Natural Resources Management Plan for Langley Research Center Final

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Approval/Signature Page
for
Natural Resources Management Plan

The NASA Langley Research Center (LaRC) Natural Resources Management Plan (NRMP) has been developed to provide strategic guidance for the sustainable management and conservation of natural resources at LaRC across all project planning, maintenance, and operations. This plan details strategies and actions to protect, enhance, and sustainably utilize natural resources, emphasizing coordination with relevant stakeholders. The Natural Resources Program and its collaborators will continue to support NASA's mission by implementing measures to minimize negative impacts on natural resources, ensure regulatory compliance, and enhance the condition of native species and habitats at the Center.

I, the undersigned, hereby approve and concur with the contents and implementation of this LaRC NRMP.

_____ _____

Director, Center Operations Directorate **Date**

NASA Langley Research Center

Record of Review

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

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

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Acronyms

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
BASH	Bird/Wildlife Aircraft Strike Hazard
BCC	Birds of Conservation Concern
BMP	best management practice
CatEx	categorical exclusion
CCC	Cultural Carrying Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act

Acronym	Definition
CERTAIN	City Environment for Range Testing of Autonomous Integrated Navigation
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DOF	Department of Forestry
EA	Environmental Assessment
EEFR	Environmental and Energy/Water Functional Review
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMD	Environmental Management Division
EMO	Environmental Management Office
EMS	Environmental Management System
EO	Executive Order
EPA	Environmental Protection Agency
ERD	Environmental Resources Document
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMO	Facilities Management Office
FY	fiscal year
GIS	geographic information system
GWMA	Groundwater Management Area
IDDE	Illicit Discharge Detection and Elimination
INPS	invasive non-native plant species
IPaC	Information for Planning and Consultation
JBLE	Joint Base Langley-Eustis
LAFB	Langley Air Force Base
LaRC	Langley Research Center
LF	Langley Form
LIFE	Langley Is the Future
LPR	Langley Procedural Requirements
LUC	Land Use Control
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MS4	Municipal Separate Storm Sewer System
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPR	NASA Procedural Requirements
NRC	Natural Resources Council
NRM	Natural Resources Manager

Acronym	Definition
NRMP	Natural Resources Management Plan
NWI	National Wetlands Inventory
ODU	Old Dominion University
PCB	polychlorinated biphenyl
RACI	Responsible, Accountable, Consulted, and Informed
REC	Record of Environmental Consideration
SAA	Space Act Agreement
SATERN	System for Administration, Training, and Educational Resources
TMDL	Total Maximum Daily Load
U.S.	United States
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USDA	United States Department of Agriculture
USDA-WS	United States Department of Agriculture – Wildlife Services
USFWS	United States Fish and Wildlife Service
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
WLA	Waste Load Allocation
WOTUS	waters of the United States
WS	Wildlife Services

Executive Summary

NASA's Langley Research Center (LaRC), located in Hampton, Virginia, is a cornerstone of innovation in aeronautics, exploration, and science. Established in 1917, it is NASA's oldest field center and plays a pivotal role in advancing aerospace technology to transform the world. LaRC is also home to hundreds of acres of wetlands, riparian buffers, and forests that filter stormwater, moderate flooding, and provide vital habitats for diverse wildlife species.

Located on the coastal basin of the Back River, a tidal estuary of the Chesapeake Bay, LaRC has invested in green infrastructure and forest areas to enhance the health of this nationally important estuary. The Chesapeake Bay is a crucial migratory flyway, offering essential nesting and wintering habitats for waterfowl. However, LaRC faces several natural resource challenges, including invasive non-native species, stormwater management, and sea level rise.

The Natural Resources Management Plan (NRMP) provides strategic guidance for the sustainable management and conservation of natural resources at LaRC across all project planning, maintenance, and operations. It outlines strategies and actions to protect, enhance, and sustainably utilize these resources, emphasizing coordination with relevant stakeholders.

The LaRC NRMP aims to establish a sustainable natural resource center that aligns with and supports NASA's mission. The NRMP supports the planning, programming, and coordination required to accomplish the following Natural Resources Program goals:

1. Address natural resources considerations early and efficiently in project planning.
2. Foster cooperation with external organizations on natural resources.
3. Protect and enhance native habitats and species populations for ecosystem health, water quality improvement, connectivity, and climate resilience.
4. Minimize negative human-wildlife interactions and ecological impacts of nuisance species.
5. Improve understanding of natural resources at LaRC.

The NRMP goals and objectives focus on addressing natural resource challenges through training, data collection, environmental monitoring, and building cooperative relationships. The Natural Resources Program and its collaborators will continue to support NASA's mission by implementing measures to minimize negative impacts on natural resources, ensure regulatory compliance, and enhance the condition of native species and habitats at the Center.

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1. Introduction

This NASA Langley Research Center (herein referred to as LaRC or the Center) Natural Resources Management Plan (NRMP) is a planning document covering the five-year period from October 2024 through September 2029. This NRMP guides natural resources management at the Center to support operational and mission success while minimizing potential impacts to natural resources and improving their condition.

1.1 Purpose and Scope

The purpose of this NRMP is to provide strategic guidance for the management of the natural resources on LaRC in support of the NASA mission. The NRMP helps ensure that operations and natural resources conservation are integrated and consistent with good stewardship and legal requirements. The LaRC NRMP prioritizes activities to protect and effectively manage the Center's aquatic and terrestrial environments and minimize negative impacts across all areas. It also documents the coordination among organizations at the Center and with external stakeholders in the development and implementation of natural resources projects at LaRC. Additionally, the NRMP serves as a natural resources planning, budgeting, and coordinating tool that aids in programming future natural resources project requirements.

The following principal goals support effective natural resources stewardship and compliance, which are key to the long-term conservation of Center natural resources, as well as the protection of NASA mission objectives.

1. Provide proactive natural resources services that support mission planning and regulatory compliance and minimize risk to the mission.
2. Manage and monitor target species populations and priority habitats to comply with Federal law, increase resiliency, and maximize mission flexibility.

