpiper (M) | *Upland Sandpiper* (B/M)* |
| | Surf Scoter (B/W/M) | Western Sandpiper (M) |
| | Tundra Swan – Eastern (W/M) | Wood Duck – Eastern (B/W/M) |
| | Whip-poor-will (B) | *Yellow-crowned Night Heron (B/M)* |
| | White-rumped Sandpiper (M) | |
| | White-winged Scoter (W/M) | |
| | Willet (B/W/M) | |
| | Willow Flycatcher (B) | |
| | Wilson's Phalarope (M) | |
| | Wilson's Plover (B) | |
| | Worm-eating Warbler (B) | |
| | Yellow-throated Vireo (B) | |

**Sources:** (USFWS, 2021; Holcomb, 2022)

**Note:** Species in italics are those whose category of concern within the BCR differs from their continental initiative because of the relative importance of the BCR to the species. Species in italics* were added because of the importance of the BCR outside of the breeding season (migration). Sub-species denoted by italics** were added to the list because of the regional importance of the BCR to their populations.

**Key:** B = breeding; BCR = Bird Conservation Region; M = migrating; W = wintering.

Songbirds found at WFF include saltmarsh sharp-tailed sparrow (*Ammodramus caudacutus*), swamp sparrow (*Melospiza georgiana*), common yellowthroat (*Geothlypis trichas*), white-eyed vireo (*Vireo griseus*), ruby-crowned kinglet (*Corthylio calendula*), and white-breasted nuthatch (*Sitta carolinensis*). Other birds that commonly utilize open and urban areas at WFF Mainland and Main Base include northern mockingbird (*Mimus polyglottos*), American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), northern bobwhite (*Colinus virginianus*), barn swallow (*Hirundo rustica*), brown-headed cowbird (*Molothrus ater*), house sparrow (*Passer domesticus*), house finch (*Carpodacus mexicanus*), rock dove (*Columba livia*), and European starling (*Sturnus vulgaris*). Non-native bird species such as house sparrow, rock dove, and European starling are not protected under the MBTA.

Raptor species commonly found at WFF include turkey vulture (*Cathartes aura*), black vulture (*Coragyps atratus*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (*Buteo lineatus*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and peregrine falcon (*Falco peregrinus*). These species are found mainly in the marsh areas to the west of Wallops Island. Great horned owls (*Bubo virginianus*) have been observed in the coastal forest (NASA, 2017). Bald eagles and peregrine falcons are discussed further in Section 4.8 (Special Status Species Management).

A large number of waterfowl species are found at WFF due to the abundance of wetlands and surface water on and adjacent to the properties. Waterfowl that occur at WFF include loons (*Gavia* spp.), Canada goose (*Branta canadensis*), snow goose (*Chen caerulescens*), gadwall (*Anas strepera*), American black duck (*Anas rubripes*), blue-winged teal (*Spatula discors*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), canvasback (*Aythya valisineria*), scaup (*Aythya* spp.), and mergansers (*Mergus* spp.). These waterfowl commonly overwinter in areas around WFF.

The marshes and shorelines at WFF also provide habitat for a variety of shorebirds and wading birds, including least sandpiper (*Calidris minutilla*), upland sandpiper (*Bartramia longicauda*), short-billed dowitcher (*Limnodromus griseus*), least tern (*Sterna antillarum*), great black-backed gull (*Larus marinus*), American oystercatcher (*Haematopus aurues*), willet (*Catoptrophorus semipalmatus*), glossy ibis (*Plegadis falcinellus*), ring-billed gull (*Larus delawarensis*), double-crested cormorant (*Nannopterum auritum*), horned grebe (*Podiceps auritus*), great blue heron (*Ardea auruse*), snowy egret (*Egretta thula*), and green heron (*Butorides striatus*) (NASA, 2017).

### *Invertebrates*

Invertebrates are found in all habitat types at WFF. However, invertebrate diversity is highest in marsh and wetlands areas. Common insects found at WFF include the salt marsh grasshopper (*Orchelium fidicinium*), planthoppers (*Prokelisia* spp.), salt marsh mosquitoes (*Ochlerotatus* spp.), greenhead flies (*Tabanus nigrovittatus*), and various wasps and parasitic flies. Spiders and mites are also common invertebrates at WFF (NASA, 2017). Common coastal invertebrates at Wallops Island include ghost crabs (*Ocypode quadrata*), calico crabs (*Ovalipes ocellatus*), fiddler crabs (*Uca* spp.),

sand shrimp (*Crangon septemspinosa*), moon jelly (*Aurelia aurita*), and coffee bean snails (*Melamups bidentatus*). The federally listed northeastern beach tiger beetle does not inhabit the Atlantic Ocean beaches of the Delmarva Peninsula, including Wallops Island, but is instead found on Chesapeake Bay beaches (USFWS, 2009).

### *Aquatic Wildlife*

The aquatic wildlife category includes fish, shellfish, and marine mammals. Refer to Section 4.8 (Special Status Species Management) for a discussion of Essential Fish Habitat (EFH).

#### *Fish*

Due to its proximity to the Atlantic Ocean, the area around WFF has the potential to provide habitat for a wide variety of fish species. Common fish in the waters near WFF include Atlantic croaker (*Micropogonias undulates*), sand shark (*Carcharias aurus*), smooth dogfish (*Mustelus canis*), smooth butterfly ray (*Gymnura micrura*), bluefish (*Pomatomidae saltatrix*), spot (*Leiostomus xanthurus*), and summer flounder (*Paralichthys dentatus*). During summer months, salinity and water depth play a major role in determining if coastal fish species are present in the bays and inlets that surround WFF (Ellis, 2003; NASA, 2019a).

#### *Shellfish*

Virginia Marine Resources Commission (VMRC) promotes and regulates clam and oyster farming and gardening, also known as shellfish aquaculture, in the subaqueous lands of Virginia. VMRC provides oyster ground leases to individuals who wish to conduct aquaculture in approved areas. VMRC also issues permits and licenses for aquaculture in public shellfish grounds, depending on location, aquaculture method, and whether or not the shellfish will be sold commercially (VMRC, 2012). The waters surrounding WFF contain numerous privately leased and public shellfish aquaculture beds (NASA, 2019a).

### *Current Management Practices*

An important function of natural resources management is to monitor, maintain, and enhance habitats that support the area's full spectrum of native wildlife species (e.g., fish, birds, mammals, and

herpetofauna) within the limits of the facility mission and regional land use. As such, the following wildlife management practices are conducted at WFF:

- USDA APHIS conducts monthly surveys to document all incidental wildlife sightings within the Aircraft Operating Area at WFF. This data is collected and recorded via a monthly monitoring report. The Monthly Monitoring Report for Wildlife Hazard Assessment is incorporated into an annual report titled Annual Monitoring Report for the Wildlife Hazard Assessment. Additionally, USDA APHIS provides nuisance wildlife control and conducts predator management services for nesting T&E shorebirds.

  Refer to Section 4.10 (Wildlife Management and Bird/Wildlife Aircraft Strike Hazard Management), for a detailed discussion regarding BASH at WFF.

- As part of the fisheries management program, WFF, partner, and contractor employees enjoy recreational fishing and aquaculture in the waters surrounding WFF. Administered by VMRC, this program stresses the conservation and enhancement of shellfish and finfish resources and the promotion of commercial and recreational fisheries.

### *4.5.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*MBTA* – This act prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior's USFWS.

*Fish and Wildlife Coordination Act* – This act requires that the Regional Administrator, before issuing a permit proposing or authorizing the impoundment (with certain exemptions), diversion, or other control or modification of any body of water, consult with the USFWS and the appropriate state agency exercising jurisdiction over wildlife resources (i.e., VDWR) to conserve those resources.

### *4.5.3 Management Goals and Objectives*

Goal D1: Maintain all current management practices at WFF, including USDA APHIS surveys and nuisance species and predator management.

Objective(s)

D1.1) Coordinate with USDA APHIS on management plans and reporting.

### Monitoring and Measurement

Monitoring of this goal will be achieved by tracking the number of predators taken on Wallops Island. USDA APHIS will also track the number of MBTA species taken under the BASH Program or discovered during trouble calls.

## 4.6 Vegetation Management

### *4.6.1 Program/Resource Description*

Locations of WFF resources can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

A full description of the vegetation communities present at WFF is provided below by each geographic area—Main Base, Mainland, and Wallops Island. In addition, a separate section has been included to discuss submerged aquatic vegetation (SAV).

#### *Main Base*

The 778-hectare (1,924-acre) Main Base is composed of three main vegetation communities: 1) managed/maintained, 2) forests, and 3) wetlands (see Table 4.6.1-1 and Appendix A, Figures, Figure 7) (NASA, 2022a). The Main Base is dominated by vegetation classified as managed/maintained or anthropogenic/planted vegetation.

**Table 4.6.1-1. Vegetation Communities at the WFF Main Base**

| Community | Main Base |
|---|---|
| Managed/maintained | 344 ha (850 ac) |
| Forests | 175 ha (432 ac) |
| Wetlands (emergent estuarine and scrub-shrub) | 156 ha (387 ac) |
| Impervious Surfaces and Unpaved Roads/Parking[(a)] | 103 ha (255 ac) |
| Total | 778 ha (1,924 ac) |

**Sources:** (NASA, 2019a; NASA, 2021a)

**Note:**

(a) This line item was included so that the total acreage for the Main Base was considered.

**Key:** ac = acres; ha = hectares; WFF = Wallops Flight Facility.

The majority of these areas are maintained as open grassland necessary for the mission; however, some areas are landscaped. In addition, there are approximately 103 hectares (255 acres) of impervious surfaces consisting of roads, parking lots, airfield runways, buildings, and unpaved

parking areas and roads with no vegetation. Forested areas cover approximately 22 percent of the Main Base and vary in composition based on historical land use and site conditions; however, three main classifications prevail: 1) hardwood, 2) pine, and 3) mixed pine-hardwood. The remaining area is comprised of wetlands, which include emergent and scrub-shrub wetland areas (NASA, 2019a).

Managed/maintained vegetation at the Main Base occurs in areas that are either mission critical (i.e., runway clear zones) or are landscaped for aesthetic or SWM purposes. Common species that occur in areas maintained by mowing are crabgrass (*Digitaria sanguinalis*), Bermuda grass (*Cynodon dactylon*), meadow fescue (*Schedonorus pratensis*), bluegrasses (*Poa* spp.), sheep sorrel (*Rumex acetosella*), chickweeds (*Cerastium* spp.), and other non-native weedy species. A variety of landscape and ornamental trees and shrubs are utilized in areas that are maintained for aesthetic purposes. Commonly used native species are loblolly pine (*Pinus taeda*) and American holly (*Ilex opaca*).

Non-native species used for landscaping include Bradford pear (*Pyrus calleryanaI*), autumn olive (*Elaeagnus umbellata*), thorny olive (*Elaeagnus pungens*), ornamental cherry (*Prunus* sp.), and privet (*Ligustrum* spp.). There are three areas of wetlands on the Main Base that function as part of the SWM system around the airfield. These seminatural communities are classified as managed/maintained vegetation because they are within the runway clear zones; therefore, the vegetation height is maintained by mowing or brush cutting (NASA, 2022a).

Forested areas on the Main Base can be broken down into hardwood forests and mixed pine-hardwood forests. The species composition of hardwood forests in the area varies by specific location. Hardwood forests that occur on upland ridges and slopes contain red oak (*Quercus rubra*), southern red oak (*Q. falcata*), white oak (*Q. alba*), hickories (*Carya* spp.), yellow poplar (*Liriodendron tulipifera*), black cherry (*Prunus serotina*), sweetgum, and scattered loblolly pine. Mid-story species include dogwood (*Cornus florida*) and American holly. Understory shrub species include dwarf huckleberry (*Gaylussacia dumosa*) and strawberry bush (*Euonymus americanus*). Herbaceous vegetation in these areas can vary greatly between sites and by season, but some common species for the area are mayapple (*Podophyllum peltatum*), partridgeberry (*Mitchella repens*), Christmas fern (*Polystichum acrostichoides*), Solomon's seal (*Polygonatum biflorum*), bellwort (*Uvularia perfoliata*), and false lily of the valley (*Maianthemum racemosum*) (NASA, 2008a).

Hardwood forests that are found in floodplains and other wet areas contain a different set of species than upland hardwood forests; however, some species are common to both habitat types. The overstory in these areas contains blackgum (*Nyssa sylvatica*), sweetgum, red maple, black willow (*Salix nigra*), and willow oaks (*Q. phellos*). Smaller trees and shrubs in this habitat include American hornbeam (*Carpinus caroliniana*), spice bush (*Lindera bezoin*), blue huckleberry (*Gaylussacia frondosa*), viburnums (*Viburnum* spp.), and sweet pepperbush (*Clethra alnifolia*). Herbaceous understory vegetation in this habitat includes sensitive fern (*Onoclea sensibilis*), cinnamon fern (*Osmunda cinnamomea*), sedges (*Cyperaceae* spp.), rushes (*Juncaceae* spp.), and other grasses and forbs. Robin's plantain (*Erigeron pulchellus*) was also observed in one hardwood stand on WFF Main Base.

Pine forests at the Main Base are composed mostly of loblolly pine but can also contain Virginia pine (*Pinus virginiana*) and hardwood species. Common hardwood species in pine forests are yellow poplar and sweetgum, and older pine stands can contain oaks and hickories. Midstory and understory cover in dense pine stands is usually sparse. However, the species composition is variable, as it is with hardwood forests. One site at the Main Base contains a large population of pink ladyslippers (*Cypripedium acaule*). Other understory species found in pine stands include vines like muscadine grape (*Vitis rotundifolia*) and trumpet creeper (*Campsis radicans*) (NASA, 2017).

The mixed pine-hardwood forests at the Main Base mostly contain a mix of the species described above for the hardwood and pine forests and are usually transitional between pine and hardwood. Succession usually favors hardwoods unless there is disturbance in the area. Wet areas contain a mix of sweetgum, red maple, yellow poplar, and loblolly pine. Understory species in wet areas include northern bayberry (*Morella pensylvanica*), wax myrtle (*Morella cerifera*), groundsel tree (*Baccharis halimifolia*), and devil's walkingstick (*Aralia spinosa*). Drier sites are usually first colonized by pine, but, over time, red oak and white oak develop and become codominants. Understory species in dry areas include mountain laurel (*Kalmia laurifolia*), fetterbush (*Leucothoe racemosa*), and maleberry (*Lyonia ligustrina*) (NASA, 2017).

### *Mainland*

The majority (90 percent) of the Mainland consists of estuarine emergent wetland vegetation with some managed/maintained areas, scrub-shrub, and hardwood forests (Table 4.6.1-2 and Appendix A, Figures, Figure 8).

**Table 4.6.1-2. Vegetation Communities at WFF Mainland**

| Community | Mainland |
|---|---|
| Managed/maintained | 29 ha (72 ac) |
| Hardwood forest | 5 ha (13 ac) |
| Wetlands (estuarine emergent) | 460 ha (1,135 ac) |
| Scrub-shrub | 15 ha (36 ac) |
| Impervious surfaces[(a)] | 1 ha (2 ac) |
| Total | 510 ha (1,258 ac) |

**Source:** (NASA, 2019a)

**Note:**

(a) This line item was included so that the total acreage for the Main Base was considered.

**Key:** ac = acres; ha = hectares; WFF = Wallops Flight Facility.

The managed/maintained vegetation at the Mainland consists of grass fields and lawns. These areas are maintained by mowing and are required for mission support. Plant species that exist in these areas are similar to those mentioned for the managed/maintained vegetation community at the Main Base (NASA, 2017).

The forests at the Mainland are composed of upland and swamp forests. Upland forests are composed of mixed pine-hardwood species in the overstory. These species include loblolly pine, black cherry, and red maple. The understory consists mostly of sassafras (*Sassafras albidum*) and bayberries. The swamp forests at the Mainland have hardwoods such as black willow and red maple in the overstory. The understory of the swamp forests contains similar species as those listed above for the floodplain hardwood forests at WFF Main Base. A major invasive species that occurs in the forests at the Mainland is Asiatic tearthumb (*Polygonum perfoliatum*), which is also referred to as mile-a-minute (NASA, 2017).

### *Wallops Island*

Wallops Island is a coastal barrier island that contains some similar vegetation communities found on the Main Base and Mainland; however, there are a variety of habitat types found on Wallops Island that do

not occur in other areas of WFF. The approximately 1,335-hectare (3,300-acre) Wallops Island consists of beaches, maritime grassland, maritime scrub, maritime woodland, maritime forest, wetlands (estuarine emergent), and managed/maintained areas (Table 4.6.1-3 and Appendix A, Figures, Figure 8). There are also interdune ponds, also referred to as sea swales, on Wallops Island, which are seasonally flooded or semipermanent flooded areas of herbaceous wetland (NASA, 2017). There are roughly 40.5 hectares (100 acres) of impervious surface making up the remaining land area on Wallops Island. The majority of Wallops Island is wetlands (predominately estuarine emergent) vegetation.

**Table 4.6.1-3. Vegetation Communities at WFF Wallops Island**

| Community | Wallops Island |
|---|---|
| Managed/maintained | 97 ha (240 ac) |
| Beach | 30 ha (74 ac) |
| Maritime grassland | 32 ha (79 ac) |
| Maritime scrub | 75 ha (186 ac) |
| Maritime woodland | 15 ha (36 ac) |
| Maritime forest | 18 ha (45 ac) |
| Wetlands (estuarine emergent) | 1,017 ha (2,514 ac) |
| Roads/impervious surfaces[(a)] | 51 ha (125 ac) |
| Total | 1,335 ha (3,300 ac) |

**Source:** (NASA, 2019a; NASA, 2021a)

**Note:**

(a) This line item was included so that the total acreage for Wallops Island was considered.

**Key:** ac = acres; ha = hectares; WFF = Wallops Flight Facility.

Managed/maintained vegetation on Wallops Island is composed mostly of meadows, lawn, and open roadside. Species found in the meadows include bushy bluestem (*Andropogon glomeratus*), little bluestem (*Schizachyrium scoparium*), thoroughworts and bonesets (*Eupatorium* spp.), and goldenrods (*Solidago* spp.). Invasive species found in the meadows are similar to those found in managed/maintained communities at WFF Main Base and WFF Mainland but may also include sericea lespedeza (*Lespedeza cuneata*) and clovers (*Trifolium* spp.). There are also a few man-made ponds on Wallops Island that are dominated by widgeon grass (*Ruppia maritima*) and duckweed (*Lemna minor*) (NASA, 2017).

Beach habitat at Wallops Island consists of upper beaches and overwash flats. Overwash flats are areas above the high tide line that are occasionally flooded by storm surges and high spring tides. These areas have sparse vegetation, which includes American searocket (*Cakile edentula*) and

seabeach orach (*Atriplex arenaria*). Russian thistle (*Salsola kali*) is an invasive species that is also common in these areas (NASA, 2008a). Beach habitat has expanded through the Shoreline Restoration and Infrastructure Protection Program (SRIPP), a long-term project to maintain an elevated beach within the approximately 6-km-long (3.7-mile-long) area of Wallops Island that was previously rock seawall. This effort began in 2010 and will continue for the next 50 years (NASA, 2010a).

Maritime grasslands occur on the foredunes and secondary dunes of Wallops Island. Vegetation in these areas includes American beachgrass (*Ammophila breviligulata*), saltmeadow cordgrass (*Spartina patens*), beach panic grass (*Panicum amarum*), and seaside goldenrod (*Solidago sempervirens*). The northern end of Wallops Island contains some areas of relatively pristine maritime grasslands. Dixie sandmat (*Chamaesyce bombensis*), also known as southern beach spurge, is a relatively rare plant species that has been documented in these more pristine areas (NASA, 2017).

Maritime scrub on Wallops Island occurs on secondary dunes and is sometimes mixed with maritime grasslands. The scrub communities are composed mostly of bayberry, marsh elder (*Iva frutescens*), and poison ivy (*Toxicodendron radicans*). Species that are less dominant include winged sumac (*Rhus copallina*), groundsel tree, stunted black cherry, and stunted loblolly pine (NASA, 2017).

An isolated area of maritime woodlands is found on a secondary dune on Wallops Island. Tree species in this habitat include scattered black cherry, loblolly pine, and scrubby oaks (*Q. nigra* and *Q. falcata*). Species found in sandy openings in this area include prickly-pear (*Opuntia humifusa*), yellow thistle (*Cirsium horridulum*), seaside needlegrass (*Aristida tuberculosa*), eastern jointweed (*Polygonella articulate*), and seaside little bluestem (*Schizachyrium littorale*) (NASA, 2017). A recent inventory of the North Wallops Island Conservation Area, published by the Virginia Department of Conservation and Recreation (VDCR), also identified 1.6 hectares (4 acres) of Maritime Dune Woodland, more specifically, black cherry xeric dune woodland communities, within the areas designated as Maritime Woodland. In addition, this inventory identified the occurrence of *Eupatorium anamolum*, a state-listed rare plant species (VDCR, 2012).

There are a few small patches of maritime forest on Wallops Island that occur in isolated stands or are intermixed with the maritime scrub habitat. The overstory of the maritime forests consists almost

entirely of loblolly pine. The understory is composed of trees like red maple, black cherry, and sassafras, and common vines in this habitat include greenbrier (*Smilax* spp.), poison ivy, Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), and grapes ( *Vitis* spp.) (NASA, 2016). Interdune ponds primarily occur in the northern and north-central parts of Wallops Island. Typical vegetation in these areas includes common threesquare (*Schoenoplectus pungens = Scirpus pungens*), sedges, switchgrass (*Panicum virgatum*), saltmeadow cordgrass, rushes (*Juncus* spp.), sea pink (*Sabatina stellaris*), saltmarsh fimbristylis (*Fimbristylis spadicea*), and seaside goldenrod. State rare species that have been documented in this habitat include Carolina fimbry (*Fimbristylis caroliniana*), long-awned sprangletop (*Leptochloa fusca* spp. *fascicularis*), and big-headed rush (*Juncus megacephalus*) (NASA, 2017).