The NRMP's primary concern is natural resources management in the undeveloped, natural areas at the Center, but the plan also applies to natural resources issues in developed areas. This NRMP addresses natural resources management on land and in water bodies at or near the Center that are:

- Owned by the United States and administered by NASA alone or in partnership with other Federal agencies;

- Used by the Center via license, permit, or lease for which the Center has been assigned management responsibility; and/or
- Leased lands at the Center and areas occupied by non-NASA entities.

1.2 Document Organization

This NRMP is organized into the following sections:

Section 1: Introduction – This section describes the purpose and scope of the NRMP and how the Natural Resources Program integrates with overall Center planning and NASA's Environmental Management System (EMS). It also describes the NRMP review and update process.

Section 2: Center Profile – This section provides information on the Center mission, location, and host/grantee/tenant relationships.

Section 3: Roles, Responsibilities, and Training – This section describes the roles and responsibilities of Agency and Center organizations related to natural resources management, as well as partnerships and collaborations with other agencies and organizations. This section also describes the natural resources training currently offered and additional training that would be beneficial to Center personnel.

Section 4: Natural Resources Program Elements – This section provides a discussion of the specific Natural Resources Program elements at the Center. For each element, there is an overview description and discussion of the management activities being implemented at the Center.

Section 5: Recordkeeping and Reporting – This section identifies the reporting and recordkeeping requirements associated with the Center's Natural Resources Program and this NRMP.

Section 6: Goals and Objectives – This section identifies the goals and objectives for natural resources management at LaRC.

Section 7: Work Plan and Implementation Monitoring – This section provides a prioritized Work Plan of projects that was developed to provide a "quick reference" for the Center's planned NRMP action implementation. This section also describes the monitoring used to track project implementation.

Section 8: References – This section lists references used in development of this NRMP.

Appendices – The appendices provide Center-specific supporting information for the NRMP, including figures (Appendix A: Figures); definitions (Appendix B: Definitions); key laws, regulations, and policies (Appendix C: Key Natural Resources Laws, Regulations, and Policies); a listing of key natural resources

management documents and links (Appendix D: Additional Management Plans, Agreements, and Key Documents); a RACI Matrix for natural resources reporting requirements (Appendix E: Responsibility Assignment RACI Matrix); and Center-specific fact sheets (Appendix F: Natural Resource Fact Sheets).

1.3 Planning Integration

NASA's natural resources management is decentralized, with primary management responsibilities residing with each Center's or component facility's Environmental Management Office (EMO) or Environmental Management Division (EMD). Each Center's EMO or EMD assigns a Natural Resources Manager (NRM), whose responsibilities include oversight of natural resources regulatory compliance, species protection, habitat management, and overall improvement of natural resource conditions.

The management of natural resources at LaRC is dependent upon the effective coordination of multiple organizations and their commitment to support the goals and objectives of LaRC's Natural Resources Program. It is essential that the organizations understand their responsibilities and ensure that natural resources management and NASA's mission are compatible and mutually supportive.

1.3.1 Integration with Other Planning Documents

The development and implementation of this NRMP is integrated with several other planning and management documents, which are incorporated by reference as appropriate. Documents that either support or are supported by the NRMP (i.e., documents that describe management/stewardship of a particular natural resource) are listed in Table 1.3.1-1.

Table 1.3.1-1. Planning Documents Integral to the LaRC NRMP

Title	Effective Dates/ Update Frequency	Description	Location
NASA Langley Research Center (LaRC) Environmental Resources Document	Updated every five years	Provides a baseline description of the environmental aspects of the operations at LaRC.	https://environmental.larc.nasa.gov/nepa/
NASA Agency Master Plan (AMP)[(a)]	Updated every four years	Defines and communicates NASA's concept for future development and management of real property assets to support the Agency, government, and private operations.	Contact the NASA OSI FRED
Environmental Assessment for the NASA LaRC Master Plan	2013	Analyzes potential environmental impacts from implementation of the LaRC ViTAL Program.	https://environmental.larc.nasa.gov/wp-content/uploads/sites/26/2013/08/Final-Master-Plan-EA-6-4-13.pdf

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

Title	Effective Dates/ Update Frequency	Description	Location
NASA LaRC ViTAL 2.0 Plan[(a)]	2019–2024	Sets forth a path for Center repair by replacement, innovative maintenance techniques, and clear decision paths for determining which infrastructure is necessary to meet future mission needs.	Contact the Smart Infrastructure Planning Team/Master Planner
NASA LaRC Framework Plan[(a)]	Updated every four years	Center-specific plan completed with OSI FRED support to illustrate current and future mission needs aligned to the AMP, including Center core missions and capabilities assessment, future state, and leadership guidance with forward steps.	Contact the Smart Infrastructure Planning Team/Master Planner
NASA LaRC Master Plan[(a)]	Updated every eight years	Aligned with the AMP, provides a detailed Center--level implementation plan with illustrated interdependencies and a tied business plan for the development and management of LaRC's real property assets to support the Agency, government, and private operations.	Contact the Smart Infrastructure Planning Team/Master Planner
NASA LaRC Integrated Cultural Resources Management Plan	Updated every five years	Provides management guidance for the cultural resources found at LaRC.	Contact the EMO
NASA LaRC Environmental and Energy Program Manual (Langley Procedural Requirements 8500.1)	Updated annually	Sets forth procedures and requirements for LaRC environmental and energy programs, as well as the Environmental Management System.	Contact the EMO
NASA LaRC Integrated Spill Contingency Plan (Langley Procedural Requirements 8715.12)	2022–2027	Provides critical response procedures to be used in the event of any unplanned discharge of oil and/or non-radiological hazardous materials to air, land, groundwater, or surface water at NASA LaRC. Also provides information on spill prevention, control, and countermeasures.	Contact the EMO