#### *Current Management Practices*

Vegetation management practices at WFF are implemented by the Grounds Maintenance Group. The Grounds Maintenance Group implements various vegetation management practices employed at the facility such as mowing, tree and shrub removal, swale maintenance, pesticide use, and other habitat modifications to ensure the airfield and Main Base are maintained as unattractive to wildlife species as possible. Vegetation management is critical to wildlife hazard management at the facility (see Section 4.6, Vegetation Management).

### *4.6.2 Regulatory Environment*

While general vegetation resource management is not guided or driven by a regulatory requirement, invasive plant species and federal- or state-listed special status species (i.e. rare plants, species of concern, etc.) are protected under the respective categories (see Section 4.7.2, Invasive Species/Pesticides Management, Regulatory Environment, and Section 4.8.2, Special Status Species Management, Regulatory Environment).

### *4.6.3 Management Goals and Objectives*

#### Goal E1: Promote sustainable landscaping practices at WFF.

#### Objective(s)

E1.1) Implement water conservation strategies, where possible.

E1.2) Promote ecological succession; allow for the natural succession of vegetative areas, where practicable.

E1.3) Investigate reforestation opportunities based on GIS and WFF Master Plan. Create a GIS layer of possible reforestation opportunities considering Master Planning growth, demolition, and operational constraints (e.g., Airfield Part 77 encroachment restrictions).

#### Monitoring and Measurement

Coordinate with Operations and Maintenance to track number of acres cleared/deforested and the acreage allowed to return to natural vegetated state. Track acres and areas of reforestation opportunities.

## 4.7 Invasive Species/Pesticides Management

### *4.7.1 Program/Resource Description*

Center resource distributions can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

#### *Invasive Species*

Invasive species are any species that are not native to a given ecosystem and whose introduction causes, or is likely to cause, economic or environmental harm and/or harm to human health (EO 13112 of February 3, 1999, *Invasive Species* and EO 13751 of December 5, 2016, *Safeguarding the Nation from the Impacts of Invasive Species*). Because of their ability to alter natural ecosystems and diminish the abundance or survival of native species, aggressive non-native species can readily displace native species and can create monoculture habitats. By lowering natural biodiversity and lessening the value of habitat to wildlife, invasive species are recognized as a threat to biodiversity and, in some instances, to native species survival. It is estimated that over 40 percent of the species protected by the Endangered Species Act are at risk primarily because of non-native, invasive species (Pimentel et al., 2005). Due to the extensive historic disturbance, land use history, and landscaping practices that occurred at all WFF locations, invasive species have colonized large areas of the facilities.

Although a variety of non-native species occur at WFF, including landscape and groundcover plants such as privet (*Ligustrum* spp.), English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), autumn olive, and ornamental cherry (*Prunus* sp.), some pose a greater threat to biodiversity and NASA's assets than others, and not all are problematic and warrant control. Therefore, assessing the extent of damage caused by the presence of invasive species and prioritizing management activities are important steps to ensure the greatest environmental and safety benefits and the success of the invasive species control program. The primary considerations for prioritizing actions are as follows: the potential impact of invasive species to the NASA mission; the severity of threat to natural ecosystems and rare, threatened, and endangered species; and the feasibility of control.

In 2007 and 2008, a combination of field surveys and aerial photograph interpretation were employed to estimate the real extent of invasive species infestation at WFF. Of the approximately 320 hectares (790 acres) of invasive species identified, *Phragmites australis* (phragmites) accounted for 88 percent of the acreage, with a total of 278 hectares (687 acres) on Wallops Island, 0.4 hectare (1 acre) on the Mainland, and 4.5 hectares (11 acres) at the Main Base (NASA, 2008b). A Natural Heritage Survey of North Wallops Island conducted in the summer and fall of 2011 by the Natural Heritage Division of VDCR came to a similar conclusion, noting that large portions of the study area were dominated by phragmites (NASA, 2012).

According to Warren et al. (2001), phragmites have been a minor component of mid-Atlantic brackish tidal wetlands for over 3,000 years (Warren et al., 2001). However, due to the introduction of new genotypes, which are invasive, and human disturbance of coastal areas, phragmites has recently become a problematic invasive species with expansion rates of 1 to 3 percent per year. The invasive genotype of phragmites is a tall (5 meters [15 feet]) perennial grass with creeping rhizomes that may make a dense vegetative mat. Thick rhizomal growth and the accumulation of litter from the aerial shoots prevent other species from becoming established. Phragmites is an opportunistic species, taking advantage of the disturbances to the local vegetative community caused by disruptions of the natural state, such as those caused by fire or earth-moving activities.

A literature review by Weinstein and Balleto (1999) states that phragmites alter the ecology and function of the wetland by building up the wetland plain, filling in the microtopographic relief of the

wetland surface, and by sequestering nitrogen (Weinstein and Balleto, 1999). In addition to the environmental damage caused by phragmites, stands of the plants present a fire hazard. The dead shoots left standing after the previous growing season ignite readily, and flames spread rapidly through the densely packed, dry vegetation. The height of the plants contributes to this spread, as breezes can quickly fan elevated sparks to new areas.

### *Current Management Practices*

NASA has worked with the VDCR in an effort to map, control, and monitor phragmites at WFF as part of an ongoing project on Virginia's Eastern Shore (VDCR, 2011). The 2011 VDCR report summarizing these activities indicates from 2006 to 2008 that a total of 130 hectares (322 acres) of phragmites on Wallops Island was treated aerially with an herbicide. Furthermore, with the goal of reducing the spread of phragmites and of the hazards that phragmites-fueled wildfires present to flight-related infrastructure, fragile marsh ecosystems, wildlife, property owned by WFF and its neighbors, and, most importantly, human life, WFF has recently developed a Phragmites Control Plan (NASA, 2014). Control methods enforced through the plan include a combination of the following:

- aerial application of an imazapyr[1]-based herbicide in late summer to early fall (August through September);
- hand herbicidal spraying, to treat small stands of phragmites or stands in locations inaccessible to aerial spraying (e.g., close to structures, underneath the Launch Pad 0-A ramp, or in small patches surrounded by non-phragmites plants);
- post-herbicide application controlled burning;
- mowing of small infestations;
- requiring special considerations for operating heavy equipment in phragmites-infested areas (e.g., restricting construction equipment from areas prone to invasion, cleaning of construction

[1]Imazapyr is an EPA-approved, non-selective, broad-spectrum herbicide marketed under various trade names, including *Chopper*, *Arsenal*, *Stalker*, and *Assault*. It was first registered for use in the United States in 1984.

equipment of all visible dirt and plant debris prior to leaving the construction site, and post-construction monitoring and mowing); and

- annual monitoring and reporting of phragmites growth.

Though the primary goal of the Control Plan is to protect NASA's launch infrastructure assets, it also protects marsh ecosystems and native plant and animal species from invasive species consistent with EO 13112 and EO 13751.

### *4.7.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*EO 13112, Invasive Species* – This EO calls upon executive departments and agencies to take steps to prevent the introduction and spread of invasive species and to support efforts to eradicate and control invasive species that are established.

*EO 13751, Safeguarding the Nation from the Impacts of Invasive Species* – This order amends EO 13112 and directs actions to continue coordinated federal prevention and control efforts related to invasive species.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) – This act provides for federal regulation of pesticide distribution, sale, and use. All pesticides distributed or sold in the United States must be registered (licensed) by the Environmental Protection Agency (EPA). Before the EPA may register a pesticide under FIFRA, the applicant must show, among other things, that using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment."

### *4.7.3 Management Goals and Objectives*

Goal F.1: Continue to develop phragmites management strategies to protect NASA's launch infrastructure assets, marsh ecosystems, and native plant and animal species from invasive species.

Objective(s)

F1.1) Periodically review the Phragmites Control Plan with WFF stakeholders to explore new management strategies and control methods.

### Monitoring and Measurement

Progress of this goal and objective will be achieved through annual tracking of how many acres of phragmites are actively managed for fire load.

In order to ascertain impacts to marsh ecosystems and native plant and animal species, current aerial photography will be compared every five years, or as available, to photography from five years prior, to analyze the change in distribution or spread of phragmites.

## 4.8 Special Status Species Management

### *4.8.1 Program/Resource Description*

Locations of WFF resources can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

#### *Special Status Species*

Special status species include any species that is listed, or proposed for listing, as threatened or endangered by the USFWS or National Marine Fisheries Service (NMFS) under the provisions of the federal Endangered Species Act; marine mammals and EFH; species protected under other federal laws including the Bald and Golden Eagle Protection Act (BGEPA); species that are considered to be T&E under Virginia's Endangered Species Act; or those species or habitats of conservation concern identified by the Commonwealth of Virginia.

Special status species that may occur on or within the vicinity of WFF are summarized in Table 4.8.1-1. Figure 10 and Figure 11 in Appendix A (Figures) show the known locations of protected species in the vicinity of the Main Base, the Mainland, and Wallops Island, respectively; however, the entire beach area is suitable nesting and/or foraging habitat for a number of special status species that are described in more detail in the subsections below.

**Table 4.8.1-1. Protected Species that May Occur on or within the Vicinity of WFF**

| Common Name | Scientific Name | Status | Expected Occurrence[(a)] | Notes |
|---|---|---|---|---|
| **Plants** | | | | |
| Seabeach amaranth | *Amaranthus pumilus* | FT, ST | Assateague Island beach | Documented at Assateague Island. |

**Table 4.8.1-1. Protected Species that May Occur on or within the Vicinity of WFF (continued)**

| Common Name | Scientific Name | Status | Expected Occurrence[(a)] | Notes |
|---|---|---|---|---|
| Florida thoroughwort | *Eupatoriu anomolum* | SGCN | Northern Wallops Island | Protected Species Monitoring Plan stipulates that WFF will maintain open areas to promote the growth of Florida thoroughwort near the North Wallops Island UAS airstrip. |
| **Invertebrates** | | | | |
| Northeast beach tiger beetle | *Cicindela d. dorsalis* | FT, ST | Chesapeake Bay beaches | Only documented on Chesapeake Bay beaches; closest beach known to be occupied by species is approximately 23 km (14 mi) west of WFF. |
| **Mammals** | | | | |
| Northern long-eared bat | *Myotis septentrionalis* | FT, ST | May roost under bark or in cavities or crevices of both live and dead trees during summer months | No Myotis guild detected during 2017–2018 bat acoustic and mist netting surveys (Barr, 2018). |
| **Sea Turtles** | | | | |
| Loggerhead sea turtle | *Caretta* | FT, ST | Coastal and offshore ocean waters; Wallops and Assateague Island beaches | Most prevalent sea turtle species in the area; has nested on Wallops and regularly nests on Assateague Island beaches; greatest in-water concentrations over continental shelf, however, is also found in deeper waters. |
| Leatherback sea turtle | *Dermochelys coriacea* | FE, SE | Coastal and offshore ocean waters | Nesting unlikely; only one individual demonstrating nesting behavior documented on Assateague Island in 1996; generally considered oceanic, however, will forage in coastal areas if prey species are available in high densities. |
| Hawksbill sea turtle | *Eretmochelys imbricata* | FE, SE | Coastal ocean waters | Rare chance for occurrence near WFF; only two observations have been recorded in Virginia since 1979. |

**Table 4.8.1-1. Protected Species that May Occur on or within the Vicinity of WFF (continued)**

| Common Name | Scientific Name | Status | Expected Occurrence[(a)] | Notes |
|---|---|---|---|---|
| Kemp's ridley sea turtle | *Lepidechelys kempi* | FE, SE | Coastal ocean waters | Second most prevalent sea turtle species in the area; traditionally nests in Mexico, however, first Virginia nest discovered in 2012 at Virginia Beach; generally found in more sheltered, shallower water habitats than other sea turtle species. |
| Atlantic green sea turtle | *Chelonia mydas* | FT, ST | Coastal ocean waters | Nesting unlikely; only one documented nest in Virginia at Virginia Beach in 2005. |
| **Birds** | | | | |
| Red knot | *Calidris canutus* | FT, SGCN IV | Wallops, Assateague, and Assawoman Island beaches | Regularly forages on Wallops, Assateague, and Assawoman Islands during migration. |
| Piping plover | *Charadrius melodus* | FT, ST | Wallops, Assateague, and Assawoman Island beaches | Regularly nests and forages on Wallops, Assateague, and Assawoman Island beaches. |
| Roseate tern | *Sterna dougallii* | FT, ST | Offshore ocean waters | Rarely observed along the U.S. coast south of New Jersey; may transit through oceanic portion of the region during seasonal migration. |
| Eastern black rail | *Laterallus jamaicensis* | FT, SE | Wallops | Species documented at WFF in 2019, and potentially suitable habitat present at and near WFF. However, no call responses detected in surveys conducted in 2021 and 2022 surrounding Wallops Island. |
| Bald eagle | *Haliaeetus leucocephalus* | BGEPA, ST | Main Base and Wallops Island | Active nests on Wallops Main Base and Island (WEST, 2021; WEST, 2022). |
| Wilson's plover | *Charadrius wilsonia* | SE | Assawoman Island beach | No active nests detected on Wallops Island; active nests on Assateague Island and two adjacent islands to the south. |

**Table 4.8.1-1. Protected Species that May Occur on or within the Vicinity of WFF (continued)**

| Common Name | Scientific Name | Status | Expected Occurrence[(a)] | Notes |
|---|---|---|---|---|
| Peregrine falcon | *Falco peregrinus* | ST | Wallops Island | Regularly nests on hacking tower on west side of North Wallops Island. |
| Loggerhead shrike | *Lanius ludovicianus* | ST | Wallops Main Base and Wallops Mainland | Historic occurrence in Accomack County; however, recent Virginia occurrences have only been in the Shenandoah Valley. |
| Gull-billed tern | *Gelochelidon nilotica* | ST | Assateague Island beach | No active nests detected on Wallops Island; active nests on Assateague Island. |
| **Fish** | | | | |
| Atlantic sturgeon | *Acipenser o. oxyrinchus* | FE, SCGN II | Coastal ocean waters | Most likely found in water depths less than 50 m. |
| Giant manta ray | *Manta birostris* | FE | Offshore ocean waters | Global distribution; lives in open waters and near productive coastlines. |
| Oceanic whitetip shark | *Carcharhinus longimanus* | FE | Offshore ocean waters | Global distribution; lives near the surface in warm open waters. |

**Sources:** (NASA, 2019a; NASA, 2021d)

**Note:**

(a) For in-water species, the term "coastal ocean waters" in this table generally corresponds with the neritic zone, which in standard oceanographic terms is between water depths of 0 to 200 m and usually includes the continental shelf; "offshore ocean waters" generally corresponds with the oceanic zone beyond the 200-m depth contour.

**Key:** BGEPA = Bald & Golden Eagle Protection Act; FC = Federal Candidate; FE = Federal Endangered; FT = Federal Threatened; km = kilometer; m = meters; mi = miles; SE = State Endangered; SGCN = Species of Greatest Conservation Need; ST = State Threatened; U.S. = United States; UAS = unmanned aerial systems; WFF = Wallops Flight Facility.

### Plants

**Seabeach amaranth.** The threatened seabeach amaranth is an herbaceous plant, which colonizes and stabilizes the areas seaward of the primary dunes, growing closer to the high tide line than any other coastal plant. Seabeach amaranth requires extensive areas of barrier island beaches and inlet areas and is most successful at colonizing unaltered beach landscapes, which are inherently dynamic. This species appears to be intolerant of competition and does well on sites with low vegetative cover. These characteristics allow it to "move around" in the landscape as a fugitive species, occupying suitable habitat as it becomes available. It often grows in the same areas selected for nesting by shorebirds such as plovers, terns, and skimmers. It emerges in summer and early fall on sand dunes, inlets, and overwash flats at the accreting ends of islands and the lower foredunes and upper strands

of non-eroding beaches. Its distribution varies from year to year, influenced by seed dispersal and locally favorable conditions for germination, growth, and flowering. Flowering begins as soon as plants are mature, sometimes as early as June, but more typically beginning in July and continuing into late fall. Seed production begins in July or August and peaks in September.

### Sea Turtles

**Loggerhead sea turtle.** Both USFWS and VDWR consider loggerhead sea turtles a threatened species. The NMFS has divided the population into nine distinct population segments (DPSs), four of which are threatened and five that are considered endangered. The population near WFF belongs to the threatened northwest Atlantic DPS. On average, adults in this DPS weigh 113 kilograms (250 pounds) and grow to a length of 1 meter (3 feet). Loggerhead sea turtles feed on hard-shelled prey such as whelks and conch. The species spends most of its life in the open ocean or nearshore coastal areas but nests on beaches and occasionally on estuarine shorelines (NOAA, 2022a). In the southeastern United States, they mate from March to early June, and females lay eggs between late April and early September. Female sea turtles leave the ocean only to lay eggs and, for most species, nest only at night. A female may nest every two to three years. Nesting can take between one and three hours. After a female turtle drags herself up the beach, she hollows out a pit with her back legs and deposits 50 to 200 eggs. When the last egg is laid, the turtle covers the eggs with sand, tamps down the sand with her plastron, and flings more sand about with her flippers to erase any signs of the nest and crawls back out to sea. After about two months, typically between late June and mid-November, the hatchling turtles emerge at night. The light reflected off the water from the moon and stars guides them to the sea.

The major nesting concentrations in the United States occur from North Carolina to southwest Florida. However, the species has been known to range northward to Virginia and westward to Texas. On July 18, 2013, the NMFS proposed 36 critical habitat units for loggerhead sea turtles. No critical habitat was proposed along or offshore of WFF (NMFS, 2013). The most northerly proposed habitat unit is off the Diamond Shoals in North Carolina. In July 2014, NMFS issued the Final Rule for in-water critical habitat for the loggerhead sea turtle. In total, 38 critical habitat areas were designated within occupied marine areas for the range of the northwest Atlantic DPS (NMFS, 2014). Also, in July 2014, the Final Rule for critical nesting habitat for loggerhead sea turtles was passed by

the USFWS. This rule included 88 nesting beaches in coastal counties in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi (USFWS, 2014). None of these areas were in the vicinity of WFF.

Current threats to the species include incidental capture in fishing gear, direct harvest, disease, consumption of marine debris, and environmental contamination. Threats to nesting include loss or degradation of nesting habitat, beach armoring, artificial lighting, and non-native vegetation on beaches (NOAA, 2022a). One loggerhead sea turtle nest was observed on Wallops Island in 2008, and four were observed in 2010 (NASA, 2010b). In 2012, two loggerhead nests were observed, including one on the renourished beach near the Navy's Aegis facility; the first nest was predated during the hatch window while the second nest had a 78 percent hatch rate, with 5 hatchlings directly observed by WFF personnel. In 2013, two loggerhead nests were identified farther south on the Wallops Island beach between Building X-079 and Launch Pad 0-A. The southernmost nest had a hatch rate of 79 percent, whereas the more northern nest was less successful (hatch rate approximately 4 percent) due to its relatively lower elevation on the beach, which resulted in its exposure to storm-induced flooding (NASA, 2021a). No loggerhead turtle nests were observed in years 2014 through 2022 (NASA, 2021a; Miller, 2022). The area where loggerhead sea turtle nests have been observed on Wallops Island is depicted in Figure 10 and Figure 11 of Appendix A (Figures).

**Leatherback sea turtle.** The leatherback sea turtle is federally and state-endangered and is the largest sea turtle and the largest living reptile, reaching up to 2 meters (6.5 feet) in length and weighing up to 900 kilograms (2,000 pounds). Leatherbacks are the only sea turtle that lack a bony shell, with the carapace being made up of thick, leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The carapace has seven distinctive longitudinal ridges and tapers to a blunt point. The front flippers lack both claws and scales and are proportionally longer than those of other sea turtles, while the rear flippers are paddle shaped. Leatherback morphology makes the species uniquely suited to long-distance foraging migrations. They feed on soft-bodied pelagic prey, such as jelly fish and salps (NOAA, 2022b). Leatherbacks are commonly known as oceanic creatures, but they also forage in coastal waters. They are the most migratory and wide ranging of all sea turtle species. Nesting typically occurs in tropical waters. After nesting, females migrate to more temperate

waters that support high densities of jellyfish (NOAA, 2022b). Leatherbacks have never been sighted on WFF but are known to occur in the waters offshore of Accomack County (NASA, 2017).

**Hawksbill sea turtle.** The hawksbill sea turtle is a federally and state-endangered sea turtle that can reach up to 1 meter (3 feet) in length and weigh up to 80 kilograms (180 pounds). Hawksbills have an elongated head that tapers to a point with a beak-like mouth that gives the species its name. The morphology of the head and mouth allows the hawksbill to reach into holes and crevices of coral reefs to find sponges, their primary food source, and other invertebrates. Hawksbills are unique among sea turtles in that they have two pairs of prefrontal scales on the top of the head, and each of the flippers typically has two claws. Females return to natal beaches to lay their eggs every two to three years. A female will usually lay 3 to 5 nests per season, laying 1 every 14 to 16 days. They normally nest high up on the beach under beach/dune vegetation. Hawksbills are a circumtropical species, generally occurring between 30-degrees south latitude and 30-degrees north latitude in the Atlantic; however, they have been sighted as far north as Massachusetts (NOAA, 2022c). Hawksbills have never been directly observed by WFF personnel (NASA, 2017). They may occur in offshore waters, but the preferred tropical habitat does not exist near WFF; therefore, they are unlikely to occur.

**Kemp's ridley sea turtle.** Kemp's ridley sea turtles are federally and state-endangered. Adult Kemp's ridley sea turtles are considered the smallest of all sea turtles, growing to 70 centimeters (28 inches) long and weighing up to 45 kilograms (100 pounds). They have a relatively round shape, with five pairs of costal scutes. Each front flipper has one claw, while back flippers may have one or two claws. Kemp's ridleys feed on crabs, fish, jellyfish, and mollusks. They range from the Gulf of Mexico to the U.S. Atlantic seaboard from Florida to Maine. They are found in the neritic zone; that is, in areas that typically contain muddy or sandy bottoms where their prey can be found. Kemp's ridley sea turtles nest from May to July, laying 2 to 3 clutches of about 100 eggs. These turtles utilize synchronized nesting techniques, where many females come ashore to nest along the same beach at the same time. Large groups are known to nest in the state of Tamaulipas, Mexico, where 95 percent of the worldwide nesting of Kemp's ridley sea turtles occurs. Occasional nests have been documented in North Carolina, South Carolina, and Gulf and Atlantic Coasts of Florida (NOAA, 2022d) and, most recently, Virginia (USFWS, 2012). The Kemp's ridley sea turtle has never been directly observed at

WFF (NASA, 2017). The species may occur offshore in relatively shallow waters (less than 50 meters [160 feet]), where habitat exists for prey species (NOAA, 2022d).

**Atlantic Green sea turtle.** Atlantic green sea turtles are federally and state-threatened. These sea turtles are the largest of all the hard-shelled marine turtles, growing to a length of 1 meter (3 feet) and weighing up to 160 kilograms (350 pounds). Green sea turtles are unique among marine turtles in that they feed exclusively on plants, primarily sea grasses and algae. Nesting locations vary in the southeastern United States but nesting generally occurs between June and July. Females lay an average of five nests per season. In the United States, green sea turtles primarily nest along the central and southern coast of Florida. They have a global distribution and are primarily found in tropical and subtropical waters along continental coasts and islands between 30-degrees south latitude and 30-degrees north latitude. The species utilize open ocean convergence zones and coastal areas for benthic feeding on sea grasses and algae (NOAA, 2022e). Atlantic green sea turtles have been directly observed in waters off WFF (NASA, 2017). These turtles are likely to inhabit the waters off WFF during the warmer months when sea grasses and algae are plentiful. However, nesting habitat occurs farther south in tropical waters.

### Birds

**Red knot.** The red knot was listed as federally threatened on December 11, 2014. It is a medium sized sandpiper and one of the longest-distance migrants known in the world. Red knots have a red head and breast during breeding plumage and are grey during the rest of the year. These small birds have wingspans of approximately 51 centimeters (20 inches) and fly more than 15,000 km (9,300 miles) from south to north each spring and in reverse each autumn. They feed on small mussels and other mollusks for a large percentage of the year and horseshoe crab eggs during migration (USFWS, 2022). Based on survey data, during the mid-1990s, 8,000 to 10,000 individuals would migrate through the barrier islands of coastal Virginia. Surveys conducted in 2005 and 2006 recorded similar numbers (NASA, 2015).

Red knots do not breed in the vicinity of Accomack County, although they have been appearing regularly during spring migration on Wallops Island beaches, mostly during the second half of May (NASA, 2015). NASA began monitoring red knot flock size in 2010. The largest flock recorded

between 2010 and 2022 occurred on May 21, 2013, with a flock size of 1,162 individuals. During those same years, red knot flock sizes on Wallops Island have averaged approximately 175 individuals (NASA, 2022b; Miller, 2022).

**Piping plover.** Piping plovers are federally and state-threatened. Piping plovers are small, beige and white shorebirds with a black band across their breast and forehead. They typically feed on invertebrates such as marine worms, beetles, fly larvae, crustaceans, and mollusks. Habitat generally consists of ocean beaches, sand, or algal flats in protected bays, while breeding occurs mainly on gently sloping foredunes or blowout areas behind dunes. In late March or early April, after they have established territories and conducted courtship rituals, plover pairs form shallow depressions for nests where they lay their eggs in the sand. Nests can be found above the high tide line on coastal beaches, sandflats at the end of spits and barrier islands, gently sloping foredunes, blowout areas behind dunes, and overwash areas between dunes. Nest site substrates may include a range of materials from fine-grained sands up to shells and cobbles. Nests are typically found in areas with little or no vegetation; however, occasionally, nests have been found under beach grass and other vegetation (NASA, 2015).

The piping plover is a common transient and summer resident of the upper Virginia barrier islands and is known to inhabit the coastal habitats of each of these islands, including Wallops. Figure 10 and Figure 11 of Appendix A (Figures) depict piping plover nesting habitat areas. Piping plovers are known to use the sandy beaches and tidal flats along the coast of Wallops Island. They were first identified on northeast Wallops Island in a survey in June 1995. In accordance with the SRIPP Biological Assessment and the 2010, 2016 and 2019 Biological Opinion (BOs), NASA monitors Wallops Island for piping plover nests between March 15 and September 15 each year. NASA has conducted piping plover surveys 3 to 4 times weekly since 2007, during which 74 nests have been found. Records of historic nesting dates between 2007 and 2022 indicate that nesting on Wallops Island may occur between May and July. The earliest recorded piping plover nest was discovered on Wallops Island on April 14, 2020, and the latest was discovered July 9, 2022. Between 2007 and 2022, a total of 233 eggs were discovered, with 39 chicks fledging, yielding a success rate of 16.75 percent. Numerous factors including predation, storm overwash, and temperature drops have impacted successful piping plover fledging.

**Eastern black rail.** The eastern black rail is federally listed as threatened. Eastern black rail habitat can be tidally or nontidally influenced and range in salinity from salt to brackish to fresh. Tidal height and volume vary greatly between the Atlantic and Gulf Coasts and, therefore, contribute to differences in salt marsh cover plants in the bird's habitat. In the northeastern United States, the eastern black rail can typically be found in salt and brackish marshes with dense cover but can also be found in upland areas of these marshes (USFWS, 2020). The species was documented at WFF in 2019, and potentially suitable habitat is present at and near WFF. However, WFF and the U.S. Air Force (USAF) have performed 2 successive years of acoustic survey in potential habitat within a 10-km radius surrounding the USAF 229-meter (750-foot) guyed instrumentation tower on Wallops Island (Project Area). The objective of the 2021 and 2022 eastern black rail acoustic surveys was to determine the presence or potential absence of eastern black rail in the Project Area. No eastern black rails were detected in the Project Area during either the 2021 or 2022 acoustic surveys (WEST, 2021; WEST, 2022).

**Wilson's plover.** Wilson's plover is considered endangered by VDWR. Wilson's plover is a small- to medium-sized plover and is a coastal wader. Its range is both the East and West Coasts of the United States, with abundant breeding populations along the Gulf Coast. Wilson's plover has been documented as occurring on South Wallops Island, and, although no nests have been documented on Wallops Island, they are historically known to nest with piping plover (NASA, 2017).

**Bald eagle.** The bald eagle was formerly federally listed as endangered, but it has been delisted and is now considered recovered; however, bald eagles are provided protection under the federal BGEPA. Bald eagles also remain listed in Virginia as a threatened species. Active bald eagle nests are located within or adjacent to all three portions of WFF. Nesting activities typically begin in November and conclude in the summer when the young fledge (NASA, 2017).

**Peregrine falcon.** Peregrine falcons were formerly listed as endangered but have been delisted and are now considered recovered; however, they remain listed in Virginia as a threatened species. One man-made peregrine falcon nesting tower is located on Wallops Island and has been historically utilized by a pair of falcons. Peregrine falcons are also known to occur on Wallops Island during migration (NASA, 2017).

**Gull-billed tern.** The gull-billed tern is state-listed as threatened and is a medium-sized, black-capped, heavy-billed, and long-legged tern, now placed by most authorities in the monotypic genus *Gelochelidon* but was formerly placed in the larger genus *Sterna*. It has a broad distribution breeding in scattered localities in Europe, Asia, northwest Africa, Australia, and the Americas. In the United States, it nests only in coastal colonies along the Atlantic and Gulf Coasts; in California, it is restricted to one coastal location and one location in the interior of the state. North American gull-billed terns winter along the Gulf Coast, Pacific Coast of Mexico, and into Central and South America. Breeding and nesting take place on sandy beaches in spring and summer (Molina et al., 2009). Gull-billed terns are possible summer residents along Virginia's Eastern Shore, uncommon transients on the coast south of Cape Henry, and rare in the Lower Chesapeake Bay. Breeding activity has been recorded on the coast of the Eastern Shore but not on Wallops Island (VDGIF, 2012).

### Fish

**Atlantic sturgeon.** The Atlantic sturgeon is a federally and state-listed endangered (state Tier II Species of Greatest Conservation Need), long-lived, estuarine dependent, anadromous fish that can grow to approximately 4 meters (14 feet) in length and weigh up to 360 kilograms (800 pounds). There are five DPSs for the Atlantic sturgeon, and the population near WFF is part of the endangered Chesapeake Bay DPS. They are similar in appearance to shortnose sturgeon but are distinguished by their larger size, smaller mouth, different snout shape, and scutes. These fish range from Newfoundland to the Gulf of Mexico and are highly migratory. Adults migrate to natal rivers and spawn in flowing waters between the salt front and fall line. Adults spawn in freshwater in the spring and early summer and migrate into estuarine and marine waters where they spend the majority of their lives. Atlantic sturgeon are benthic feeders and typically forage on benthic invertebrates (e.g., crustaceans, worms, mollusks, etc.). Though historically abundant, the slow reproducing populations have been depleted due to overfishing, water pollution, and commercial bycatch (NOAA, 2022f). Atlantic sturgeon are known to occur, and have been documented, in the deeper waters off WFF.

**Giant manta ray.** The giant manta ray is listed as threatened under the Endangered Species Act. In January 2018, NOAA published its final rule (NMFS, 2018a). The largest of the ray family, the giant manta ray can reach a disc size of up to 7 meters (23 feet) across and weigh over 1,350 kilograms (2,980 pounds). The species is found worldwide; on the U.S. East Coast, the giant manta ray has been documented as far north as New Jersey. Mantas remain in the open ocean waters and travel with the currents. They may travel alone or in groups of up to 50 individuals. The giant manta ray grows

slowly and may live up to 30 years. The biggest threat to the species over the last 20 years is overfishing (artisanal, targeted, and bycatch). Overfishing is detrimental to a species that has a low fecundity rate and produces a single pup about every two to three years.

**Oceanic whitetip shark.** The oceanic whitetip shark is listed as threatened under the Endangered Species Act. In January 2018, NOAA published its final rule (NMFS, 2018b). The oceanic whitetip shark is a stocky, slow-moving species that can reach up to 3.4 meters (11.2 feet) in length and weigh over 230 kilograms (500 pounds). The species is easily distinguishable from other sharks by its whitish-tipped first dorsal, pectoral, pelvic, and caudal fins. They are found worldwide in warm tropical and subtropical waters between 20-degress north and 20-degrees south latitude but can be found up to about 30-degrees north and south latitude during seasonal movements to higher latitudes in the summer months. They tend to remain in the open ocean well offshore. The lifespan is up to 19 years, with maturity between years 4 to 7; mothers typically give birth every 2 years, with pup litter sizes ranging from 1 to 14. The oceanic whitetip shark was historically one of the most abundant shark species; however, due to inadequate regulations and overpressure in the fishing industry from bycatch related mortality, estimates of decline range from 50 to 80 percent across the Atlantic Ocean, with higher declines across the Pacific Ocean and variable declines across the Indian Ocean.

### EFH

In accordance with the Magnuson-Stevens Act, federal agencies must consult with the NMFS for activities that may adversely affect EFH that is designated in a federal Fisheries Management Plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The NFMS provides species lists with designated EFH divided into ten-minute by ten-minute geographic squares. The waters near WFF fall within two of these ten-minute by ten-minute squares of latitude and longitude (EFH1 and EFH2 – Figure 9 in Appendix A, Figures).

One or more life stages of 26 federally managed fish species have designated EFH within the area (depicted in Figure 9 of Appendix A, Figures). The list of the species and life stages with designated EFH is provided in Table 4.8.1-2.

**Table 4.8.1-2. Species and Life Stages with Designated EFH in Waters Surrounding WFF**

| Species | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|
| Atlantic butterfish (*Peprilus triacanthus*) | | | X | X |
| Atlantic sea herring (*Clupea harengus*) | | | | X |
| Atlantic sharpnose shark (*Rhizoprionodon terraenovae)* | | | | X |
| Black sea bass (*Centropristus striata)* | | | X | X |
| Bluefish (*Pomatomus saltatrix*) | | X | X | X |
| Clearnose skate (*Raja eglanteria*) | | | X | X |
| Cobia (*Rachycentron canadum*) | X | X | X | X |
| Dusky shark (*Charcharinus obscurus*) | | X | X | |
| King mackerel (*Scomberomorus cavalla*) | X | X | X | X |
| Little skate (*Leucoraja erinacea*) | | | X | X |
| Monkfish (*Lophius americanus*) | X | X | | |
| Red drum (*Sciaenops occelatus*) | X | X | X | X |
| Red hake (*Urophycis chuss*) | X | X | X | |
| Sand tiger shark (*Odontaspis aurus*) | | X | | X |
| Sandbar shark (*Charcharinus plumbeus*) | | X | X | X |
| Scalloped hammerhead shark (*Sphyrna lewini*) | | | X | |
| Scup (*Stenotomus chrysops*) | | | X | X |
| Spanish mackerel (*Scomberomorus maculatus*) | X | X | X | X |
| Spiny dogfish (*Squalus acanthias*) | | | | X |
| Surf clam (*Spisula solidissima*) | | | X | |
| Summer flounder (*Paralicthys dentatus*) | | | X | X |
| Tiger shark (*Galeocerdo cuvieri*) | | X | | |
| Windowpane flounder (*Scopthalmus aquosus)* | | | X | X |
| Winter flounder (*Pleuronectes americanus*) | X | X | X | X |
| Winter skate (*Leucoraja ocellata*) | | | X | X |
| Witch flounder (*Glyptocephalus cynoglossus*) | X | | | |

**Source:** (NASA, 2021d)

**Note:** "X" indicates that EFH has been designated within the square for a given species and life stage.

**Key:** EFH = Essential Fish Habitat; WFF = Wallops Flight Facility.

### Submerged Aquatic Vegetation

Grasses that grow to the surface of, but do not emerge from, shallow water are called SAV. SAV beds are an important component of the estuarine ecosystem. SAV is a diverse assemblage of marine and bay grasses that occur in shallow areas of the Chesapeake Bay, Delmarva Peninsula bays, and the Atlantic Ocean. SAV beds have be designated by the NMFS as EFH since they are an important resource that contributes the following: provides habitat for juvenile and adult fish and shellfish;

grants protection from predators for fish and shellfish; and produces food for waterfowl, fish, and mammals. Additionally, SAV beds absorb wave energy and nutrients, produce oxygen and improve water clarity, and help settle suspended sediments in the water and stabilize bottom sediments (NASA, 2019a).

VIMS has been mapping SAV in the Chesapeake Bay and Delmarva Peninsula bays since the 1970s using aerial photo-interpretation and ground surveys. The most recent report of SAV mapping was in 2020 (VIMS, 2020). According to the VIMS aerial surveys, SAV beds throughout the Chesapeake and Delmarva Peninsula Bays are generally in decline. SAV beds are present in the waters north of the Main Base, near the mouth of Little Mosquito Creek, and further east in the waters of Chincoteague Bay, but none are located in the waterways on or adjacent to WFF (VIMS, 2020).

### Marine Mammals

Nearshore, or Virginia Commonwealth, water extends from the shoreline out to 5.5 km (3 nautical miles). The six marine mammal species that VMRC has identified in the waters around Virginia's Eastern Shore/Accomack County include the following: 1) bottlenose dolphin (*Tursiops aurus*); 2) harbor seal (*Phoca vitulina*); 3) harbor porpoise (*Phocoena phocoena*); 4) fin whale (*Balaenoptera physalus*); 5) humpback whale (*Megaptera novaeangliae*); and 6) Florida manatee (*Trichechus manatus*) (NASA, 2019a).

#### Bottlenose Dolphin

The western North Atlantic coastal stock of bottlenose dolphin is considered depleted under the Marine Mammal Protection Act (MMPA). Bottlenose dolphins range in length from 1.8 to 3.8 meters (6 to 12.5 feet) and can weigh between 136 and 635 kilograms (300 and 1,400 pounds). The species is found in temperate and tropical waters around the world. Inshore bottlenose dolphins are smaller and lighter in color and are commonly found in groups of 2 to 15 individuals. Offshore individuals are larger, darker in color, have smaller flippers, and can be found in pods that contain several hundred dolphins. Coastal populations of bottlenose dolphins migrate into bays, estuaries, and river mouths, and offshore populations inhabit pelagic waters along continental shelves. Bottlenose dolphins are considered generalists and eat a variety of prey species that are endemic to their habitat. Coastal populations generally feed on benthic invertebrates and fish, and offshore populations feed on pelagic squid and fish. Bottlenose dolphins in the Western Atlantic Ocean face threats from

incidental injury and mortality from fishing gear, exposure to pollutants and biotoxins, and viral outbreaks (NOAA, 2022g). The primary habitat for the coastal morphotype of the bottlenose dolphin extends from New Jersey south to Florida during summer months and in waters less than 20 meters (65 feet) in depth; this includes estuarine and inshore waters (Waring et al., 2009).

### Harbor Seal

Harbor seals range from 1.7 to 1.9 meters (5.6 to 6.3 feet) in length and weigh up to 110 kilograms (245 pounds). The species eats a variety of prey including fish, shellfish, and crustaceans. Harbor seals live in temperate coastal habitats and use rocks, reefs, and beaches as haul-out sites. These sites are utilized for rest, thermal regulation, social interaction, and pupping. In the West Atlantic Ocean, harbor seals are found from the Canadian Arctic to southern New England and New York, although they are occasionally spotted as far south as the Carolinas. The harbor seal population in the New England area is believed to be increasing, and there are an estimated 91,000 seals in this population. Threats to harbor seals include incidental capture in fishing gear, boat strikes, oil spill exposure, chemical contaminants, power plant entrainment, and human harassment (NOAA, 2022h). Harbor seals would be considered an infrequent visitor to WFF; generally, the only reports of the species occurring from New Jersey south to Cape Hatteras, North Carolina, are from strandings (Waring et al., 2009).

### Harbor Porpoise

Harbor porpoises range from 1.5 to 1.7 meters (5 to 5.5 feet) in length and weigh between 61 and 77 kilograms (135 and 170 pounds). Harbor porpoises are found in northern temperate and subarctic coastal and offshore waters and are commonly found in bays, estuaries, and harbors less than 200 meters (650 feet) deep. The species is usually seen in groups composed of two to five individuals. In the western North Atlantic, harbor porpoises range from West Greenland south to Cape Hatteras. The main threat to this species is bycatch in fishing gear, specifically gillnets and trawls (NOAA, 2022i). In winter months (January through March), intermediate densities of harbor porpoises can be found in coastal ocean waters from New Jersey to North Carolina (Waring et al., 2009).

### Fin Whale

The fin whale is federally and state-listed as endangered and is considered depleted under the MMPA. Fin whales are the second largest species of whale, grow to a maximum length of

approximately 23 meters (75 feet) in the Northern Hemisphere, and can weigh from 35 to 75 metric tons (40 to 80 tons). This species is found in social groups that range from two to seven individuals. They feed on krill, small schooling fish, and squid in the summer and fast during the winter migration. Little is known about fin whale migration patterns. Fin whales are found in deep, offshore waters primarily in temperate and polar latitudes and less commonly in the tropics. Currently, the minimum population estimate for fin whales in the North Atlantic Ocean is 1,678 individuals. Historically, the fin whale population was diminished through commercial whaling. Current threats to the species include collision with vessels, entanglement in fishing gear, reduced prey abundance due to overfishing, habitat degradation, and disturbance from low-frequency noise (NOAA, 2022j). Fin whales may be found in ocean waters over the continental shelf off the coast of WFF (Waring et al., 2009) and have been documented as close as 1.5 km (1 mile) offshore when following prey species such as rockfish (Whealton, 2022).

#### Humpback Whale

The humpback whale is federally and state-listed as endangered and is considered depleted under the MMPA. Humpback whales grow to lengths of up to 18 meters (60 feet) and have long pectoral fins that can grow to 4.5 meters (15 feet) in length. Humpback whales spend summer months in high-latitude feeding grounds building fat reserves by feeding on krill, plankton, and small fish. The species migrates seasonally and spends the winter months in tropical or subtropical waters where they congregate and engage in mating activities. Humpback whales stay near the surface of the ocean during migration and prefer shallow waters for feeding and calving. The best available population estimate for humpback whales in the North Atlantic Ocean is currently 11,570 individuals; however, the species is believed to be increasing in abundance in much of its range. Threats to humpback whales include entanglement in fishing gear, collision with vessels, whale-watch harassment, and habitat impacts (NOAA, 2022k). Humpback whales may be found in ocean waters off the coast of WFF during migration, and recent data suggests that habitat off the mid-Atlantic states (Virginia and North Carolina) may be important for juvenile humpbacks (Waring et al., 2009). A juvenile humpback whale was stranded on North Wallops Island beach in September 2012 (Whealton, 2013). In December of 2016, the NMFS established 14 DPSs for humpback whales. The West Indies DPS, which includes habitat in the Mid-Atlantic region, is no longer listed by the NMFS.