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

Title	Effective Dates/ Update Frequency	Description	Location
NASA LaRC Annual Standards and Specifications: Erosion and Sediment Control (ESC) & Stormwater Management (SWM)	Updated annually	Provides processes and requirements for design, construction, redevelopment, and maintenance activities at LaRC to support compliance with ESC and SWM regulations and Energy Independence and Security Act Section 438.	Contact the EMO
Back River TMDL Action Plan, NASA LaRC, MS4 Permit #VAR040092	2023–2028	Provides action plan to address bacterial contamination in the Back River.	https://environmental.larc.nasa.gov/water/back-river-tmdl/
Chesapeake Bay TMDL Action Plan Phase 3, NASA LaRC, MS4 Permit #VAR040092	2023–2028	Demonstrates LaRC's ability to ensure compliance with the Chesapeake Bay TMDL Special Condition and the means/methods used to meet required reductions and schedule.	https://environmental.larc.nasa.gov/wp-content/uploads/sites/26/2023/09/CB-Action-Plan_NASA-LaRC_2023_DRAFT.pdf
Joint Base Langley-Eustis (JBLE) Integrated Natural Resources Management Plan	2024–2029	Provides guidance for natural resources management at JBLE for 2024 to 2029.	https://www.jble.af.mil/Units/Army/Eustis-Enviromental/

Note:
(a) NASA Agency Master Plan (AMP) currently is the umbrella document for Centers. Each Center has completed a Framework Plan in response to the AMP and will proceed with full Center Master Plan (CMP) updates. LaRC is scheduled for CMP update in fiscal year 2025.
Key: # = number; AMP = Agency Master Plan; EMO = Environmental Management Office; ESC = Erosion and Sediment Control; FRED = Facilities and Real Estate Division; JBLE = Joint Base Langley-Eustis; LaRC = Langley Research Center; MS4 = Municipal Separate Storm Sewer System; NASA = National Aeronautics and Space Administration; NRMP = Natural Resources Management Plan; OSI = Office of Strategic Infrastructure (OSI); SWM = Stormwater Management; TMDL = Total Maximum Daily Load; ViTAL = Vibrant Transformation to Advance Langley.

In addition to those listed in Table 1.3.1-1, other documents important to natural resources planning are Space Act Agreements (SAAs), Memoranda of Understanding, and other management plans such as those listed in Table D-1 (Additional Management Plans, Agreements, and Key Documents for LaRC) in Appendix D (Additional Management Plans, Agreements, and Key Documents).

1.3.2 Environmental Management System (EMS)

NASA's EMS, codified under NASA Procedural Requirements (NPR) 8553.1C, is the Agency's overall approach to managing environmental activities. Consistent with NASA's environmental policy (NASA Policy Directive 8500.1), the intended outcomes of an EMS include enhancement of environmental performance, fulfilment of compliance obligations, and achievement of environmental objectives. Within the framework of the NASA EMS, the NRMP provides guidance and requirements for natural resources management and regulatory compliance.

Langley Procedural Requirements (LPR) 8500.1, *Environmental and Energy Program Manual*, sets forth procedures and requirements for the Center-level EMS. The EMS helps LaRC to assess the potential impacts, benefits, and associated risks of its activities on mission accomplishment, environmental stewardship, and community support. Environmental risks are regularly and systematically reevaluated to verify progress toward environmental goals and to ensure consideration of LaRC's changing environmental conditions and evolving mission requirements. The Center identifies objectives and targets for high- and medium-priority environmental aspects and develops Environmental Management Plans to reduce identified risks; these are reviewed and updated annually. The EMS also establishes the necessary personnel structure to facilitate communication throughout all levels of Center management, ensuring that the Center's most significant environmental issues receive appropriate attention. Center senior management uses these Environmental Management Plans to advocate for technical, financial, and human resources to attain environmental compliance and EMS objectives. In 2009, LaRC established an Environmental Management Committee, which reports to the Center's Executive Safety Council and is responsible for implementation of the LaRC EMS Program (NASA, 2021).

LPR 8500.1 applies to Center personnel, programs, projects, and activities, including contractors and resident agencies to the extent specified in their respective contracts or agreements. "Contractors," for the purposes of this paragraph, include contractors, grantees, Cooperative Agreement recipients, SAA partners, and other agreement parties. All tenants shall comply with environmental laws and regulations and other environmental requirements described in their leases or agreements. While other Federal agencies co-located at the Center are not included in the Center's EMS at this time, they shall comply with all environmental laws, regulations, and Center policies for activities performed onsite.

Every three years, NASA Headquarters conducts an Environmental and Energy/Water Functional Review (EEFR) to assess the Center's EMS, energy/water, and environmental compliance programs. During recent EEFRs at most Centers, the Natural Resources Program was not assessed because either it was not included in the scope for that review or there was not a regulatory driver for it at the Center (NASA, 2022). However, this is subject to change as new compliance requirements arise from Federal species listings or from new tenants and development onsite. At LaRC, the April 2022 EEFR recommended that LaRC should have qualified biologists perform a special status species survey of the Center to update previous survey records; this survey was completed in 2023 (NASA, 2023).

1.3.3 Environmental Planning Process

The environmental planning process is another element of Center planning that is important to the management of natural resources. Project or Program Managers initiating any new projects or actions at the Center are responsible for ensuring that the appropriate documentation is prepared in accordance with the requirements of LPR 8500.1 and other relevant environmental laws, regulations, and Executive Orders (EOs). Complete documentation is required to ensure that LaRC environmental staff can evaluate the proposed projects or actions for potential environmental impacts (NASA, 2021).

The first step in the LaRC environmental review process requires Project and Program Managers to complete the Web-based Langley Form (LF) 461, Environmental Project Planning Form. In addition to requiring a detailed description of the proposed action or project, it includes a series of questions spanning various environmental media areas. LF 461s are divided into two sets of questions, one set for research and development projects and one set for facilities and infrastructure projects. Completed forms, along with project documents, are submitted electronically to the LaRC National Environmental Policy Act (NEPA) Manager who then coordinates review among LaRC environmental staff. The review takes into consideration the environmentally sensitive areas located throughout the Center, as shown in LaRC Environmental Resources Document (ERD) Figure 1-3 (Environmental Constraints at NASA LaRC) (NASA, 2021).