### Florida Manatee

Florida manatees are listed as threatened under the Endangered Species Act and protected under the MMPA. Manatees are large, slow-moving herbivores with a low metabolic rate and high thermal conductance, which limits their ability to maintain core body temperatures in cold waters. Manatees depend on seagrass and other aquatic vegetation for food. In the winter, they congregate around warm water springs and man-made sources of warm water such as power plant discharges. Manatees can live for several decades. Adult females give birth to a calf about once every three years. The current best available population count for the Florida manatee is 4,834 individuals, with a modeled long-term decline in population and a change in their regional distribution throughout Florida (Cummings et al., 2014). Manatees are known to range north into the Mid-Atlantic during warmer summer and fall months. Of the 112 Florida manatee sightings in Virginia between 1991 and 2012, most occurred between June and October in rivers and creeks, followed by sightings in the open ocean, sounds and bays, Intracoastal Waterway, and marinas (Cummings et al., 2014). The most northerly recorded Virginia sighting noted by Cummings et al. (2014) was from Metompkin Island, approximately 12 km (7.5 miles) southwest of Wallops Island.

## Terrestrial Mammals

**Northern long-eared bat.** The northern long-eared bat is currently listed as threatened by the USFWS. In February 2016, the USFWS published a final 4(d) rule further defining "takes" and "incidental takes." Endangered Species Act 4(d) rules allow the USFWS the ability to provide more specific rules or measures to protect a species that is threatened (not endangered). The Endangered Species Act 4(d) rule was passed due to the mortality faced by this species from white-nose syndrome, a fungal disease that is poorly understood at this time.

This northern long-eared bat is medium-sized, measuring roughly 8 to 9 centimeters (3 to 3.7 inches) in length and weighing approximately 5.7 to 8.5 grams (0.2 to 0.3 ounces). Its fur color can be medium to dark brown on the back and tawny to pale brown on the underside. The northern long-eared bat is distinguished by its long ears, particularly as compared to other bats in its genus. This species spends winter hibernating in caves and abandoned mines. During the summer, they tend to roost singly or in colonies underneath loose tree bark and in the cavities or crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places such as caves or

mines. Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices. This bat has also rarely been found roosting in structures, like barns or sheds (NASA, 2017). Threats that have contributed to the species decline include commercialization of caves, loss of summer habitat, pesticides, and other contaminants and, most recently, the disease known as white-nose syndrome. The disease is named for the white fungus that infects skin of the muzzle, ears, and wings of hibernating bats. Bats infected with the disease exhibit abnormal behaviors in their hibernacula that result in the loss of stored fat reserves causing emaciation and, ultimately, death.

## *Current Management Practices*

### T&E Species

Because Wallops Island is also home to many of WFF's operational activities that could affect special status species, WFF has engaged in Endangered Species Act consultations with the USFWS over the years. A key component of conducting an Endangered Species Act consultation is to understand the status of listed species within the area potentially affected by the action. To this end, the need for a protected species monitoring program at WFF was initially identified during two programmatic Endangered Species Act consultations between NASA and the USFWS Virginia Field Office and was finalized in a consolidated effort. Once a monitoring program was developed, its implementation at WFF became a condition for complying with the USFWS BOs resulting from the multiple consultations.

In 2019, the USFWS issued a combined BO for the SRIPP and expanded operations at WFF. As part of the terms and conditions of the BO to manage special status species, WFF administers a Protected Species Monitoring Plan (NASA, 2021a). The plan is reviewed annually in cooperation with the USFWS and revised if applicable. Due to lack of Endangered Species Act-status species habitat on the Main Base and Mainland, the plan only applies to Wallops Island. Wallops Island is further divided into four distinct monitoring areas: 1) North End, 2) Recreational Beach, 3) New Beach, and 4) South End. Procedures are outlined for monitoring a number of protected species that are likely to occur at Wallops Island, including seabeach amaranth, red knot, piping plover, northern long-eared bat, and sea turtles. Also included in the monitoring plan is the marine mammal and sea turtle stranding

program protocols managed at WFF in cooperation with the Virginia Aquarium. Periodic monitoring occurs on the WFF Main Base and Mainland for the presence of northern long-eared bats and eastern black rail. However, since surveys for these species have not detected their presence, monitoring is not systematic under this plan.

The Protected Species Monitoring Plan (NASA, 2021a) also outlines mission-specific monitoring. The purpose of mission-specific monitoring is to survey the area adjacent to a rocket launch on Wallops Island for a protected species. Following launches and as soon as safety permits, monitoring staff conduct surveys for injured, dead, or impaired birds and sea turtles. Post-launch beach surveys are conducted between March 15 and November 30 of every year to coincide with plover and sea turtle nesting seasons. The survey area includes the beach within 1,000 feet, to the north and south, of the respective launch pad for sounding and orbital-class rocket launches. Letter reports of survey results are provided to the USFWS in digital format, within 15 business days of each launch event (USFWS, 2019).

### Bald Eagles

Through cooperation with the USFWS, NASA has adopted measures to protect nesting, foraging, and roosting bald eagles at WFF. In addition, NASA developed measures to provide ample habitat for any new nesting pairs of bald eagles at WFF. Adhering to these measures will also ensure compliance with the BGEPA.

In order to prevent injury to bald eagles, aircraft, and pilots, NASA holds a USFWS Permit for bald eagle nest take for any nests found within the Aircraft Operations Area surrounding either the Main Base or UAS Airstrip. Beginning in December, MARS and USDA personnel monitor both airfields in accordance with the permit and actively dissuade nesting through noise and pyrotechnics if nest building is noticed. If a pair cannot be dissuaded, limbs or the nest tree may be felled and the nest material scattered.

For nesting bald eagles outside the Aircraft Operating Area, protection measures include the establishment of three Protection Zones (PZs) around existing nests. Each PZ's boundary is progressively further from the nest, and different restrictions are placed on each zone. Suggested radii for each PZ are 330 feet for PZ 1, 660 feet for PZ 2, and 1,320 feet for PZ 3. Human activity should be

kept to a minimum in PZs 1 and 2 during the bald eagle nesting season (approximately December 15 through June 30) to avoid disturbance that could cause nest abandonment. In the event an additional bald eagle nest is discovered at WFF, PZs should be established and restrictions enforced in order to minimize disturbance of the nesting pair. Any significant bald eagle habitat outside the existing PZs should be protected to preserve ample habitat for fledglings from the existing nest or future nesting pairs at WFF.

### Marine Mammal Monitoring

The Navy has undertaken a large-scale modeling effort to determine the density of marine mammals within Navy training ranges and operating areas in the Atlantic Ocean. The modeling effort is referred to as "Navy at-sea Operating Area Density Estimates" and has been used to create the Navy's Marine Species Density Database (Navy, 2022). The Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations, which is a spatially referenced online database aggregating marine mammal, seabird, and sea turtle observation data from across the globe (UNEP-WCMC and IUCN, 2022), was used to generate marine mammal densities by season in the potential offshore impact area as shown in Figure 12 of Appendix A (Figures). The results are shown in Table 4.8.1-3. Modeled densities are reported in the number of animals per 1 square km (0.3 square nautical mile). The densities vary by season but, for the most part, are extremely low (all significantly less than 1).

**Table 4.8.1-3. Marine Mammal Densities in Waters off WFF**

| Common Name | Modeled Density in Geographic Range (animals per 1 $km^2$ [0.3 $nm^2$]) | | | |
|---|---|---|---|---|
| | Spring | Summer | Fall | Winter |
| Atlantic spotted dolphin (*Stenella frontalis*) | 0.112 | 0.112 | 0.112 | 0.112 |
| Atlantic white-sided dolphin (*Lagenorhynchus acutus*) | 0 | 0 | 0 | 0 |
| Blainville's beaked whale (*Mesoplodon densirostris*) | 0.001032 | 0.000943 | 0.001032 | 0.001032 |
| Blue whale[(a)] (*Balaenoptera musculus*) | no data | no data | no data | no data |
| Bottlenose dolphin | 0.04616 | 0.05087 | 0.04616 | 0.04616 |
| Clymene dolphin (*Stenella clymene*) | 0.009137 | 0.009137 | 0.009137 | 0.009137 |
| Common dolphin (*Delphinus delphis*) | 0.2973 | 0.2973 | 0.2973 | 0.2973 |
| Cuvier's beaked whale (*Ziphius cavirostris*) | 0.001032 | 0.000943 | 0.001032 | 0.001032 |

**Table 4.8.1-3. Marine Mammal Densities in Waters off WFF (continued)**

| Common Name | Modeled Density in Geographic Range (animals per 1 km² [0.3 nm²]) | | | |
|---|---|---|---|---|
| | Spring | Summer | Fall | Winter |
| Dwarf sperm whale (*Kogia sima*) | no data | no data | no data | no data |
| Fin whale[(a)] | 0.00044 | 0.00044 | 0.00044 | 0.00044 |
| Gervais' beaked whale (*Mesoplodon europaeus*) | 0.001032 | 0.000943 | 0.001032 | 0.001032 |
| Gray seal (*Halichoerus grypus*) | 0 | 0 | 0 | 0 |
| Harbor porpoise | 0 | 0 | 0 | 0 |
| Harbor seal | 0 | 0 | 0 | 0 |
| Harp seal (*Pagophilus groenlandicus*) | no data | no data | no data | no data |
| Humpback whale | 0.000998 | 0 | 0.000998 | 0.000499 |
| Long-finned pilot whale (*Globicephala melas*) | 0.04326 | 0.04814 | 0.04326 | 0.04326 |
| Minke whale (*Balaenoptera acutorostrata*) | 0.000034 | 0.000034 | 0.000034 | 0.000034 |
| North Atlantic right whale[(a)] (*Eubalaena glacialis*) | 0.0003 | 0 | 0 | 0.0003 |
| Pantropical spotted dolphin (*Stenella attenuate*) | 0.01913 | 0.01913 | 0.01913 | 0.01913 |
| Pygmy sperm whale (*Kogia breviceps*) | no data | no data | no data | no data |
| Risso's dolphin (*Grampus griseus*) | 0.02188 | 0.02188 | 0.02086 | 0.02188 |
| Rough-toothed dolphin (*Steno bredanensis*) | 0.000413 | 0.000413 | 0.000413 | 0.000413 |
| Sei whale[(a)] (*Balaenoptera borealis*) | 0 | 0 | 0 | 0 |
| Sowerby's beaked whale (*Mesoplodon bidens*) | 0.001032 | 0.000943 | 0.001032 | 0.001032 |
| Sperm whale[(a)] (*Physeter macrocephalus*) | 0.01113 | 0.01845 | 0.01113 | 0.01113 |
| Striped dolphin (*Stenella coeruleoalba*) | 0.284 | 0.284 | 0.284 | 0.284 |
| True's beaked whale (*Mesoplodon mirus*) | 0.001032 | 0.000943 | 0.001032 | 0.001032 |
| Florida manatee[(a)] | no data | no data | no data | no data |

**Source:** (UNEP-WCMC and IUCN, 2022)

**Note:**

(a) T&E species (federally threatened or endangered)

**Key:** km² = square kilometer; nm² = square nautical mile; T&E = threatened and endangered; WFF = Wallops Flight Facility.

## *4.8.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*Endangered Species Act* – Section 7 of the Endangered Species Act requires that federal agencies consult with the Endangered Species Act administering services to ensure any projects authorized, funded, or carried out by an agency will not likely jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat of such species.

*Virginia Endangered Species Act (29 VAC 1-563–29.1-570)* – The Virginia Endangered Species Act prohibits the taking, transport, processing, sale, or offer for sale of any federally or state-listed T&E species. NASA voluntarily complies with Virginia's Endangered Species Act and recognizes species listed by the Commonwealth of Virginia as being at potential risk of extinction.

*BGEPA*– This act prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald or golden eagles, including their parts, nests, or eggs.

*MMPA* – All marine mammals are protected under the MMPA. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the United States.

*EFH Provisions of the Magnuson-Stevens Act* – This act promotes the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. The act requires that the EPA consult with the NMFS for any EPA-issued permits that may adversely affect EFH identified under the Magnuson-Stevens Act.

### *4.8.3 Management Goals and Objectives*

#### Goal G1: Protect and enhance rare species populations and their habitats at WFF.

#### Objective(s)

G1.1) Maintain compliance with the Endangered Species Act, BGEPA, MBTA, MMPA, Magnuson-Stevens Act, and applicable state regulations.

G1.2) Initiate early consultation with regulators regarding potential program and project impacts.

#### Monitoring and Measurement

Monitoring and measurement may be achieved by annually tracking the number of consultations.

### Goal G2: Assess and monitor the occurrence of rare, threatened, and endangered species.

#### Objective(s)

G2.1) Continue to collaborate with natural resource organizations and agencies to monitor species of concern.

G2.2) Annually manage protected species nesting and breeding areas (e.g., signs, announcement, etc.).

G2.3) Coordinate and report on VCSFA and USDA monitoring of bald eagle nesting pairs on North Wallops Island and Main Base, respectively.

G2.4) Coordinate with Virginia Aquarium and monitor marine turtle and marine mammal strandings.

G2.5) Coordinate with the USFWS and VDWR on red knot, eastern black rail, and northern long-eared bat population surveys.

#### Monitoring and Measurement

Refer to the Protected Species Monitoring Plan (NASA, 2021a) for a detailed account of the species-specific monitoring measures.

Monitoring and measurement may be achieved by annually tracking the species-specific survey results and reporting.

### Goal G3: Explore partnerships, funding, planning, and implementation for regional coastal resiliency to promote and sustain species habitats.

#### Objective(s)

G.3.1) Enter into a USFWS-led Structured Decision Making (SDM) process with regional stakeholders including regulators, NASA WFF Divisions, tenants, other federal agencies, elected officials, and academia.

G.3.2) Investigate structural mechanisms that allow formal partnering programs. (e.g., DOD Readiness and Environmental Protection Integration, DOD Sentinel Landscape, USFWS North Atlantic Landscape Conservation Cooperative).

G.3.3) Seek funding sources that would allow for application into formal partnership with other stakeholders.

G.3.4) Apply and enter into formal partnership with other stakeholders.

G.3.5) Perform the prey base ecological surveys of Wallops Island in support of shoreline resiliency.

#### Monitoring and Measurement

Monitoring and measurement will entail tracking the number of annual SDM meetings and overall SDM progress. Additionally, WFF will track the funding secured and number of applications submitted.

### Goal G4: Maintain existing population levels and habitat and, where feasible, increase populations and enhance habitat when no mission impact is anticipated.

#### Objective(s)

G.4.1) Continue shoreline restoration to maintain and/or increase protected shoreline species nesting and foraging habitat.

#### Monitoring and Measurement

WFF will utilize biannual shoreline monitoring transect data to track current acreage of habitat. WFF may also utilize light detection and ranging (LIDAR), satellite, or ortho-photo aerial imagery data to calculate the annual changes in acreages of habitat(s).

## 4.9 Coastal Resource Management

### *4.9.1 Program/Resource Description*

Locations of WFF resources can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

Wallops Island is a 6-mi$^2$ island in Accomack County, Virginia, part of the Virginia Barrier Islands that stretch along the eastern seaboard. Barrier islands such as Metopkin, Assawoman, Wallops, and Assateague Islands are elongated, narrow landforms that consist largely of unconsolidated and shifting sand and lie parallel to the shoreline between the open ocean and the Mainland. These islands provide protection to the Mainland, prime recreation resources, important natural habitats to unique species, and valuable economic opportunities to the county. The northern end of Wallops

Island also contains coastal primary sand dunes that serve as protective barriers from the effects of flooding and erosion caused by coastal storms (NASA, 2019a).

Virginia boasts more than 5,000 miles of shorelines, and the Virginia Coastal Zone Management Program (CZMP) works to protect coastal resources and the industries and livelihoods that depend upon them. The VDEQ serves as the lead agency for the Virginia CZMP network of state agencies and coastal localities. The VDEQ helps develop coordinated policies, and the network implements the enforceable laws, regulations, and policies that protect the coastal resources and foster sustainable development across Virginia's coastal zone. A Coastal Policy Team consisting of representatives from each of the agencies and coastal Planning District Commissions discusses and resolves crosscutting coastal resource management issues (VDEQ, 2022).

### *Shoreline Restoration and Sea Level Rise*

Coastal environments are highly dynamic and particularly vulnerable to climate change. Potential impacts at WFF from climate change would likely include rising sea levels; more frequent flooding; and increasingly intense, unevenly distributed rain events. Wallops Island has experienced shoreline changes throughout the six decades that NASA has occupied the site. Currently, the sandy portion of Wallops Island has an elevation of about 6.9 feet above mean sea level (AMSL). The highest elevation on Wallops Island is approximately 15 feet AMSL. Most of the Island is less than 10 feet AMSL. Along with sea level rise, storm surges from hurricanes and nor'easters may increasingly make natural and built systems vulnerable to disruption or damage (NASA, 2022a).

In 2019, WFF employed the Shoreline Enhancement and Restoration Project (SERP) to evaluate the potential environmental impacts of both enhancing and restoring the shoreline on Wallops Island (NASA, 2019b). The purpose of the SERP is to restore the Wallops Island shoreline in order to reduce the potential for damage to, or loss of, NASA, U.S. Navy, and VCSFA's MARS assets on Wallops Island from wave impacts associated with storm events.

### *Current Management Practices*

Federal agency activities that have coastal effects must be consistent to the maximum extent practicable with federally approved enforceable policies of a state's CZMP. As such, for any projects with potential to impact coastal zones, WFF seeks a federal Consistency Determination from the

VDEQ. All projects at WFF must go through the E&SR system, a web application for gathering the data needed for GSFC environmental and safety personnel to review the proposed project and ensure compliance with multiple environmental and safety regulations, including the Virginia CZMP.

In response to sea level rise, NASA continues to implement an adaptive management and monitoring strategy for the shoreline restoration program. Throughout the 50-year term of the project, the beach profile in front of the present shoreline would be renourished with sand every 5 years or as needed. To account for sea level rise impacts to the shoreline at Wallops Island, additional sediment volume would be placed during each beach renourishment event. Modifications would be made as needed to ensure the viability of the long-term project meant to reduce the potential for damage to, or loss of, NASA, U.S. Navy, and VCSFA assets on Wallops Island from storm-induced wave action and sea level rise impacts (NASA, 2022a).

### *4.9.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*Section 307 of the Coastal Zone Management Act (CZMA) (16 U.S. Code (U.S.C.) 1456)* – This act is enacted to protect the nation's coastal zone and is implemented through state-federal partnerships. Section 307(c) of the CZMA prohibits the issuance of National Pollutant Discharge Elimination System permits for activities affecting land or water use in coastal zones unless the permit applicant certifies that the proposed activity complies with the state CZMP.

*Coastal Barrier Resources Act (Public Law 97-348, 16 U.S.C. 3501-3510)* – This act limits federal expenditures and financial assistance that have the effect of encouraging development on designated coastal barriers. Designated units are ineligible for direct or indirect federal financial assistance programs that could support development on coastal barrier islands; exceptions are made for certain emergency and research activities. * *Wallops Island is not included in the Coastal Barrier Resources System; therefore, the Coastal Barrier Resources Act does not apply*.

### *4.9.3 Management Goals and Objectives*

#### Goal H1: Coastal Resource Protection

Protect and restore WFF coastal resources, habitats, and species where practicable. This includes, but is not limited to, wetlands, subaqueous lands and vegetation, beaches, sand dune systems, barrier islands, underwater or maritime cultural resources, riparian forested buffers, and endangered or threatened species.

#### Objective(s)

H1.1) Maintain SRIPP for mitigating and/or accommodating the effects of recurrent flooding, storm surge events, and sea level rise for the Navy, NASA, and VCSFA's MARS facilities on Wallops Island.

H1.2) Reduce or prevent losses of Wallops Island coastal habitat, life, and property caused by shoreline erosion, storms, relative sea level rise, and other coastal hazards in a manner that balances environmental and economic considerations.

H.1.3) Perform sediment transport studies of Wallops Island and parts of adjacent areas in support of shoreline resiliency.

#### Monitoring and Measurement

NASA incorporates sea level rise into planning and project designs, particularly for any facilities at Wallops Island as part of their SRIPP. Any permanent new construction that could be damaged and that is less than 3.4 meters (11 feet) AMSL must be hardened or raised to avoid flooding from storm surge (NASA, 2010b). WFF will perform biannual transects to track volume of sand gained/lost across the beach face and efficacy of breakwaters. WFF will also track frequency of shoreline renourishment actions.

#### Goal H2: Coastal Management Coordination

This goal includes the exploration of partnerships, funding, planning, and implementation for regional coastal resiliency concurrent with objectives for Goal H3.

#### Objective(s)

H2.1) Ensure sustainable development on Wallops Island and support effective coordination of governmental planning processes.

H2.2) Avoid and minimize coastal and ocean resource use conflicts through research, planning, and coordination with the Goal G3 partnership.

H3.3) Promote Goal G3 SDM and partnerships by maximizing the availability of up-to-date educational information, technical advice, and scientific data including the use of new tools such as marine spatial planning (i.e., NASA Climate Adaptation Science Investigators data sets).

#### Monitoring and Measurement

Progress of these goals and objectives will be monitored through tracking the number of annual SDM/partnership meetings and SDM/partnership progress. Additionally, WFF will track the number of MOSI E&SRs for projects proposed on Wallops Island.

## 4.10 Wildlife Management and Bird/Wildlife Aircraft Strike Hazard Management

### *4.10.1 Program/Resource Description*

WFF resource locations can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD (NASA, 2017) located under "Documents" on the NASA WFF MEMD website.

Aircraft collisions with birds in flight have the potential to cause damage to equipment or even to destroy an aircraft, resulting in injury or death to aircrews. WFF lies in the center of the Atlantic Flyway, a major migration corridor for migratory birds, which creates collision hazards for operating aircraft at the facility. Additional BASH potential is created by the mosaic of open mowed fields and wooded areas at WFF that provide abundant habitat for whitetail deer, red fox, and other small mammals. Airfield operations at WFF include research aircraft (NASA- and privately owned), military aircraft, and a small number of general aviation operations.

Wildlife hazards can occur at WFF when animals enter the runways and launch areas or inhabit areas commonly utilized by facility vehicles. Additionally, sensitive bird species that nest on the island are at risk of nest and direct predation by red fox, Northern raccoon, Virginia opossum (*Didelphis virginiana*), and, with increasing frequency, coyote (*Canis latrans*). This predation on ground-nesting bird eggs may increase as predator density and diversity increases. Air operations and/or vehicular

traffic collisions with wildlife can result in wildlife injury and sometimes mortality. As such, WFF implements wildlife control measures through the Wildlife Hazard Management, Predator Management, and BASH Programs.

Hazardous wildlife control is primarily managed through a contract with the USDA/APHIS/Wildlife Services (WS) in accordance with the facility Wildlife Hazard Management Plan (WHMP) (NASA, 2021b) and the Wallops Island Predator Management Plan (USDA, 2020). The WHMP addresses the responsibilities, policies, and procedures necessary to reduce wildlife hazards at airports. Recognizing the potential hazards wildlife pose to aircraft and human lives, the Federal Aviation Administration (FAA) requires airports that incur strikes between wildlife and aircraft to implement a WHMP. NASA also recognizes this hazard and requires each center with an airfield to develop a WHMP according to NPR (NASA, 2021b).

The WFF Airport Manager/Wildlife Program Manager is responsible for overall implementation of this WHMP and for ensuring coordination between all supporting organizations and individuals. WS personnel are primarily responsible for conducting bird and mammal surveys at WFF, monitoring wildlife populations at the facility, and identifying hazardous species. WS personnel also, if deemed necessary, disperse or remove birds and/or mammals that pose a threat to aviation safety or human health and safety by nonlethal or lethal means under appropriate permits. WS personnel are also responsible for completing the required application for renewing WFF's migratory bird depredation permits with the USFWS, as well as WFF's state kill permit from VDWR. Wallops Control Tower Operators, Fire Department, and Aviation Safety Officer also have responsibilities in BASH management as indicated in the WHMP (NASA, 2008b).

### *Current Management Practices*

#### BASH

The overall goal of the BASH Program is to reduce wildlife/aircraft strike incidents through compliance with 14 Code of Federal Regulations (CFR) 139.337 – *Wildlife Hazard Management*. BASH Program objectives include reducing the attractiveness to birds and wildlife by minimizing food sources, nesting sites, and roosting habitat within the airfield clear zones. All bird and wildlife aircraft strike incidents are recorded and investigated by WS, as required by the WHMP.

Current management practices implemented under the BASH Program include the following:

- decreasing airfield attractiveness to birds; and
    - Grass height management. Mowing operations should maintain a uniform grass height between 7 and 14 inches. Taller grass discourages flocking species from utilizing the airfield's adjacent grasslands, because reduced visibility disrupts interflock communication and flock integrity and reduces predator detection. Grass must be cut before it goes to seed to discourage seed-eating birds from utilizing the airfield. If possible, the airfield should be planted with one type of grass species, so that uniformed growing and cutting times can be established.
    - Broad-leaf weed control. Broad-leaf weeds should be kept to a minimum in the airfield environment. Herbicide applications can be scheduled as needed.
    - Shelters and debris. Birds are attracted to areas that provide shelter to roost and nest. All structures such as trees, unnecessary inactive planes, etc., should be removed from the airfield vicinity.
- dispersing birds on the airfield.
    - Pyrotechnics. Pyrotechnics are 12-gauge scare cartridges that produce a secondary explosion to scare the birds from the area. There are three pyrotechnic scare cartridges used at WFF: 1) a 12-gauge shot from a shotgun, 2) a 15mm shot from a pyrotechnic launcher, and 3) a CAPA shot from a CAPA launcher (bird scare cartridges are commercially known as CAPA cartridges). The scare cartridges are launched from either a shotgun or a pyrotechnic launcher. Pyrotechnics are effective for dispersing most bird species and can also be used for deer, fox, and turkey.
    - Propane cannons. Propane cannons may also be used. These devices should be operated, especially at dawn and dusk, as birds come in to feed and roost. Cannons must be relocated frequently to avoid habituation. These devices are very effective on waterfowl and other game birds and can also be used for gulls and blackbirds.

- Depredation. Birds and other animals must be killed occasionally as a reinforcement of other methods. The USDA, APHIS, and WS will remove birds and/or mammals that pose a threat to aviation safety or human health and safety by lethal means under appropriate permits. WS personnel are responsible for maintaining WFF's migratory bird depredation permits with the USFWS and a state kill permit from VDWR.

- Other devices. Ingenuity is encouraged in the bird/wildlife strike hazard program. Other devices such as the crash truck, sirens, and public address systems may be used.

- Ineffective methods. Ultrasound, rubber snakes, stuffed owls, rotating/flashing lights, loud music, and other such devices have not proved effective and should not be used.

- Aviation Safety Working Group (ASWG). NASA requires that the center shall conduct a periodic review of bird hazards. The ASWG serves as WFF's BASH team and is responsible for reviewing the WHMP and making recommendations to the Wildlife Program Manager, who in turn reviews and grants approval if satisfied with the progress of the WHMP.

- Maintaining and implementing a WHMP.

    - The WHMP places emphasis on identification and abatement of wildlife hazards within the airfield environment. WFF takes measures to identify and mitigate wildlife hazards whenever they are detected or whenever airport management has been advised that hazardous conditions exist. The WHMP outlines steps for monitoring, documenting, and reporting potential wildlife hazards and wildlife strikes at WFF. Protocols for responding to hazardous wildlife situations, including roles and responsibilities of airport personnel, are included, and management methods for hazardous wildlife are also discussed.

    - Various wildlife is afforded some type of protection under federal or state regulations. Therefore, special permits are required before management

activities are initiated. The WHMP outlines WFF's permit status, and current copies of each are included as an appendix to the plan (NASA, 2021b).

- At WFF, supplies and equipment necessary for management activities are acquired and maintained by Airport Management and WS. WFF personnel are trained to properly identify wildlife and apply wildlife management techniques in a safe, effective, and efficient manner, as outlined in the WHMP (NASA, 2021b).

- WFF's ASWG, chaired by the Wildlife Program Manager, is held at least annually to review management activities and evaluate the need to update and modify the WHMP, as well as review the Annual Monitoring Report for the Wildlife Hazard Assessment (NASA, 2021b).

### Wallops Island Predator Management Plan

USDA has been working with WFF, the USFWS, The Nature Conservancy, and the Virginia Department of Game and Inland Fisheries to enhance native nesting shorebird, colonial waterbird, and duck populations on the barrier islands off the Eastern Shore of Virginia since 1991. These partners share technical information, conduct surveys of nesting birds, and remove mammalian and avian predators. This partnership has resulted in increased breeding populations and range distribution of some native bird species. The purpose of the Wallops Island Predator Management Plan is to identify the policies and activities that will be conducted for the protection of native nesting shorebirds, colonial waterbirds, and ducks on Wallops Island, including some species listed as threatened or endangered (USDA, 2020).

### Species-Specific Information for Hazard Reduction

The following presents management practices enforced for problematic wildlife at WFF.

**Blackbirds, grackles, cowbirds, and starlings.** These species can be particularly hazardous because they frequently occur in huge flocks, sometimes in the millions. Blackbirds and starlings are attracted to flat, open areas to feed, rest, or stage before roosting. Maintenance of grass height between 7 and 14 inches is the best means of reducing airfield blackbird and starling numbers.

**Gulls.** These species represent the most significant hazard to aircraft worldwide. Due to their omnivorous feeding habits and preference for flat, open areas to rest, they are commonly found on airfields. Gulls are most active just after sunrise and before sunset, as they move to and from feeding areas. Maintenance of grass height between 7 and 14 inches is critical to reducing gull numbers. Even with this in effect, gulls may roost on the runway, particularly during inclement weather. Persistent harassment using pyrotechnics is necessary to discourage these birds. APHIS WS holds a permit to use lethal control, if needed, to reinforce these techniques. Gulls should not be allowed to establish the habit of using the airfield to feed and rest.

**Deer.** Deer prefer to graze on broad-leaf weeds, shrubs, grass, and trees. Maintaining recommended grass heights at WFF makes grass less palatable and less attractive for grazing deer. The airfield on the Main Base is approximately 95-percent fenced, with an 8-foot-high chain-link fence topped with barbed wire. This perimeter fence is essential to keeping deer out of the Main Base and is very effective (except for the opening at the main entrance or when damaged by a storm before repairs can be made). While the fence does not prevent all deer from entering the property, it does serve as a major deterrent. Deer are not common on the airfield. However, APHIS WS holds a permit to use lethal control for deer that access the property and are not easily frightened from the airfield using scare tactics. Deer that have to be lethally removed from the airfield are donated to the Eastern Shore Hunters for the Hungry food bank or to a WFF employee willing to take it for their personal consumption, whenever possible.

### *4.10.2 Regulatory Environment*

Management of this resource at WFF is guided or driven by the following regulatory requirements:

*CFR Part 139.337(e)* – As part of Wildlife Hazard Management, this code requires FAA to issue airport operating certificates to airports that serve scheduled and unscheduled air carrier aircraft with more than 30 seats; serve scheduled air carrier operations in aircraft with more than 9 seats, but less than 31 seats; and is required to have a certificate by the FAA Administrator.

*NPR 7900.3 (Airport Operations Management)* – This requirement establishes requirements, responsibilities, and procedures that will assist NASA centers and other locations operating NASA aircraft to create local policies and procedures for the management of NASA aircraft resources, flight

operations, and related matters. This NPR provides a standard approach for the management and use of the NASA aircraft operations program.

### *4.10.3 Management Goals and Objectives*

#### Goal I1: Maintain and implement the WFF WHMP.

#### Objective(s)

I1.1) Fulfill all actions in WHMP including the following: 1) wildlife population management; 2) habitat modification; 3) land use changes; 4) requirements for and, where applicable, copies of local, state, and federal wildlife control permits; 5) identification of resources that WFF will provide to implement the plan; and 6) procedures to be followed during aircraft operations.

#### Monitoring and Measurement

Monitoring and measurement actions for this goal and objective include the review of APHIS WS Wildlife Hazard Assessments, predator management reports, bald eagle monitoring reports, VDWR kill permit reports, and the USFWS MBTA depredation report.

## 4.11Environmental Outreach/Recreation Management

### *4.11.1 Program/Resource Description*

WFF resource locations can be found in Appendix A (Figures), with detailed descriptions provided by accessing the NASA WFF ERD located under “Documents” on the NASA WFF MEMD website.

Recreational resources primarily include outdoor natural resources and built facilities that are designated or available for public recreational use. There are no recreational areas open to the public at WFF. The Wallops Island beach is open, after operational hours, for recreation to WFF permanently badged employees, tenants, and their guests. The northern portion of this recreational area is closed annually from March 15 through August 31 during piping plover nesting season.

There are additional recreational opportunities in the vicinity of WFF that are open to badged employees, tenants, and their guests, including boating, paddling, fishing, and shellfish harvesting. Waterways near Wallops Island are open to the public year-round for commercial and recreational fishing and boating; recreation primarily occurs in the warmer months of the year between spring and fall. The Virginia Seaside Water Trail, a water trail for day use paddlers, runs between

Chincoteague Island and the Eastern Shore of Virginia NWR at Cape Charles. The Virginia CZMP funded development of the water trail for nonmotorized use by paddlers using kayaks or canoes, as well as several public access points (VDEQ, 2020; Virginia Water Trails, 2020).

The VMRC regulates aquaculture (shellfish harvesting) in tidal waters, including recreational harvests by the public in areas designated as Baylor Grounds. Shellfish harvest grounds, which occur in some of the subaqueous bottom areas include private oyster grounds in Ballast Narrows and Chincoteague Channel and public clamming ground along the west side of Walker Marsh, north of Wallops Island (NASA, 2021d).

#### Current Management Practices

WFF issues a center-wide memorandum prior to nesting season each year to define the dos and don'ts of using the recreational areas (NASA, 2022c). Only permanently badged employees, contractors, tenants, and their guests may access Wallops Island's recreational offerings.

### *4.11.2 Regulatory Environment*

Management of this resource at WFF is not guided or driven by regulatory requirements.

### *4.11.3 Management Goals and Objectives*

#### Goal J1: Communicate requirements for species and area protection with internal and external stakeholders.

#### Objective(s)

J1.1) Annually review and maintain WFF Natural Resources Management webpage.

J1.2) Annually review and update training module on Code 250 website and provide to Protective Services Division.

J1.3) Prepare and distribute announcements and fact sheets, including the annual Recreational Beach Use Memo.

J1.4) Utilize MOSI E&SR at project planning and/or kick-off meetings to identify natural resource issues.

### Monitoring and Measurement

Monitoring and measurement will be achieved by tracking the number of Protected Services Division (PSD) staff who attended the Natural Resource Management training class and the number of WFF employees who have completed SATERN Natural Resource Management training. Additionally, the PSD will track the number of visitors to Wallops Island beach.

# 5. Recordkeeping and Reporting

## 5.1 Recordkeeping

The following records are required to be maintained in order to support natural resources management at WFF.

**Table 5.1-1. Recordkeeping Requirements**

| Record Name | Purpose/Driver | Record Location |
|---|---|---|
| WFF NRMP | Sikes Act Compliance | WFF internal share drive |
| Programmatic BO Proposed and Ongoing Operations and Shoreline Restoration/Infrastructure Protection Program | USFWS Compliance - Incidental Take Statement | WFF internal share drive |
| Annual Wildlife Hazard Assessment | USDA APHIS | WFF internal share drive |
| MOSI Environmental and Safety Review Portal | E&SR System - Ensures compliance with multiple environmental and safety regulations. | WFF internal share drive |
| National Heritage Inventory | Compliance with the VDCR | WFF internal share drive |
| Marsh Fiber Wetland Permit | VMRC Permit | WFF internal share drive |
| Wetland Permits | USACE Compliance; 401/404 Permit(s) | WFF internal share drive |
| Shoreline Restoration and Infrastructure Protection Permit | VMRC Permit | WFF internal share drive |
| Subaqueous Bottoms Permit - Shoreline Restoration and Infrastructure Protection | USACE Compliance; 401/404 Permit(s) | WFF internal share drive |
| Scientific Collection Permit | VDWR | WFF internal share drive |
| USAF Tower Migratory Bird Special Purpose Utility Permit | USFWS MBTA Compliance | WFF internal share drive |

**Key:** APHIS = Animal and Plant Health Inspection Service; BO = Biological Opinion; E&SR = Environmental and Safety Review; MBTA = Migratory Bird Treaty Act; MOSI = Management Operations Services and Information; NRMP = Natural Resources Management Plan; USACE = United States Army Corps of Engineers; USAF = United States Air Force; USDA = United States Department of Agriculture; USFWS = United States Fish and Wildlife Service; VDCR = Virginia Department of Conservation and Recreation; VDWR = Virginia Department of Wildlife Resources; VMRC = Virginia Marine Resources Commission; WFF = Wallops Flight Facility.

## 5.2 Reporting

The following reporting requirements are associated with this NRMP and other requirements associated with natural resources management at WFF.

**Table 5.2-1. Reporting Requirements**

| Report Name/ Data Requirement | Recipient | Frequency/ Due Date | Format | Purpose/Driver |
|---|---|---|---|---|
| SWPPP | VDEQ | As needed on a project basis | Report | VPDES Permit |
| VPDES Monthly Discharge Monitoring Report | VDH | Monthly | Report | VPDES Permit |
| Monthly Monitoring Report for Wildlife Hazard Assessment | USFWS, VDWR | Monthly | Report | USDA APHIS WS Program |
| Protected Species Management Plan - Monitoring Annual Report | USFWS, VDWR | 1 year | Report | In accordance with the Terms and Conditions of the June 7, 2019, *Wallops Flight Facility Update and Consolidation of Existing Biological Opinions, Accomack County, VA* |
| Protected Species Monitoring Post-Launch Letter | USFWS | Within 15 days post launch | Letter | BO |
| Annual Review, Phragmites Management Plan | WFF | 5 years | Report | NEPA |
| March 10, 2021, Letter of Modification to the BO | WFF | Where applicable | Letter | BO |
| Turtle Lighting Plan | WFF | 5 years | Report | BO |
| Turtle Lighting Survey | WFF | 1 year | Survey | BO |
| Bald Eagle Survey | College of William & Mary Center for Conservation Biology/USFWS | 1 year | Email | BGEPA |
| Bald Eagle Nest Surveys | MARS/APHIS WS | Biweekly, then monthly | Survey | USFWS Permit |
| Bald Eagle Nesting Report | NASA | 1 year | Report | USFWS Permit |
| Annual Antarctic/ New Zealand Balloon Program Office (BPO) Summary Report | NMFS/National Science Foundation | 1 year | Report | NEPA, Section 7 of the Endangered Species Act |
| Avian Mortality Survey Annual Report | USFWS, VDWR | As needed | Report | NEPA, VDWR and USFWS Permits |
| Virginia Breeding Bird Atlas | VDWR | 5 years | Survey | Research and collaborative citizen science project. |

**Key:** APHIS = Animal and Plant Health Inspection Service; BGEPA = Bald and Golden Eagle Protection Act; BO = Biological Opinion; MARS = Mid-Atlantic Regional Spaceport; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; SWPPP = Storm Water Pollution Prevention Plan; USDA = United States Department of Agriculture; USFWS = United States Fish and Wildlife Service; VDEQ = Virginia Department of Environmental Quality; VDH = Virginia Department of Health; VDWR = Virginia Department of Wildlife Resources; VPDES = Virginia Pollutant Discharge Elimination System; WFF = Wallops Flight Facility; WS = Wildlife Services.

# 6. Work Plan(s)

This section consolidates and summarizes the natural resources management directions identified in Section 4 (Natural Resources Management Program Elements) and, for each goal and objective, identifies the associated priority and planned implementation schedule by FY, as well as the driver behind the goal and/or objective.

Priority determinations were based on the following factors:

- One factor is whether the objective is driven by regulatory and/or compliance issues, or critical to the WFF mission. For example, a "Level 1" priority item may be related to requirements associated with a permit, USFWS consultation, etc. Not completing the objective may result in issues of noncompliance or negatively affect the ability of WFF to carry out a specific mission or its natural resources management program.
- A second factor is whether the objective is a major initiative on which other initiatives are dependent. For example, the objective is one that will be responsible for bringing about another or will have to be done before another can start. This direct relationship means that the objective (or objectives), if not completed, can serve as a bottleneck for a variety of other objectives that are dependent upon its completion. When a fair amount of objectives cannot be initiated without a precursor, the initial objective becomes a necessary priority. Depending on scope, this can be either a "Level 1" or "Level 2" priority.
- A third factor is whether the objective is related to a BMP or other recommended activity or simply enhances the natural resources management program. Typically, these "Level 3" priority items are not tied to specific requirements but serve to strengthen the natural resources management program and support the overall associated goal.