If the review determines that the project or proposed action is covered by a categorical exclusion (CatEx) as defined in 14 Code of Federal Regulations Part 1216, or is considered to have minimal or no potential to produce an environmental impact, the LaRC NEPA Manager may prepare a Record of Environmental Consideration (REC) to document the decision. For those actions not requiring a REC, the CatEx decision would be documented on the LF 461. Although no further NEPA documentation is normally required following review of the LF 461 and/or completion of the REC, additional environmental requirements may apply to the project. These requirements, such as obtaining permits, conducting regulatory consultations, and following waste disposal procedures, would be listed on the LF 461 or REC, and LaRC environmental staff would follow up to ensure all requirements are followed throughout the duration of the project. If the review determines that the project or proposed action requires further analysis, an Environmental Assessment or Environmental Impact Statement would be prepared (NASA, 2021).

Project managers at LaRC should be aware that the potential presence of multiple Federally listed species on-site may necessitate consultation under section 7 of the Endangered Species Act (ESA) for

project activities, including tree and shrub removal. This consultation process is required to ensure that project activities avoid or minimize adverse effects to listed species and their habitat. The process involves a 60-day to 135-day review period by the United States (U.S.) Fish and Wildlife Service (USFWS), during which the potential impacts of the proposed project on the listed species are thoroughly evaluated. Early engagement with the EMO can help identify and mitigate potential conflicts, ensuring compliance with Federal regulations and the protection of endangered species while minimizing impacts to the project's cost and schedule.

1.4 NRMP Review and Update Process

This NRMP identifies control of records procedures, Center-specific natural resources goals, objectives, projects, and implementation monitoring within the framework of the Center's Natural Resources Program. This NRMP must be reviewed annually, with a comprehensive revision every five years or earlier if there are significant changes to the Center's mission requirements, Master Plan, or natural resources. Annual reviews and administrative changes to this NRMP must be captured in the Record of Review table located at the front of this document.

NASA Centers are not required to submit their NRMPs to the USFWS for review and approval, as the Sikes Act is applicable only to Department of Defense installations. However, NASA is still required to consult with the USFWS during project development, maintenance, and operations to comply with ESA when section 7 applies.

These periodic reviews assess the effectiveness of plan implementation, evaluate potential impacts of NRMP actions on NASA's mission, and confirm that the regulations and information within the plan are current. LaRC personnel and other interested parties use these reviews to support project tracking and evaluation and to facilitate adaptive management. Reviews may be accomplished via correspondence or in a meeting of appropriate parties.

The annual review is to verify the following:

- All compliance-driven projects and activities have been budgeted for and implementation is on schedule.
- All positions that cover required natural resources duties have been filled or are in the process of being filled.
- All required coordination and reporting have occurred.

- Natural resources management goals, objectives, and projects for the upcoming year have been identified and included in Section 6 (Goals and Objectives) and Section 7 (Work Plan and Implementation Monitoring) of the NRMP.
- Table 1.3.1-1 and Section 2.3.2 (NASA as Host) are up to date.
- The document is current with regard to:
    - Regulatory and scientific information (surveys conducted as needed);
    - Center mission requirements and Natural Resources Program requirements; and
    - Center Natural Resources Program information, including Uniform Resource Locators (URLs) (Internet addresses) and hyperlinks.

At the end of each five-year planning period, the NRMP is to be comprehensively reviewed, and a revised/updated plan shall be prepared for the next planning period. The five-year revision will include all aspects of an annual review, as well as the following:

- Evaluation of progress on long-term goals and objectives and effectiveness of project implementation, with adjustments as necessary;
- Identification of new goals, objectives, and projects for the subsequent five-year planning period;
- Identification of new issues that may affect the subsequent five-year planning period; and
- Update of the signature page.

2. Center Profile

2.1 LaRC Location

NASA LaRC is situated near the southern end of the lower Virginia Peninsula, approximately 241 kilometers (km) (150 miles) south of Washington, D.C., and 80 km (50 miles) southeast of Richmond, Virginia (Figure 1, Appendix A: Figures). Langley Air Force Base (LAFB), part of Joint Base Langley-Eustis (JBLE), dominates land use in the immediate vicinity of LaRC. To the east of LaRC are the Northwest Branch Back River and Southwest Branch Back River, beyond which is the Chesapeake Bay. To the south and north of LaRC are the densely developed residential communities of Hampton and Poquoson. The area to the west of LaRC is one of the least developed areas of the City of Hampton; development immediately outside the western-southwestern LaRC boundary consists of two residential trailer parks, an apartment complex, and an auto racetrack. Designated preservation areas in the vicinity of LaRC include the Plum Tree Island National Wildlife Refuge in the City of Poquoson and the North End Point Natural Preserve and Grandview Nature Preserve, which are both located in the City of Hampton (NASA, 2021).

The Center is comprised of research facilities located in two areas approximately 4.8 km (3 miles) apart. The two areas, commonly called the West Area and the East Area, are divided by the runways of JBLE-Langley (Figure 2, Appendix A: Figures). The East Area covers 1.2 hectares (3 acres) and is fully developed. Although most of the 310-hectare (764-acre) West Area is also developed, there are large undeveloped wooded tracts in the southern portion adjacent to JBLE-Langley and along State Route 172 and individual open tracts scattered throughout the northern portion of the Center, which is also known as LaRC's "North 40" area. Establishment of City Environment for Range Testing of Autonomous Integrated Navigation (CERTAIN) unmanned aerial systems ranges have been underway at the Center since 2016. Phase I of CERTAIN was established in the North 40 with subsequent ranges being added in future phases (NASA, 2021).

2.2 LaRC Mission

LaRC's mission focus areas include aeronautics, exploration, and science, with a purpose to innovate to drive NASA's ability to change the world through aerospace. In 2023, LaRC stood up Langley Is the Future (LIFE) to define the path toward the future at Langley, including understanding the needs to achieve the desired workforce, technology, and infrastructure for 2040. The LIFE endeavor aligns with

the NASA 2040 initiative. LIFE prioritizes efforts around three workstreams: Mission, People, and Workplace. More information on LIFE can be found at https://nasa.sharepoint.com/sites/larcstrategy.

The Langley strategic framework aims to make LaRC the go-to center for the foundational work that drives NASA and the nation forward, to deliver technology and innovative research for all missions, and to seek opportunities to contribute to the nation in complementary activities. LaRC's foundational capabilities include research and support in entry, descent, and landing; aerosciences; atmospheric characterization; systems analysis and concepts; advanced materials and structural systems; and intelligent flight systems. Additional information on LaRC's mission and program activities is available at https://www.nasa.gov/langley/about-langley-research-center/.

2.3 Host/Grantee/Tenant Relationships

2.3.1 NASA as Grantee/Tenant

The LaRC East Area, which is the original 1917 portion of LaRC, is located on land permitted to NASA by JBLE. It contains several wind tunnels, research facilities, and administrative offices. NASA and the U.S. Air Force (USAF) operate as two separate Federal agencies that share a common property boundary.

2.3.2 NASA as Host

At this time, the only tenants at LaRC are organizations that conduct activities inside offices and facilities; thus, they are not discussed in this plan. The NRM interfaces with these groups as needed.

3. Roles, Responsibilities, and Training

3.1 Agency and Center Natural Resources Collaboration

NRMs from different Centers and Facilities collaborate regularly to share implementation strategies, identify opportunities, and learn from one another. Together the NRMs make up the Natural Resources Council (NRC). Agencywide, the NRC serves as an advisory and information-sharing body to the NASA EMD. Center NRMs and the NRC support implementation of many of the Agency-level goals and objectives in the NASA Natural Resources Strategic Plan, such as developing natural resources conservation policy and leadership strategy, promoting consensus of priorities across Operational and Mission Directorates, and recommending NASA initiatives to benefit the nation's natural resources. The NRC supports NASA's compliance with Federal natural resource laws, such as the ESA, by developing best practices, recommendations, and guidance.

While each Center manages its resources independently, NRMs from different Centers collaborate through the NASA Natural Resources Community of Practice using the Natural Resources Program SharePoint site (https://nasa.sharepoint.com/sites/EME-NRM) and virtual and face-to-face meetings. The monthly virtual NRC meetings typically include an invited speaker who provides information on a topic of interest to NRMs, such as ESA section 7 consultations or climate change tools. Past presentations have been made by personnel from other agencies and different organizations within NASA, as well as Center-level Natural Resources staff. These meetings provide a platform for NRMs to learn about wider natural resources issues and to discuss potential solutions and opportunities for collaboration.

EMD and a working group composed of Center NRMs are developing a Natural Resources NPR to guide natural resources management on NASA Centers and Component Facilities. Once the NPR is finalized, a link to the document will be added to all NASA NRMPs.

3.2 LaRC Natural Resources Program and Cooperating Organizations

Several organizations play a role in managing and protecting natural resources at LaRC. The Environmental and Energy Program is managed by the LaRC EMO within the Center Operations Directorate. The main elements of the program are environmental compliance, management, and sustainability. LaRC environmental staff are responsible for reviewing activities and projects on the Center for environmental impacts, providing guidance on regulatory requirements, acting as the formal Point of Contact with all environmental regulatory agencies, reviewing and maintaining environmental

permits, and assisting LaRC personnel in pursuing and implementing cost--effective energy efficiency and water conservation practices. The Environmental and Energy Program at LaRC includes the following media areas: EMS, sustainability and pollution prevention, energy and water conservation, waste management and disposal, air management and permitting, water management and permitting, hazardous material management and reporting, storage tank management and spill prevention/response, NEPA conformance, cultural and historic resource management, environmental restoration and remediation, recycling and reuse programs, environmentally preferable purchasing, and natural resources management (NASA, 2021). Additional information regarding the LaRC Environmental and Energy Program can be found on the LaRC public environmental Web site at https://environmental.larc.nasa.gov.

The EMO reviews all LF 461s and NEPA documents and assists Points of Contact with determining and implementing requirements for compliance with environmental regulations for programs, projects, and other activities. The LaRC ArcGIS Enterprise portal contains an environmental constraints map that can be used by project proponents to assess preliminary levels of environmental restriction for project planning purposes. The environmental constraints map is also used by the EMO to facilitate project reviews. Prior to activity, surveys must be completed for special status species and wetlands, and all necessary environmental permits and approvals must be obtained. Projects must follow any resulting mitigations, permit requirements, conservation measures, and other environmental requirements. Inspections for implementation of NEPA, consultation, and permit requirements are typically handled by the appropriate subject matter expert (e.g., water). The NEPA Office follows projects through compliance and end stages.

The NRM has primary day-to-day responsibility for natural resources management. The NRM is part of the EMO and may have several other roles and responsibilities. The NRM reviews the NRMP annually to update as necessary and submits funding requests to the EMO Branch Head for natural resources management projects and activities. The EMO Branch Head advocates for appropriate funding and staffing to ensure implementation of the NRMP and oversees the management of natural resources. Additionally, various NASA contractors contribute to the success of NRMP implementation, such as the Facilities Management Office (FMO) contractors.

It is the responsibility of the FMO to ensure that the environmental constraints identified in the NRMP are considered during the planning process for maintenance and development projects and that such projects are implemented in compliance with applicable environmental laws and regulations. The FMO provides support to the Natural Resources Program through vegetation management and pest control duties contracted out of its office.

Table 3.2-1 delineates the roles and responsibilities for LaRC natural resources activities.