**Table 6-1. NRMP Work Plan**

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|
| A1 – Proactively manage facility wetlands. | A1.1. Maintain an accurate inventory of wetlands for use by WFF personnel. | Needed for planning purposes | L2 | FY 2022/As needed |

Table 6-1. NRMP Work Plan (continued)

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|
| | A1.2. Program Offices to fund jurisdictional wetland delineations as needed for specific projects. | CWA Compliance | L1 | FY 2022/As needed |
| | A1.3. Upload survey data and wetland boundaries to the Institutional GIS/ERT. Occurs as surveys are completed. | NPR 8580.1 | L2 | FY 2022/As needed |
| | A1.4. Develop long term wetlands compensation strategy (refer to the EMP). | WFF EMS | L3 | FY 2022/As needed |
| A2 – Ensure no net loss of wetland functions. | A.2.1. Maintain an accurate inventory of wetland functionality by performing wetland functionality assessment (Tiner, 2005) every 10 years with the next assessment performed by 2027. | WFF EMS | L2 | Decadal |
| | A.2.2. Determine wetland functionality for proposed projects that would impact wetlands. | CWA | L1 | FY 2022/As needed |
| | A.2.3. Program Office would fund and mitigate for wetland function as well as acreage to ensure no net loss of wetland functionality. | CWA | L1 | FY 2022/As needed |
| A3 – Avoid any instance of unpermitted fill or dredge within a wetland area. | A.3.1. WFF Natural Resources staff will be notified through the online E&SR process of new projects that have the potential to impact wetlands. | GPR 8500.1 | L2 | FY 2022/As needed |
| | A.3.2. WFF Natural Resources staff will work with the project proponent to delineate wetlands, submit and obtain Joint Permits, and conduct any required monitoring and/or mitigation. Project proponent is responsible for funding this objective. | CWA | L1 | FY 2022/As needed |
| A4 – Monitor Wetland Response to Sea Level Rise. | A.4.1. NASA will monitor sea level changes at WFF through the available data sources. | Shoreline Restoration | L3 | FY 2022/As needed |
| | A.4.2. WFF will participate in USFWS SET data collection and monitoring on Wallops Island. | EMS | L3 | FY 2022/As needed |
| B1 – Prevent contamination to surface and | B1.1. Prepare and implement appropriate permits and plans to prevent pollution to surface and groundwaters, such as the VPDES | CWA | L1 | FY 2022/As needed |

Table 6-1. NRMP Work Plan (continued)

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|
| groundwater on or adjacent to WFF. | permit, SWPPP, sediment and erosion control plan, and ICP. | | | |
| | B1.2. Annually train staff in the implementation of permits and plans to prevent pollution to surface water and groundwater. | CWA/ICP | L1 | FY 2022/Annually |
| | B1.3. Maintain accurate ECR studies, inventories, and remediation for impacted surface water and groundwater. | CERCLA AAOC | L1 | FY 2022/Annually |
| | B1.4. Conduct monitoring required by permit(s), (e.g., FOTW DMRs) deluge monitoring at Pad 0-A and launch surface water monitoring in case of a launch anomaly. | CWA/VPDES | L1 | FY 2022/As needed |
| | B1.5. Research and implement innovative natural stormwater management strategies (e.g., tree boxes, bioretention basins). | WFF EMS | L3 | FY 2022/As needed |
| C1 – Prevent contamination to soils and geology on or adjacent to WFF. | C1.1. Prepare and implement appropriate permits and plans to prevent pollution to soils, such as the VPDES permit, SWPPP, sediment and erosion control plan, and ICP. | CWA/RCRA | L1 | FY 2022/As needed |
| | C1.2. Annually train staff in the implementation of permits and plans to prevent pollution. | CWA/RCRA | L1 | FY 2022/Annually |
| | C1.3. Maintain accurate ECR studies, inventories, and remediation for impacted soil. | CERCLA AAOC | L1 | FY 2022/Annually |
| | C1.4. Annually submit NASA WFF Annual Standards and Specifications to VDEQ. Utilize the MOSI E&SR to ensure that the SEED Team reviews all ground-disturbing activities. | CWA/VPDES | L1 | FY 2022/Annually |
| D1 – Maintain all current management practices at WFF, including USDA APHIS surveys and nuisance species and predator management. | D1.1. Coordinate with USDA APHIS on management plans and reporting. | Endangered Species Act/USFWS BO/Depredation Permit | L1 | FY 2022/Annually |
| E1 – Promote sustainable | E1.1. Implement water conservation strategies, where possible. | WFF EMS | L3 | FY 2022/As needed |

Table 6-1. NRMP Work Plan (continued)

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|
| landscaping practices at WFF. | E1.2. Promote ecological succession; allow for the natural succession of vegetative areas, where practicable. | WFF EMS | L3 | FY 2022/As needed |
| | E1.3. Investigate reforestation opportunities based on GIS and WFF Master Plan. Create a GIS layer of possible reforestation opportunities considering Master Planning growth, demolition, and operational constraints (e.g., Airfield Part 77 encroachment restrictions). | WFF EMS | L3 | FY 2022/As needed |
| F1 – Continue to develop phragmites management strategies to protect NASA's launch infrastructure assets, marsh ecosystems, and native plant and animal species from invasive species. | F1.1. Periodically review the Phragmites Control Plan with WFF stakeholders to explore new management strategies and control methods. | National Invasive Species Act/EO 13112 | L1 | FY 2022/Annually |
| G1 – Protect and enhance rare species populations and their habitats at WFF. | G1.1. Maintain compliance with the Endangered Species Act, BGEPA, MBTA, MMPA, EFH, and applicable state regulations. | Endangered Species Act, BGEPA, MBTA, MMPA, EFH, and applicable state regulations | L1 | FY 2022/As needed |
| | G1.2. Initiate early consultation with regulators regarding potential program and project impacts. | Endangered Species Act, BGEPA, MBTA, MMPA, EFH, and applicable state regulations | L1 | FY 2022/As needed |
| G2 – Assess and monitor the occurrence of rare, threatened, and endangered species. | G2.1. Continue to collaborate with natural resource organizations and agencies to monitor species of concern. | Endangered Species Act, BGEPA, MMPA and applicable state threatened and endangered species regulations | L1 | FY 2022/Annually |
| | G2.2. Annually manage protected species nesting and breeding areas (signs, announcement, etc.). | BO | L1 | FY 2022/Annually |
| | G2.3. Coordinate and report on VCSFA and USDA monitoring of bald eagle nesting pair on North Wallops Island and Main Base, respectively. | USFWS Eagle Depredation Permit | L1 | FY 2022/Annually |
| | G2.4. Coordinate with Virginia Aquarium and monitor marine turtle and marine mammal strandings. | BO | L2 | FY 2022/As needed |

Table 6-1. NRMP Work Plan (continued)

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|
| | G2.5. Coordinate with USFWS and VDWR on red knot habitat and eastern black rail and northern long-eared bat population surveys. | Endangered Species Act | L2 | FY 2022/As needed |
| G3 – Explore partnerships, funding, planning, and implementation for regional coastal resiliency to promote and sustain species habitats. | G3.1. Enter into a USFWS-led SDM process with regional stakeholders including regulators, NASA WFF Divisions, tenants, other federal agencies, elected officials, and academia. | Shoreline Permits | L2 | FY 2022/As needed |
| | G3.2. Investigate structural mechanisms that allow formal partnering programs. (e.g., DOD REPI, DOD Sentinel Landscape, USFWS North Atlantic Landscape Conservation Cooperative). | Shoreline Permits | L2 | FY 2022/As needed |
| | G3.3. Seek funding sources that would allow for application into formal partnership with other stakeholders. | Shoreline Permits | L1 | FY 2022/As needed |
| | G3.4. Apply and enter into formal partnership with other stakeholders. | Shoreline Permits | L2 | FY 2022/As needed |
| | G3.5 Perform the prey base ecological surveys of Wallops Island in support of shoreline resiliency. | Shoreline Permits | L1 | FY 2023/As needed |
| G4 – Maintain existing population levels and habitat and, where feasible, increase populations and enhance habitat when no mission impact is anticipated. | G4.1. Continue shoreline restoration to maintain and/or increase protected shoreline species nesting and foraging habitat. | SRIPP EIS and BO | L1 | FY 2025/As needed |
| H1– Coastal Resource Protection. | H1.1. Maintain SRIPP for mitigating and/or accommodating the effects of recurrent flooding, storm surge events, and sea level rise for the Navy, NASA, and VCSFA's MARS facilities on Wallops Island. | SRIPP PEIS and BO | L1 | FY 2025/As needed |
| | H1.2. Reduce or prevent losses of Wallops Island coastal habitat, life, and property caused by shoreline erosion, storms, relative sea level rise, and other coastal hazards in a manner that balances environmental and economic considerations. | SRIPP PEIS and BO | L2 | FY 2025/As needed |

Table 6-1. NRMP Work Plan (continued)

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|
| | H1.3 Perform sediment transport studies of Wallops Island and parts of adjacent areas in support of shoreline resiliency. | Shoreline Permits | L1 | FY 2023/As needed |
| H2 – Coastal Management Coordination. | H2.1. Ensure sustainable development on Wallops Island and support effective coordination of Governmental planning processes. | NEPA<br>EO 14057<br>(December 8, 2021) | L3 | FY 2022/As needed |
| | H2.2. Avoid and minimize coastal and ocean resource use conflicts through research, planning, and coordination with the Goal G3 partnership. | Goddard Sustainability Plan | L3 | FY 2022/As needed |
| | H2.3. Promote SDM and partnerships by maximizing the availability of up-to-date educational information, technical advice, and scientific data, including the use of new tools such as marine spatial planning such as NASA CASI data sets. | Goddard Sustainability Plan | L3 | FY 2022/As needed |
| I1 – Maintain and implement the WFF WHMP. | I1.1. Fulfill all actions in WHMP, including the following: 1) wildlife population management; 2) habitat modification; 3) land use changes; 4) requirements for and, where applicable, copies of local, state, and federal wildlife control permits; 5) identification of resources that WFF will provide to implement the plan; and 6) procedures to be followed during aircraft operations. | 14 CFR 139<br>(FAA Bird/Wildlife Aircraft Strike Hazard Program) | L1 | FY 2022/As needed |
| J1 – Communicate requirements for species and area protection with internal and external stakeholders. | J1.1. Annually review and maintain WFF Natural Resources Management webpage. | WFF EMS | L3 | FY 2022/As needed |
| | J1.2. Annually review and update training module on Code 250 website and provide to Protective Services Division. | WFF EMS | L3 | FY 2022/As needed |
| | J1.3. Prepare and distribute announcements and fact sheets, including annual Recreational Beach Use Memo. | WFF EMS | L3 | FY 2022/As needed |
| | J1.4. Utilize MOSI E&SR at project planning and/or kickoff meetings to identify natural resources issues. | WFF EMS<br>NPR 8500.1 | L2 | FY 2022/As needed |

**Key:** AAOC = Administrative Agreement on Consent; APHIS = Animal and Plant Health Inspection Service; BGEPA = Bald and Golden Eagle Protection Act; BO = Biological Opinion; CASI = Climate Adaptation Science Investigators; CERCLA = Comprehensive

**Table 6-1. NRMP Work Plan (continued)**

| Goal | Objective | Driver | Priority | Implementation Schedule (FY) |
|---|---|---|---|---|

Environmental Response, Compensation, and Liability Act; CFR = Code of Federal Regulations; CWA = Clean Water Act; DMR = Discharge Monitoring Report; DOD = Department of Defense; E&SR = Environmental and Safety Review; ECR = Environmental Compliance and Restoration; EFH = Essential Fish Habitat; EIS = Environmental Impact Statement; EMP = Environmental Management Plan; EMS = Environmental Management System; EO = Executive Order; ERT = Environmental Resources Tool; FAA = Federal Aviation Administration; FOTW = Federally Owned Treatment Works; FY = fiscal year; GIS = geographic information system; GPR = Goddard Procedural Requirement; ICP = Integrated Contingency Plan; MARS = Mid-Atlantic Regional Spaceport; MBTA = Migratory Bird Treaty Act; MMPA = Marine Mammal Protection Act; MOSI =Management Operations Services and Information; NEPA = National Environmental Policy Act; NPR = NASA Procedural Requirements; NRMP = Natural Resources Management Plan; PEIS = Programmatic Environmental Impact Statement; RCRA = Resource Conservation and Recovery Act; REPI = Readiness and Environmental Protection Integration; SDM = Structured Decision Making; SEED = Stormwater Erosion and Environmental Development; SET = Surface Elevation Table; SRIPP = Shoreline Restoration and Infrastructure Protection Program; SWPPP = Storm Water Pollution Prevention Plan; USDA = United States Department of Agriculture; USFWS = United States Fish and Wildlife Service; VCSFA = Virginia Commercial Space Flight Authority; VDEQ = Virginia Department of Environmental Quality; VDWR = Virginia Department of Wildlife Resources; VPDES = Virginia Pollutant Discharge Elimination System; WFF = Wallops Flight Facility; WHMP = Wildlife Hazard Management Plan.

# 7. References


Audubon. (2021). *Important Bird Areas: Barrier Island/Lagoon System, Virginia*. Retrieved from Barrier Island/Lagoon System: https://www.audubon.org/important-bird-areas/barrier-islandlagoon-system.

Barr, E. (2018). *Post-WNS Survey of Bats at NASA Wallops Island Flight Facility: Contract/Grant G16AC00327, 2018 Final Report.* Prepared by E. Barr, Virginia Tech College of Natural Resources and Environment, Department of Fish and Wildlife for NASA Natural Resources Branch and U.S. Geological Survey Cooperative Research Units Program.

Cowardin et al. (1979). *Classification of wetlands and deepwater habitats of the United States.* Cowardin, Lewis M., Virginia Carter, Francis C. Golet, and Edward T. LaRoe. Washington, D.C.: United States Fish and Wildlife Service, U.S. Dept. of the Interior.

Cummings et al. (2014). *Spatial and temporal patterns of habitat use and mortality of the Florida manatee (Trichechus manatus latirostris) in the Mid-Atlantic states of North Carolina and Virginia from 1991 to 2012.* Cummings, Erin W., D. Ann Pabst, James E. Blum, Susan G. Barco, Shannon J. Davis, Victoria G. Thayer, Nicole Adimey, and William A. McLellan. Aquatic Mammals 40, no. 2.

Ellis, J. K. (2003). *Diet of the sandbar shark, Carcharhinus plumbeus, in Chesapeake Bay and adjacent waters.* Williamsburg, VA: The College of William and Mary. Masters Thesis.

Holcomb. (2022). Personal communication between Kevin Holcomb of USFWS CNWR and Shari Silbert of WFF regarding BCC species in the vicinity of WFF. May 6.

Miller, S. (2022). *Personal Communication from Shari Miller regarding protected species.*

Molina et al. (2009). *Gull-billed tern (Gelochelidon nilotica).* (A. Poole, Ed.) Ithaca, New York: Cornell Lab of Ornithology. Molina, K. C., Parnell, J. F., & Erwin, R. M. The Birds of North American Online. Retrieved from http://bna.birds.cornell.edu/bna/species/140.

NASA. (2008a). *Goddard Space Flight Center Master Plan: A Twenty-Year Plan for NASA's Wallops Flight Facility, Wallops Island, Virginia.* National Aeronautics and Space Administration. December.

NASA. (2008b). *(Pre-final) Integrated Natural Resources Management Plan Goddard Space Flight Center Wallops Flight Facility.* National Aeronautics and Space Administration.

NASA. (2010a). *Shoreline Restoration and Infrastructure Protection Program. Final Programmatic Environmental Impact Statement/Record of Decision.* National Aeronautics and Space Administration.

NASA. (2010b). *Final Programmatic Environmental Impact Statement for Wallops Flight Facility Shoreline Restoration and Infrastructure Protection Programs.* National Aeronautics and Space Administration.

NASA. (2012). *Invasive Species Management Plan for North Wallops Island UAS Airstrip.* National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility.

NASA. (2014). *Wallops Island Phragmites Control Plan.* National Aeronautics and Space Administration.

NASA. (2015). *Final Supplemental Environmental Assessment Antares 200 Configuration Expendable Launch Vehicle at Wallops Flight Facility.* National Aeronautics and Space Administration. September.

NASA. (2016). *Wallops Island Protected Species Monitoring Report.*

NASA. (2017). *Environmental Resources Document. Goddard Space Flight Center Wallops Flight Facility.* National Aeronautics and Space Administration.

NASA. (2019a). *Wallops Flight Facility Site-wide Programmatic Environmental Impact Statement.* Wallops Island, VA: National Aeronautics and Space Administration.

NASA. (2019b). *Final NASA WFF Shoreline Enhancement and Restoration Project Environmental Assessment.* National Aeronautics and Space Administration.

NASA. (2020a). *Wallops Flight Facility Environmental Management System Manual.* Wallops Island, VA: National Aeronautics and Space Administration.

NASA. (2020b). *Annual Standards and Specifications - Erosion and Sediment Control (ESC) and Stormwater Management (SWM).* National Aeronautics and Space Administration.

NASA. (2021a). *Wallops Island Protected Species Management Plan.* National Aeronautics and Space Administration.

NASA. (2021b). *Wildlife Hazard Management Plan.* Wallops Isalnd: National Aeronautics and Space Administration.

NASA. (2021c). *Storm Water Pollution Prevention Plan - Virginia Pollutant Discharge Elimination System Permit No. VA0024457.* Wallops Island, Virginia: National Aeronautics and Space Administration, Goddard Space Flight Center, Wallops Flight Facility.

NASA. (2021d). *Wallops Flight Facility Wallops Island Northern Development Environmental Assessment.* National Aeronautics and Space Administration.

NASA. (2022a). *Site Development Plan Wallops Flight Facility.* National Aeronautics and Space Administration.

NASA. (2022b). *Red Knot Monitoring Data.* Wallops Flight Facility.

NASA. (2022c). Special Announcement - Recreational Use of Wallops Island. March 3. *Memo*. Wallops Island: NASA Goddard Space Flight Center Wallops Flight Facility.

Navy. (2022). *Navy Marine Species Density Database for U.S. Pacific & Gulf of Alaska*. Retrieved May 2, 2022, from Navy Oparea Density Estimates (NODE) for Atlantic (Northeast and Southeast OPAREAs) & Gulf of Mexico (GOMEX OPAREA)

NMFS. (2013). *Proposed Rule: Endangered and Threatened Species: Designation of Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead.* National Marine Fisheries Service. Retrieved from https://www.federalregister.gov/documents/2013/07/18/2013-17204/endangered-and-threatened-species-designation-of-critical-habitat-for-the-northwest-atlantic-ocean.

NMFS. (2014). *Endangered and Threatened Species: Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS.* National Marine Fisheries Service. Retrieved from https://www.federalregister.gov/documents/2014/07/10/2014-15748/endangered-and-threatened-species-critical-habitat-for-the-northwest-atlantic-ocean-loggerhead-sea.

NMFS. (2018a). Endangered and Threatened Wildlife and Plants; Final Rule to List the Giant Manta Ray as Threatened Under the Endangered Species Act.

NMFS. (2018b). Endangered and Threatened Wildlife and Plants; Final Rule Listing the Oceanic Whitetip Sharks as Threatened Under the Endangered Species Act. January.

NOAA. (2021). *Sea Level Trends*. Retrieved from NOAA Tides and Currents: https://tidesandcurrents.noaa.gov/sltrends/

NOAA. (2022a). *Loggerhead Turtle*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/loggerhead-turtle

NOAA. (2022b). *Leatherback Turtle*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/leatherback-turtle

NOAA. (2022c). *Hawksbill Turtle*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/hawksbill-turtle

NOAA. (2022d). *Kemp's Ridley Turtle*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/kemps-ridley-turtle#:~:text=Kemp's%20ridley%20sea%20turtles%20are,species%20for%20identification%20in%201906

NOAA. (2022e). *Green Sea Turtle*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/green-

turtle#:~:text=Green%20turtles%20are%20found%20worldwide%20primarily%20in%20subtropical%20and%20temperate,Virgin%20Islands%2C%20and%20Puerto%20Rico.

NOAA. (2022f). *Atlantic Sturgeon*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/atlantic-sturgeon

NOAA. (2022g). *Bottlenose Dolphin*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/common-bottlenose-dolphin

NOAA. (2022h). *Harbor Seal*. Retrieved April 29, 2022, from https://www.fisheries.noaa.gov/species/harbor-seal

NOAA. (2022i). *Harbor Porpoise*. Retrieved May 2, 2022, from https://www.fisheries.noaa.gov/species/harbor-porpoise#:~:text=Harbor%20porpoises%20in%20the%20United,science%2C%20partnerships%2C%20and%20outreach.

NOAA. (2022j). *Fin Whale*. Retrieved May 2, 2022, from https://www.fisheries.noaa.gov/species/fin-whale

NOAA. (2022k). *Humpback Whale*. Retrieved May 2, 2022, from https://www.fisheries.noaa.gov/species/humpback-whale

Pimentel et al. (2005). *Update on the environmental and economic costs associated with alien-invasive species in the United States.* Pimentel, D.; Zuniga, R.; Morrison, D. Ecological Economics, 52, no. 3.

Tiner, R. W. (2005). Assessing cumulative loss of wetland functions in the Nanticoke river watershed using enhanced national wetlands Inventory data. *Wetlands, 25*(2), 405–419.

UNEP-WCMC and IUCN. (2022). *Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM)*. Retrieved from https://www.protectedplanet.net/en

USDA. (2020). *Wallops Island Predator Management Plan.* Wallops Island : United States Department of Agriculture's Wildlife Services.

USFWS. (2009). *Northeastern Tiger Beetle 5-Year Review: Summary and Evaluation.* U.S. Fish and Wildlife Service.

USFWS. (2012). *Back Bay National Wildlife Refuge Annual Sea Turtle Program Report.* U.S. Fish and Wildlife Service.

USFWS. (2014). *Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northwest Atlantic Ocean Distinct Population Segment of the Loggerhead Sea Turtle; Final Rule.* Department of the Interior, U.S. Fish and WIldlife Service. Retrieved from https://www.govinfo.gov/content/pkg/FR-2014-07-10/pdf/2014-15725.pdf#page=1.

USFWS. (2019). *Biological Opinion - Wallops Flight Facility Update and Consolidation of Existing Biological Opinions, Accomack County, VA, Project # 2015-F-3317.* U.S. Fish and Wildlife Service.

USFWS. (2020). *Eastern black rail.* U.S. Fish and Wildlife Service. Retrieved from https://www.fws.gov/southeast/wildlife/birds/eastern-black-rail/#

USFWS. (2021). *Birds of Conservation Concern.* U.S. Fish and Wildlife Service.

USFWS. (2022). *Red knot (Calidris canutus rufa).* U.S. Fish and Wildlife Service. Retrieved from U.S. Fish and Wildlife Service Environmental Conservation Online System: https://ecos.fws.gov/ecp/species/1864

VDCR. (2011). *Phragmites autralis on Wallops Island. An updated of control and monitoring done by Virginia Natural Heritage Program 2004-2009. Division of Natural Heritage. Technical Report 11-04. February.* Virginia Dept. of Conservation and Recreation.

VDCR. (2012). *Draft Report of A 2011 Reinventory of the Natural Heritage Resources in the North Wallops Island Conservation Site, Wallops Flight Facility, Virginia.* Virginia Department of Conservation and Recreation (VDCR).

VDEQ. (2020). *Virginia Coastal Zone Management Magazine. November 10*. (Virginia Department of Environmental Quality) Retrieved from VDEQ. 2019. Virginia Coastal Zone Management Magazine

VDEQ. (2022). *Coastal Zone Management*. (Virginia Department of Environmental Quality) Retrieved from https://www.deq.virginia.gov/coasts/coastal-zone-management

VDGIF. (2012). *Virginia Fish and Wildlife Information Service*. Retrieved from http://vafwis.org/fwis/.