Table 3.2-1. Roles and Responsibilities for LaRC Natural Resources Activities

Activity	Location	Approval Authority	Funding Organization	Implementing Organization	Advisors
Wetlands and Surface Waters					
Clean Water Act, Wetland permit application, reporting	Center-wide	Water Program Manager, EMO	Project/Program Proponent	EMO	EMO
Clean Water Act, Wetland delineations, implement permit requirements		COD		Project/Program Proponent	EMO
Vegetation Management and Invasive Plant Species Control					
Landscape maintenance	Developed areas[(a)]	Facilities	Facilities or Indefinite Delivery, Indefinite Quantity contract	Grounds Maintenance and Pest Control Contractor	EMO, Strategic Infrastructure Transformation Office (SITO)
Pollinator garden maintenance	(Figure 8, Appendix A: Figures)	EMO	N/A – Volunteer Run	Volunteers	Grounds Maintenance and Pest Control Contractor
Invasive plant species surveys	Center-wide	EMO	EMO	EMO	Facilities
Invasive plant species control	Developed areas[(a)]	Facilities	Facilities	Grounds Maintenance and Pest Control Contractor	EMO
Invasive plant species control	Outside of developed areas	EMO			
Tree planting and maintenance	Center-wide	EMO, SITO	Project/Program Proponent	Grounds Maintenance and Pest Control Contractor or Project/Program Proponent	
Tree removals		EMO	COD or Project/Program Proponent		
Nuisance and Pest Species Control					
Pest control[(b)]	Developed areas[(a)]	Facilities	Facilities	Grounds Maintenance and Pest Control Contractor	EMO
Nuisance species control permits, reporting[(c)]	Center-wide				
Nuisance species control[(c)]		Facilities, EMO (species dependent)			
BASH management meetings (with LAFB/USDA-WS)		EMO, RSD	N/A	LAFB/USDA-WS	RSD, SMAO
Protected Species/Habitat Management					
Surveys for protected species	Center-wide	EMO	EMO	EMO	USFWS
Endangered Species Act consultations, reporting			EMO or Project/Program Proponent	EMO and Project/Program Proponent	
Migratory bird, bald eagle permits, reporting			EMO	EMO	Facilities, USFWS
Migratory bird nest removal (active and inactive nests)			EMO or Project/Program Proponent	Nest, location, and project dependent	USFWS

Table 3.2-1. Roles and Responsibilities for LaRC Natural Resources Activities (continued)

Activity	Location	Approval Authority	Funding Organization	Implementing Organization	Advisors
Other Natural Resources Management Activities					
Wildfire management	Center-wide	NASA Fire Department			EMO
Natural Resources GIS/data management		LaRC GIS Office, EMO	COD	LaRC Smart Infrastructure Technology Team	EMO
Climate resiliency planning for natural resources		SITO	OSI	SITO, EMO	EMO, Facilities

Notes:
(a) Developed areas include, but are not limited to, buildings, facilities, roads, rights-of-way, parking lots, sidewalks, and other paved areas.
(b) Pest species include, but are not limited to, roaches, ants, and rodents.
(c) Nuisance animal species include, but are not limited to, feral cats, racoons, and opossums.
Key: BASH = Bird/Wildlife Aircraft Strike Hazard; COD = Center Operations Directorate; EMO = Environmental Management Office; GIS = geographic information systems; LAFB = Langley Air Force Base; LaRC = Langley Research Center; N/A = not applicable; NASA = National Aeronautics and Space Administration; OSI = Office of Strategic Infrastructure; RSD = Research Services Directorate; SITO = Strategic Infrastructure Transformation Office; SMAO = Safety and Mission Assurance Office; U.S. = United States; USDA-WS = U.S. Department of Agriculture-Wildlife Services; USFWS = U.S. Fish and Wildlife Service.

3.3 Training

The NASA EMS requires that all employees are made aware of NASA environmental policy and its applicability to their work. Appropriate training is provided as required at each level and function of the organization. NPR 8553.1C, *NASA Environmental Management System*, 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.

NASA's System for Administration, Training, and Educational Resources (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 Center-specific training sessions, SATERN, other Government agencies (e.g., USFWS), or through third-party training vendors. SharePoint training modules are provided via the Natural Resources Program SharePoint site (https://nasa.sharepoint.com/sites/EME-NRM).

LPR 8500.1 details the environmental policies and requirements for LaRC operations. It is made available to Center personnel through the Langley Management System and the public Environmental Web site and is also included in annual environmental training sessions. Onsite personnel (civil servants and contractors) at LaRC shall complete all required environmental compliance training prior to working independently. Natural resource elements and environmental impacts are integrated into several training classes and outreach

opportunities, including quarterly articles, educational Inside Langley announcements, and annual Facility Environmental Coordinator training. Although no LaRC-specific natural resources training course exists, recently developed LaRC natural resources fact sheets will be distributed to educate personnel (Appendix F: Natural Resource Fact Sheets).

The training listed in Table 3.3-1 would be beneficial for Natural Resources Program personnel and other personnel, as applicable.

Table 3.3-1. Training Suggestions Related to Natural Resources at LaRC

Training	Link	Suggested Personnel to Attend
Natural Resources Management at NASA – Overview for NASA Program and Project Managers	SATERN	Program Managers, Project Managers
National Environmental Policy Act (NEPA) – Overview for NASA Program and Project Managers	SATERN	
U.S. Fish and Wildlife Service Information for Planning and Consultation (IPaC)	https://ipac.ecosphere.fws.gov/	Natural Resources Manager
Endangered Species Act	https://www.fws.gov/course/endangered-species-act-overview	
Wetlands and Wetland Plant Identification	https://www.deq.virginia.gov/our-programs/water/wetlands-streams	
Training Required to Capture or Handle Sick, Injured, or Nuisance Wildlife	https://dwr.virginia.gov/permits/https://dwr.virginia.gov/permits/	Grounds Maintenance and Pest Control Contracting Officer's Representative
LaRC Invasive, Nuisance, and Protected Species	Contact the LaRC Environmental Management Office for a copy of the LaRC Invasive, Nuisance, and Protected Species fact sheet.	Facilities personnel, Grounds Maintenance and Pest Control personnel, Program Managers, Project Managers, Construction Managers
LaRC Migratory Bird Protections	Contact the LaRC Environmental Management Office for a copy of the LaRC Migratory Bird Management fact sheet.	
Green Infrastructure Maintenance	Contact the LaRC Environmental Management Office for a copy of the LaRC Green Infrastructure Handbook.	Grounds Maintenance and Pest Control personnel, Natural Resources Manager
International Society of Arboriculture Training: Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance, Pruning, Trimming, Repairing, and Removal of Trees and Shrubs	International Society of Arboriculture > Online Learning > Online Courses (isa-arbor.com)	

Pesticides and the Environment	https://www.vdacs.virginia.gov/pesticide-applicator-certification.shtml	

Key: IPaC = Information for Planning and Consultation; LaRC = Langley Research Center; NASA = National Aeronautics and Space Administration; NEPA = National Environmental Policy Act; SATERN = System for Administration, Training, and Educational Resources.

3.4 Partnerships and Collaborations

Partnerships with Federal, state, and local agencies, as well as universities and conservation groups, expand the expertise and assistance available to Center personnel for the development and implementation of sound management practices. The following is a list of groups and agencies that have formed or could form significant partnerships with LaRC.

- **USFWS.** The USFWS provides information and guidance related to Federally threatened and endangered species.
- **JBLE-LAFB.** The USAF and LaRC have a no-cost agreement for Canada goose (*Branta canadensis)* mitigation and deer (*Odocoileus virginianus*) surveys and culling to minimize potential bird/wildlife strike hazards for vehicles and aircraft. LaRC also partners with JBLE-LAFB on outreach events (see Section 4.12, Outreach and Education).
- **U.S. Department of Agriculture – Wildlife Services (USDA-WS).** The USDA-WS implements nuisance animal control at LaRC as needed under a no-cost agreement with the USAF.
- **Virginia Department of Game and Inland Fisheries (VDGIF).** The VDGIF provides information and guidance related to the state's rare, threatened, and endangered species.
- **Old Dominion University (ODU) Tick Lab.** In 2017, LaRC partnered with the ODU Tick Lab to test the TickBot along the fence line near the LaRC Child Development Center. In 2022, the partnership was expanded to include five treatment sites and adjacent control sites around the Center. The TickBot is a semi-autonomous, eco-friendly robot created to kill and collect ticks along transects. These efforts contribute to reducing tick populations around LaRC personnel and facilities while advancing valuable research on ticks and tick-borne diseases.
- **Virginia Department of Forestry (DOF).** LaRC maintains a relationship with the DOF for consulting on tree species health and outreach opportunities. The DOF visits LaRC at least annually to present Tree City USA recognition materials and attend Arbor Day events.
- **Virginia Security Corridor Sentinel Landscape.** This Sentinel Landscape may provide a stakeholder and funding mechanism for LaRC to partner with JBLE-LAFB, non-governmental organizations, and state agencies more easily for encroachment issues as well as LaRC natural resources management initiatives (https://sentinellandscapes.org/landscapes/virginia-security-corridor/#interactive-landscape-map).
- **Virginia Big Tree Program, Virginia Tech**. Several trees on LaRC are listed in the Virginia Big Tree Program for being among the largest in the state. LaRC frequently works with Virginia Big Tree

partners to consult on tree health, update register information about each tree's size, location, and unique characteristics, and complete 10-year recertifications.

4. Natural Resources Program Elements

4.1 Introduction

This section covers the elements of the LaRC Natural Resources Program, including regulatory drivers, current conditions, management activities, and interactions with a changing climate. The management activities implemented at LaRC are subject to the availability of funding and to changes in LaRC's mission.

4.1.1 Key Laws, Regulations, and Policies for Natural Resources Management

The primary regulatory drivers for natural resources protection and management are the ESA; Clean Water Act (CWA); Rivers and Harbors Act; Bald and Golden Eagle Protection Act; Migratory Bird Treaty Act (MBTA); various EOs related to wetlands, floodplains, invasive species, migratory birds, and climate change; and the Presidential Memorandum for pollinators. Appendix C (Key Natural Resources Laws, Regulations, and Policies) includes summaries of key laws, regulations, and policies related to natural resources, as well as a table cross-referencing each LaRC natural resource element with applicable Federal and state laws and regulations and NASA and Center-specific policies and requirements (Table C-1, Key Laws, Regulations, and Policies Related to Natural Resources Management at LaRC).

4.1.2 Resource Area Not Addressed

Table 4.1.2-1 presents the resource area that was not included in this NRMP because LaRC does not conduct such activity onsite.

Table 4.1.2-1. Resource Area Not Addressed for LaRC

Resource Area	Reason not Addressed
Forest Management	There is little potential for commercial forest management at LaRC. Since reforestation efforts on the Center are primarily focused on the improvement of water and habitat quality, they are discussed in Section 4.3 (Surface Water and Groundwater Resource Management).

Key: LaRC = Langley Research Center.

4.2 Wetland and Floodplain Management

4.2.1 Resource Description

Wetlands

According to the National Wetlands Inventory (NWI), approximately 66 hectares (163.2 acres) of scrub shrub, emergent, and forested wetlands are present in the LaRC West Area (Table 4.2.1-1) (NASA, 2021). Onsite surveys and delineations have provided additional information on the wetlands at LaRC.

However, per the May 2023 *Sackett v. Environmental Protection Agency* Supreme Court decision that the CWA extends only to wetlands with a continuous surface connection with waters of the United States (WOTUS), some areas formerly classified as wetlands may no longer meet the regulatory criteria of a jurisdictional wetland. No wetlands data is currently available for the LaRC East Area.

Table 4.2.1-1. National Wetlands Inventory Classifications for Wetlands at LaRC

Classification Code	Description
E1UBL	Estuarine and Marine Deepwater
E2EM1P	Estuarine and Marine Wetland
PFO1Bd	Freshwater Forested/Shrub Wetland
PFO1B	Freshwater Forested/Shrub Wetland
PFO1C	Freshwater Forested/Shrub Wetland
PFO1Ed	Freshwater Forested/Shrub Wetland
PFO4R	Freshwater Forested/Shrub Wetland
PSS4R	Freshwater Forested/Shrub Wetland
R2UBHx	Riverine
R4SBC	Riverine

Source: National Wetlands Inventory, February 2024, https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/
Key: LaRC = Langley Research Center.