VIMS. (2020). *Virginia Institute of Marine Sciences - Distribution of SAV in Chesapeake Bay*. Retrieved May 2, 2022, from https://www.vims.edu/research/units/programs/sav/reports/2020/exec_sum.php

Virginia Water Trails. (2020). *Eastern Shore*. Retrieved from Virginia Water Trails: https://virginiawatertrails.org/eastern-shore/

VMRC. (2012). *Shellfish Aquaculture, Farming, and Gardening.* Virginia Marine Resources Commission (VMRC).

Waring et al. (2009). *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments.* Waring, G. T., E. Josephson, C. P. Fairfield-Walsh, and K. Maze-Foley. NOAA Technical Memorandum NMFS-NE-210. 440pp.

Warren et al. (2001). *Rates, Patterns, and Impacts of Phragmites australis - Expansion and Effects of Experimental Phragmites Control on Vegetation, Macroinvertabrates, and Fish within*

*Tidelands of the Lower Connecticut River.* Warren, R. Scott, Paul E. Fell, Jonna L. Grimsby, Erika L. Buck, G. Chris Rilling, and Rachel A. Fertik. Estuaries 24, no. 1.

Weinstein and Balleto. (1999). *Does the Common Reed, Phragmites australis, Affect Essential Fish Habitat?* Weinstein, Michael P., and John H. Balletto. Estuaries 22, no. 3.

WEST. (2021). *Eastern Black Rail (Laterallus jamaicensis jamaicensis) Acoustic Surveys for the NASA GSFC's WFF, Draft Report June 10 – July 13, 2021.* Accomack County, Virginia: Western EcoSystems Technology, Inc. Prepared for US Air Force, Wright-Patterson Air Force Base, Ohio and National Aeronautics and Space Administration, Wallops Island, Virginia.

WEST. (2022). *Eastern Black Rail (Laterallus jamaicensis jamaicensis) Acoustic Surveys for the NASA GSFLC's WFF, Final Report May 1 – June 6, 2022.* Accomack County, Virginia: Western EcoSystems Technology, Inc. Prepared for US Air Force, Wright-Patterson Air Force Base, Ohio, and NASA, Wallops Island, Virginia.

Whealton, S. (2013). Personal Communication between Shari Silbert and Shane Whealton of WFF regarding protected species at WFF. February.

Whealton, S. (2022). Personal Communication between Lori Levine and Shane Whealton of WFF regarding protected species at WFF.

# Appendix A Figures

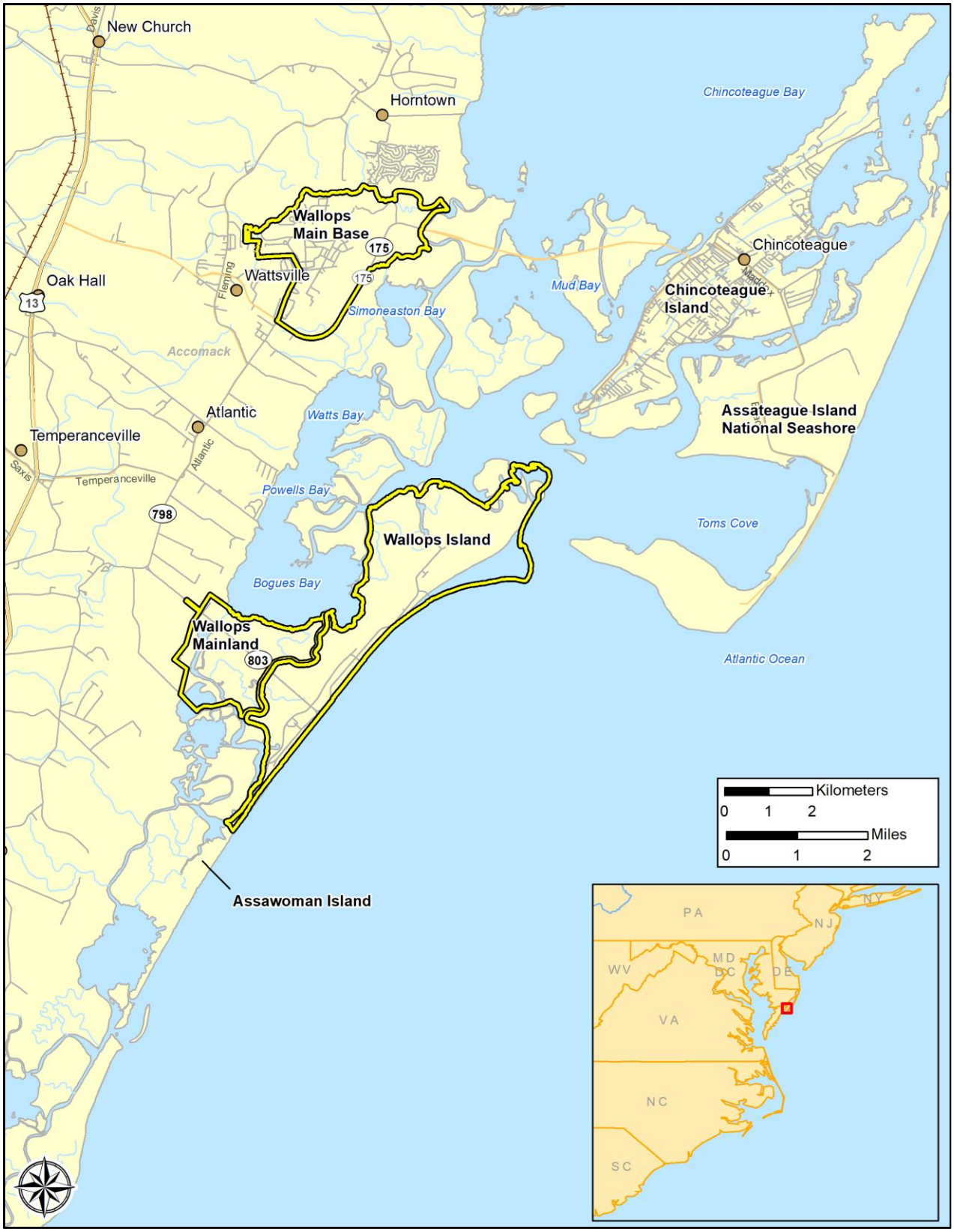


Figure 1. Location

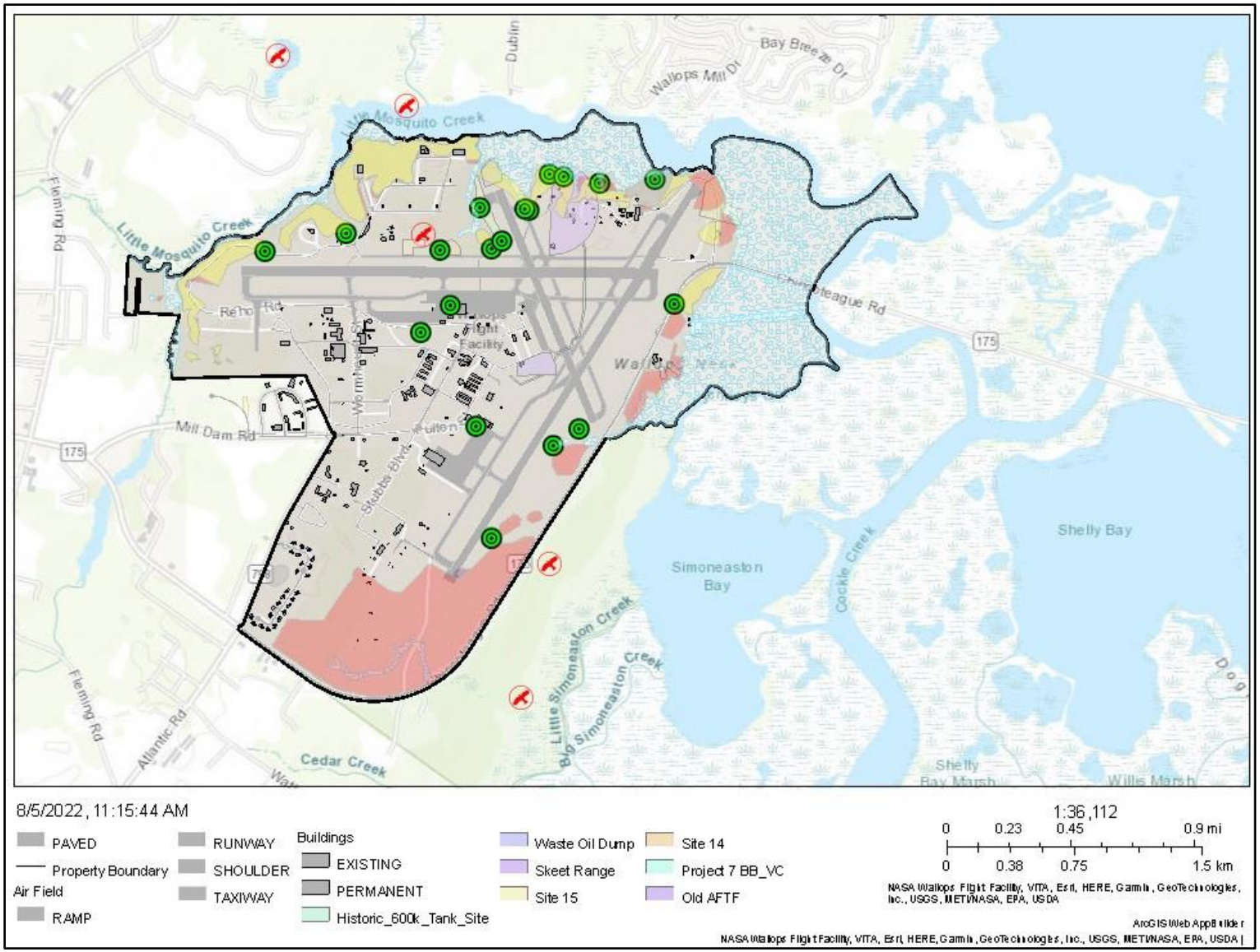


**Figure 2. WFF Main Base Environmentally Sensitive Areas**

(Image: screenshot of online GIS query)

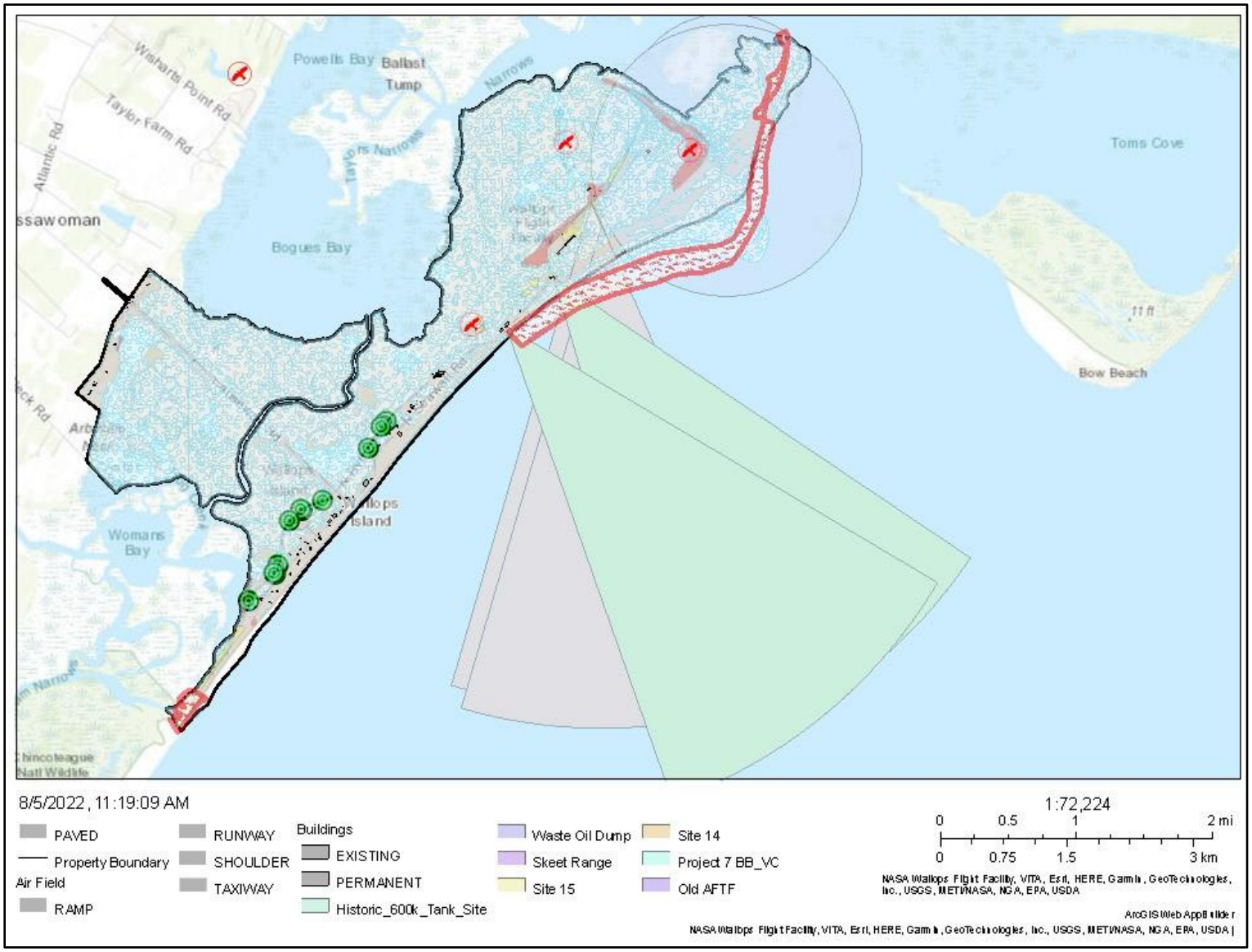


**Figure 3. Wallops Island and Mainland Environmentally Sensitive Areas**

(Image: screenshot of online GIS query)

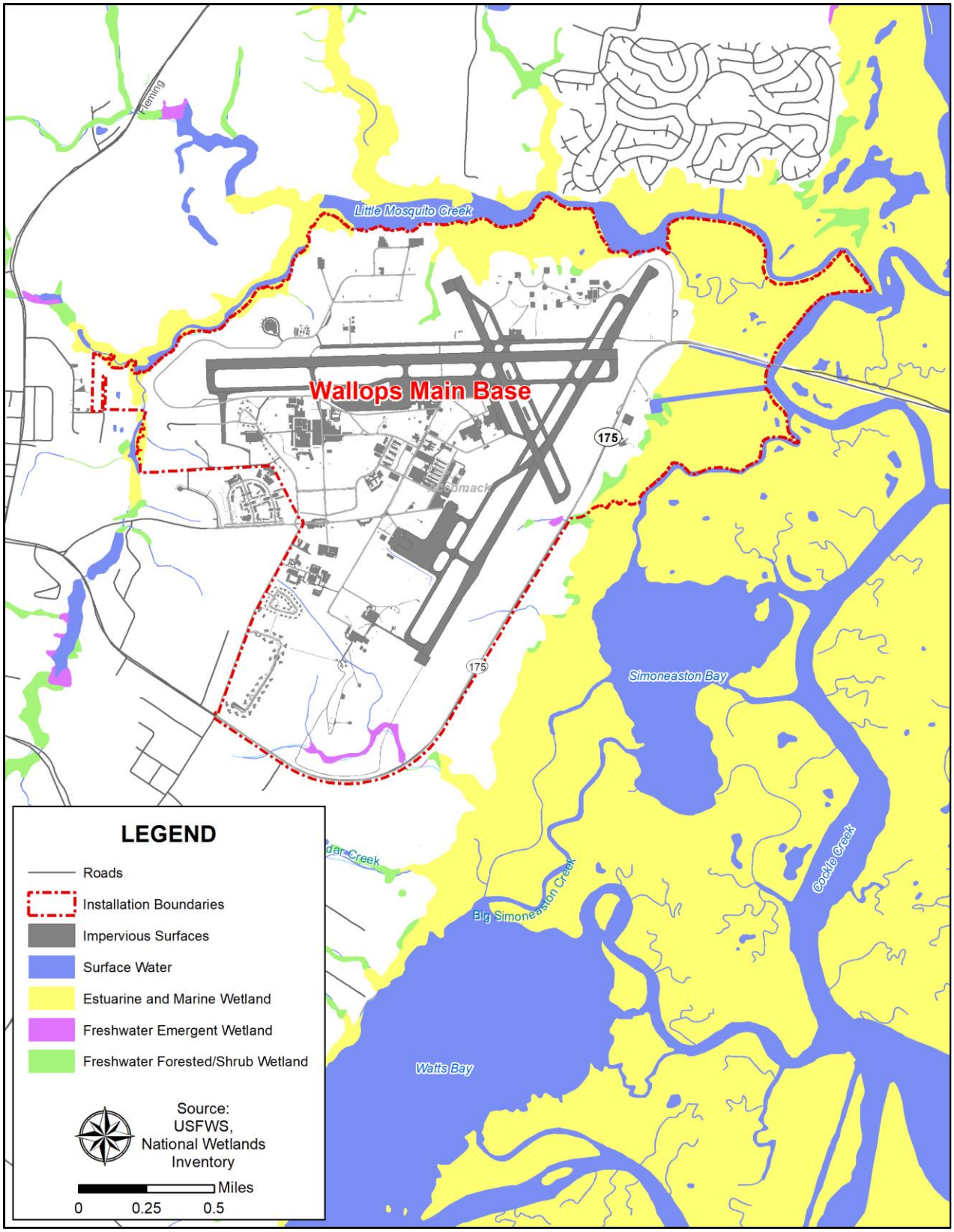


Figure 4. Location of Main Base Wetlands


Figure 5. Location of Mainland and South Wallops Island Wetlands


Figure 6. Location of North Wallops Island Wetlands

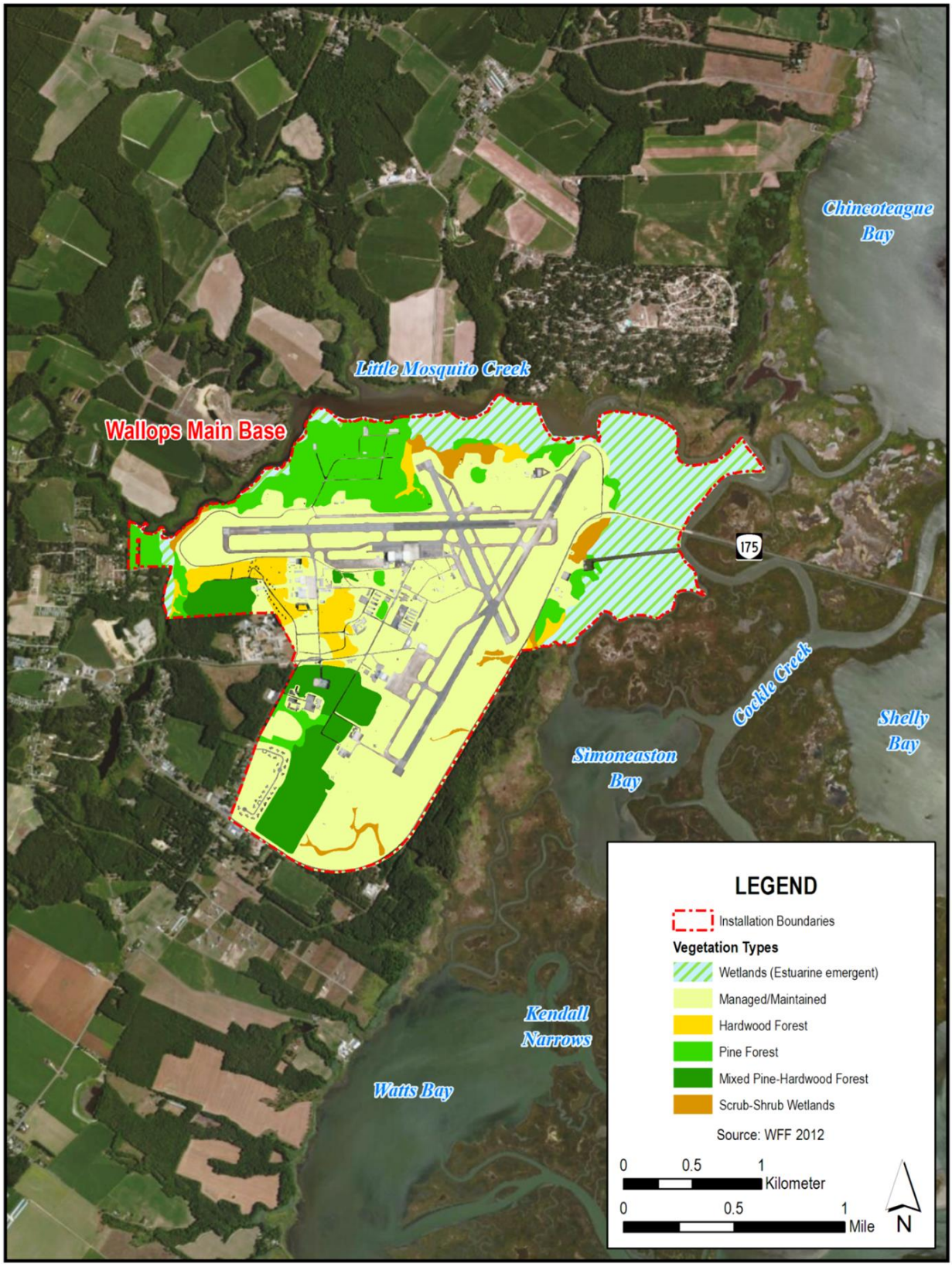


Figure 7. Vegetation Communities at Wallops Flight Facility Main Base

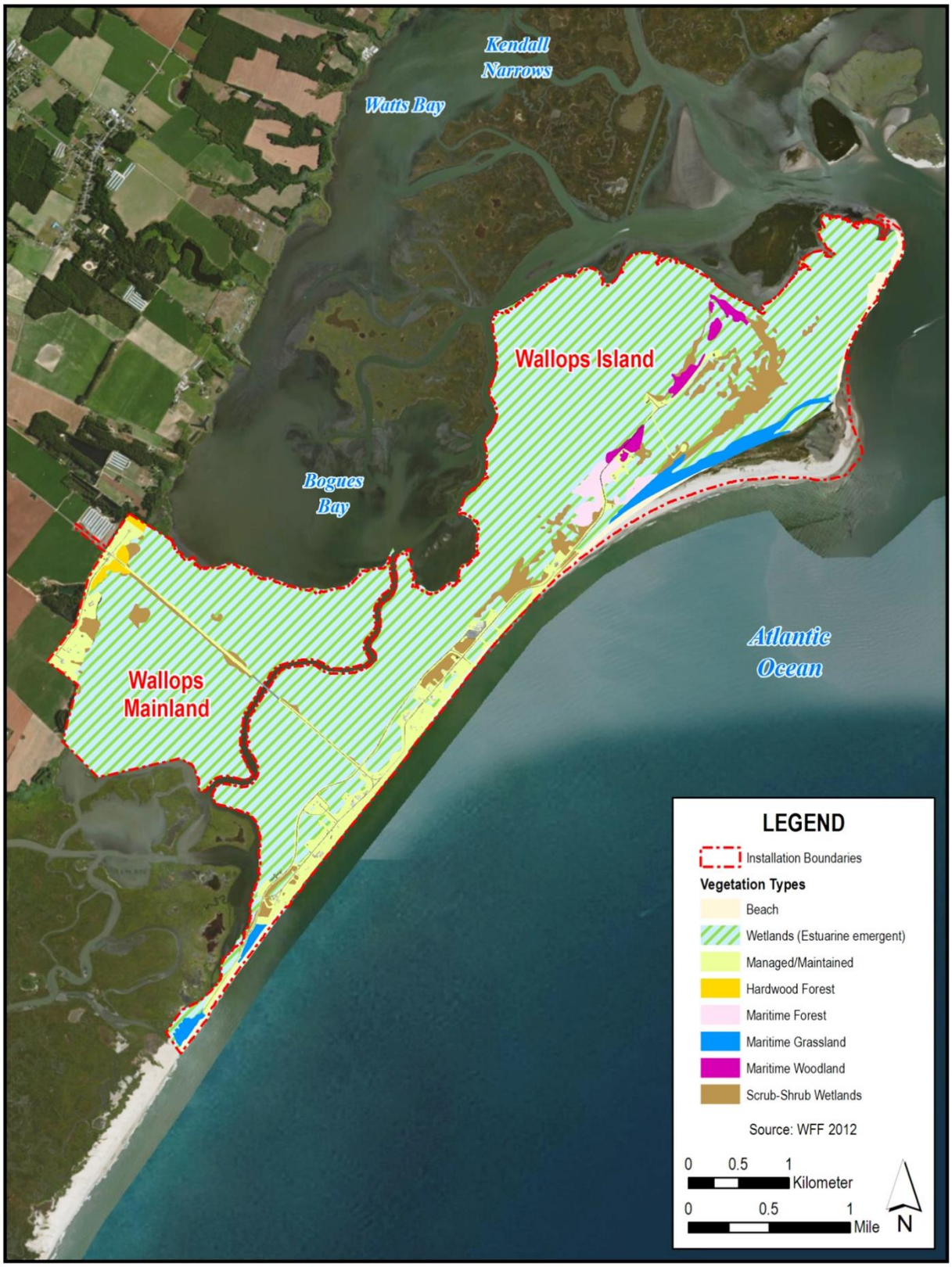


Figure 8. Vegetation Communities at Wallops Flight Facility Mainland and Wallops Island

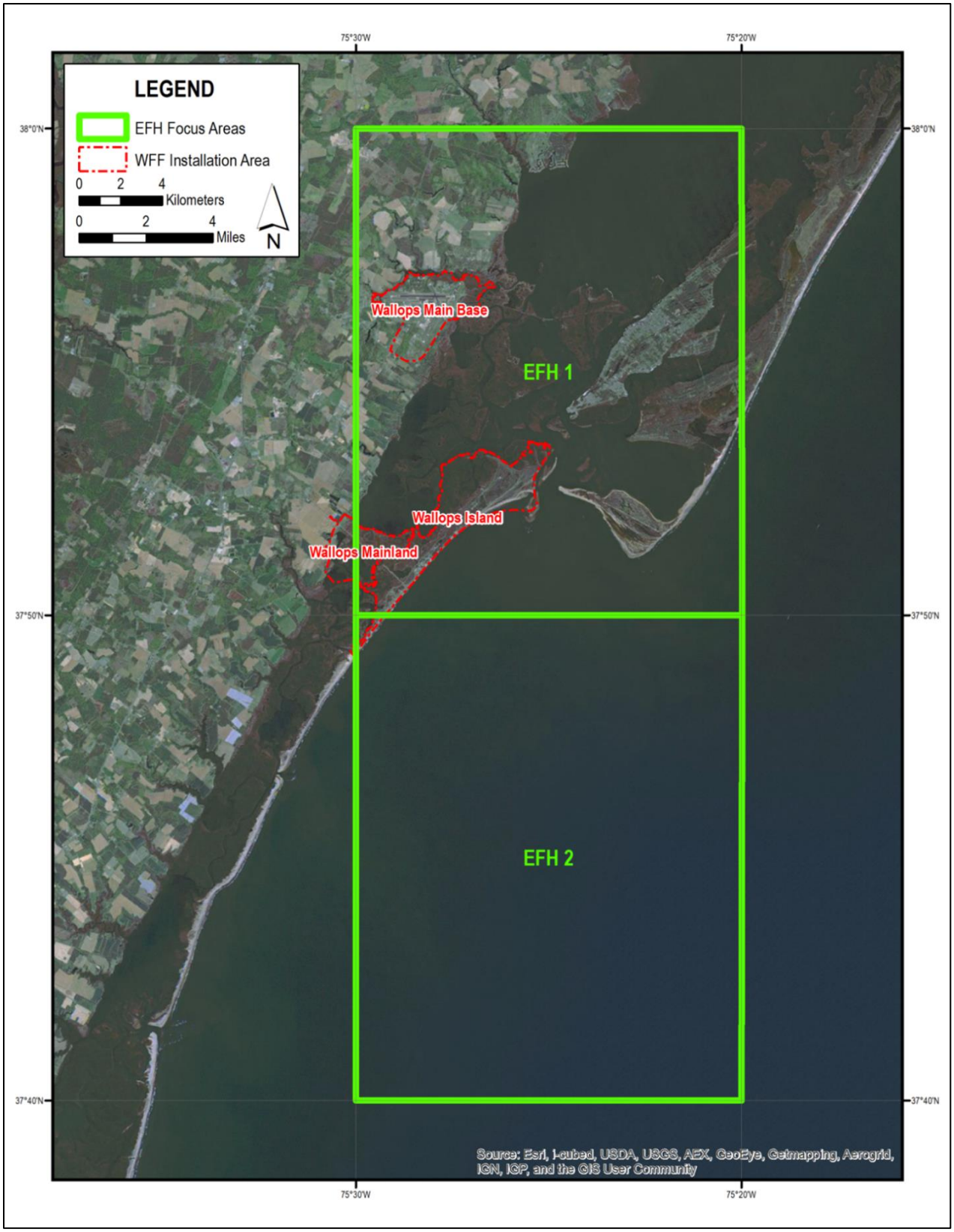


Figure 9. Essential Fish Habitat Management Squares Adjacent to Wallops Flight Facility

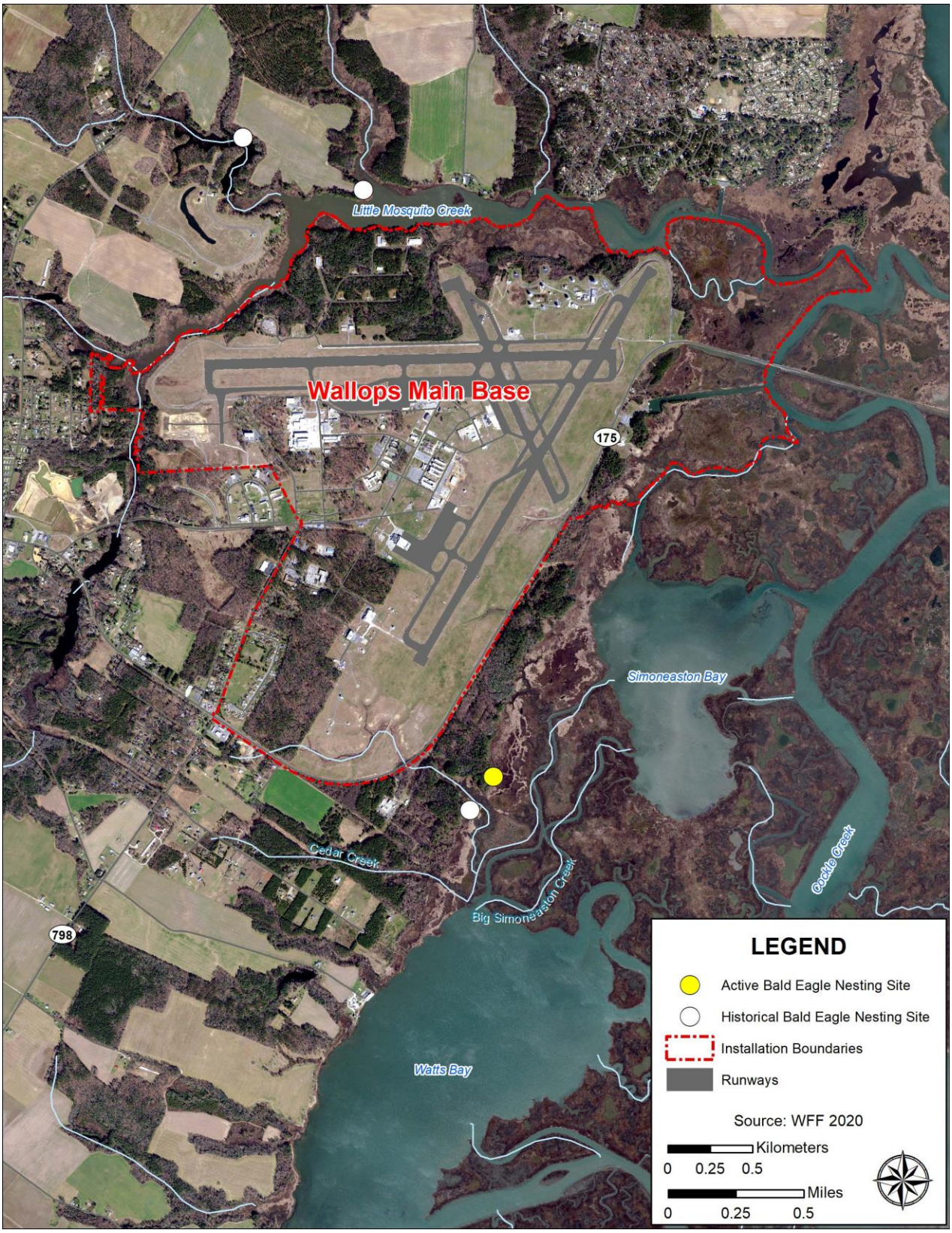


Figure 10. Special Status Species at Wallops Flight Facility Main Base

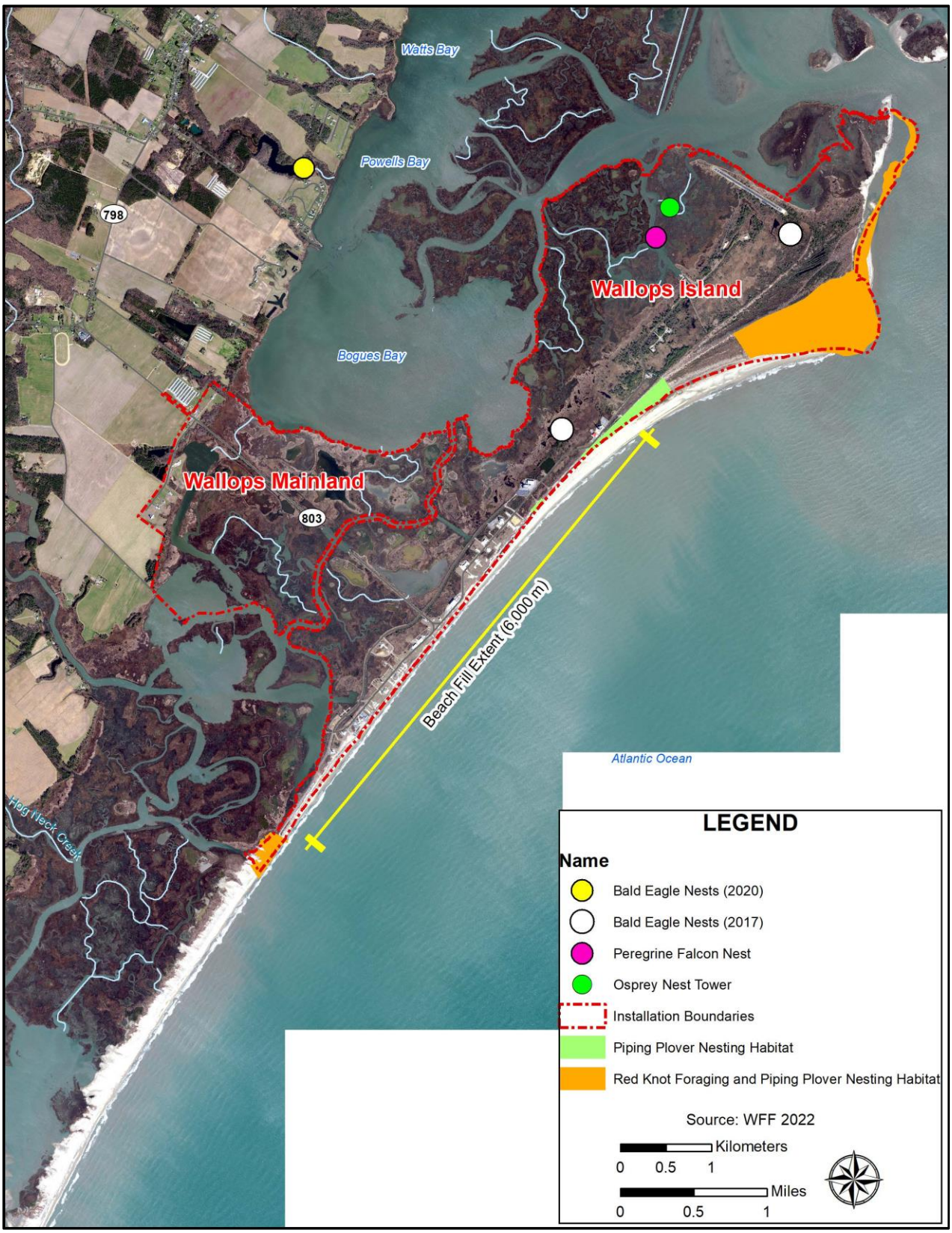


Figure 11. Special Status Species at Wallops Flight Facility Mainland and Wallops Island

Figure 12. Potential Offshore Impact Area

# Appendix B Definitions

**Bird/Wildlife Aircraft Strike Hazard (BASH).** A bird strike, bird ingestion, bird hit, or bird aircraft strike hazard is a collision between an airborne animal and a moving vehicle, usually an aircraft. The term is also used for bird deaths resulting from collisions with structures such as power lines, towers, and wind turbines.

**Biological Assessment.** Document prepared by federal agencies per section 7(a)(2) of the Endangered Species Act, to analyze potential impacts to federally listed species and designated critical habitat from actions that they authorize, permit, fund, or otherwise carry out.

**Biological Opinion.** Document prepared by the United States (U.S.) Fish and Wildlife Service (USFWS) at the conclusion of formal section 7 consultation that states whether the federal agency has ensured that its action will not destroy or adversely modify critical habitat and is not likely to jeopardize the continued existence of a listed species. Typically includes mandatory terms and conditions to minimize take of listed species.

**Candidate Species.** Species that the USFWS may propose as endangered or threatened at some point.

**Coastal Plain.** A coastal plain is flat, low-lying land adjacent to a seacoast. A fall line commonly marks the border between a coastal plain and a piedmont area.

**Critical Habitat.** Habitat designated by the USFWS or National Oceanic and Atmospheric Administration Fisheries as necessary to support the recovery of a listed species.

**Endangered Species.** Species that is in danger of extinction throughout all or a significant portion of its range.

**Environmental Assessment.** A type of National Environmental Policy Act (NEPA) document that provides brief but sufficient evidence and analysis to determine whether an Environmental Impact Statement (EIS) needs to be prepared. An Environmental Assessment (EA) is sufficient for NEPA compliance only when all potential significant impacts have been determined to be avoided or mitigated to less than significant. An EA informs decision makers and the public of the expected effects to the environment from proposed actions.

**Environmental Impact Statement.** A type of NEPA document that provides discussion of significant, and potentially significant, environmental impacts that would occur as a result of actions under consideration. An EIS is used to inform decision-makers and the public of the consequences of a proposed action. An EIS is an action-forcing device to ensure that the policies and goals of NEPA are integrated into NASA programs and actions.

**Erosion.** The action of surface processes that removes soil, rock, or dissolved material from one location on the Earth's crust, and then transports it to another location where it is deposited. Erosion is distinct from weathering, which involves no movement.

**Essential Fish Habitat (EFH).** Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Implementing regulations clarified that waters include all aquatic areas and their physical, chemical, and biological properties; substrate includes the associated biological communities that make these areas suitable for fish habitats, and the description and identification of EFH should include habitats used at any time during the species' life cycle. EFH includes all types of aquatic habitat, such as wetlands, coral reefs, sand, seagrasses, and rivers.

**Floodplain.** The lowland and relatively flat areas adjoining inland and coastal waters, and flood-prone areas that are subject to a 1-percent or greater chance of flooding in any given year. The base floodplain shall be used to designate the 100-year floodplain (1-percent chance floodplain). The critical action floodplain is defined as the 500-year floodplain (0.2-percent floodplain).

**Groundwater.** Groundwater is the water present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. About 30 percent of all readily available freshwater in the world is groundwater. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of groundwater.

**Invasive Species.** An introduced organism that becomes overpopulated and harms its new environment. Although most introduced species are neutral or beneficial with respect to other species, invasive species adversely affect habitats and bioregions, causing ecological, environmental, and/or economic damage.

**Migratory Bird.** Any species or family of birds that lives, reproduces, or migrates within or across international borders at some point during the annual life cycle.

**NEPA Proponent**. The owner of a NASA action that requires NEPA documentation. The NEPA proponent must be a civil servant, even when the program or project is delegated to or managed by a contractor except when the owner of the action that NASA is considering to approve or to authorize is a tenant. In that case, the NEPA proponent may be a tenant.

**Natural Resources Management Plan (NRMP)**. A comprehensive plan for natural resource conservation and management (e.g., fish and wildlife, wetlands, land management, outdoor recreation, etc.) for a specific NASA facility. The conservation plan focuses on ecosystem-based management with a goal of managing the natural resources to meet stewardship requirements while supporting, and even enhancing, facility operations.

**Project Proponent**. All personnel responsible for reviewing or authorizing programs, projects and activities; or managers of proposed programs, projects, and activities that are being conducted by NASA, on behalf of NASA, or with approval by NASA.

**Proposed Species.** Species that has been proposed in the Federal Register for listing under the Endangered Species Act.

**Recreational Area**. Land that is designed, constructed, designated, or used for recreational activities. Examples are national, state, county, or city parks, other outdoor recreational areas such as golf courses or swimming pools and bodies of waters (oceans, lakes, rivers, and streams) when used by the public for fishing, swimming, or boating. Public and private areas that are predictably used for hunting, fishing, bird watching, bike riding, hiking, or camping or other recreational use also would be considered recreational areas.

**Sediment.** Naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice or by the force of gravity acting on the particles.

**Shoreline.** The line along which a large body of water meets the land.

**Special Status Species**. Any species that has protections as defined in either the Endangered Species Act, Virginia's Endangered Species Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, Marine Mammal Protection Act, Essential Fish Habitat Provisions of the Magnuson-Stevens Act, or those species or habitats of conservation concern identified by the Commonwealth of Virginia.

**Stormwater Pollution Prevention Plan.** Site-specific document that identifies possible sources of stormwater pollution from construction, describes practices to reduce stormwater pollutants, and details procedures to comply with permits.

**Surface Water.** Surface water is water located on top of the Earth's surface. In common usage, it is usually used specifically for terrestrial waterbodies, the vast majority of which is produced by precipitation and runoff from nearby higher areas.

**Take**. To harass, harm, shoot, wound, trap, collect, hunt, pursue, catch, capture, or kill a species.

**Threatened Species.** Species that is likely to become an endangered species within the foreseeable future because of a decline in its numbers throughout all or a significant portion of its range or habitat.

**Wetlands.** Those areas that meet three main criteria, including water saturation, duration of saturation, and vegetation, as defined by the USFWS, Regional Water Quality Control Board, and the U.S. Army Corps of Engineers. These areas may be inundated by surface or groundwater and normally support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include marshes, sloughs, potholes, river overflows, meadows, and water bodies.

This page intentionally left blank.