A 1991 wetland field survey identified the tidal marsh wetlands associated with Brick Kiln Creek and Tabbs Creek as the predominant wetland areas in the vicinity of LaRC. The survey also documented three types of forested wetlands at the Center: 1) red maple (*Acer rubrum*) swamp, 2) sweetgum (*Liquidambar styraciflua*) swamp, and 3) water oak (*Quercus nigra*) pond wetlands. These wetlands were located primarily along the upper reaches of the Brick Kiln Creek and Tabbs Creek marsh wetlands and in the undeveloped portion of the LaRC West Area. The survey stated that the forested wetlands may be remnants of a larger wetland area that had been converted by ditches and draining. Shrub-scrub wetlands were identified in limited areas, mostly in ditches adjacent to the marsh wetlands (NASA, 1991a; NASA, 1991b).

In 2001, as part of a potential development project and at LaRC's request, the U.S. Army Corps of Engineers (USACE) reviewed the wooded property to the south and east of the Center's main gate and determined that no jurisdictional wetlands exist at the site. In the fall of 2004, LaRC performed a wetlands delineation study on approximately 54 hectares (134 acres) of mixed pine, hardwood forest, and lawn to update and verify portions of the 1991 survey (NASA, 2005).

LaRC has two facilities located within wetland areas—a tidal gauge pier (installed in 2015) and the Construction Debris Landfill (a long-term monitored Comprehensive Environmental Response,

Compensation, and Liability Act [CERCLA] site). These facilities are in restricted areas and are not actively visited by LaRC personnel (NASA, 2019).

Center wetland distributions can be found in Figure 3, Appendix A (Figures), with additional wetland descriptions provided in the 1991 wetland survey (NASA, 1991a; NASA, 1991b), as well as the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

Floodplains

When flooding occurs, floodplains can help to moderate impacts to upland areas. Based on the Federal Emergency Management Agency Flood Insurance Rate Maps, much of the Center falls within the 100-year floodplain and the 500-year floodplain. A 100-year floodplain is defined as the area that has a 1 percent chance of that level of flooding in any given year. Likewise, A 500-year floodplain is defined as the area that has a 0.2 percent chance of that level of flooding in any given year. According to the USACE hurricane evacuation studies in Virginia, a Category 2 hurricane could produce a water level similar to a 100-year flood in the LaRC area, and a Category 3 hurricane may produce a level higher than a 500-year flood event in the area, which would put the majority of the Center under several feet of water (NASA, 2021). Due to their extent, floodplains are an important planning consideration at LaRC.

Center floodplain distributions can be found in Figure 4, Appendix A (Figures), with additional floodplain descriptions provided in the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

4.2.2 Management Activities

Projects and activities at LaRC rarely encounter wetlands or floodplains, and the Center conducts no active management of these resources. Most EMO efforts regarding wetlands and floodplains are focused on minimizing projects/activities in these areas, when feasible. The LaRC 20-year revitalization plan has focused heavily on moving away from flood-prone areas and building new construction in the central area of the Center.

Wetlands, floodplains, and waterways are protected on NASA LaRC through recognition of special natural areas, application of buffer zones around significant resources, and compliance with applicable state and Federal requirements (see Appendix C: Key Natural Resources Laws, Regulations, and Policies). NASA LaRC obtains all appropriate Federal, state, interstate, and local certifications and permits required for point and nonpoint source pollution control, groundwater protection, dredge and fill operations, and stormwater management.

To further minimize adverse impacts to natural areas, LaRC implements the following best management practices (BMPs) (NASA, 2021):

- Avoid and minimize impacts to undisturbed forest, wetlands, and streams to the fullest extent practicable.
- Maintain undisturbed naturally vegetated buffers of at least 30.5 meters (100 feet) in width around all onsite wetlands and on both sides of all perennial and intermittent streams (Figure 5, Appendix A: Figures).
- Design stormwater controls to replicate and maintain the hydrographic condition of the site prior to the change in landscape, to the fullest extent possible.
- Attempt to restrict tree removal and ground clearing activities, and adhere to a time-of-year restriction from March 15 through August 15 to protect nesting resident and migratory birds and bats.
- Adhere to erosion and sediment controls during ground disturbance.

Maintenance of current, accurate geographic information system (GIS) data on wetlands and floodplains is vitally important to supporting FMO efforts to design infrastructure projects to avoid these sensitive areas to the greatest extent practicable. These data also are used by the EMO during the work order review process to evaluate whether a proposed action may affect wetlands or floodplains and to work with the proponent to modify the action to avoid or further minimize potential impacts. If a project/action cannot be modified to entirely avoid impacts, the EMO determines the NEPA, permitting, and mitigation requirements for the action. Obtaining permits may include conducting environmental site reviews and wetland delineations and following the wetland compensatory mitigation process, as defined in regulatory permitting processes.

4.3 Surface Water and Groundwater Resource Management

4.3.1 Resource Description

Surface Waters

NASA LaRC is located on the small coastal basin of the Back River, a tidal estuary of the Chesapeake Bay. Brick Kiln Creek runs along the western boundary of the Center, joining the Northwest Branch Back River, and drains approximately 40 percent of the LaRC West Area. Tabbs Creek, which drains most of the rest of the West Area and part of LAFB, flows in a northerly direction to join the Back River. A small portion of the West Area in the south drains to Tides Mill Creek. The East Area drains to the Back River. The local waterways are influenced by tides in the Chesapeake Bay (NASA, 2021). The northern

boundary of LaRC (predominantly wetlands), Brick Kiln Creek, and the Back River are designated as Essential Fish Habitat (https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper) (NASA, 2019).

The four basic aquatic community types at LaRC are 1) brackish tidal marshes, 2) brackish ponds with occasional tidal influence, 3) palustrine freshwater ponds, and 4) brackish and freshwater ditch systems (NASA, 1995). LaRC has two brackish ponds, and multiple palustrine freshwater forested ponds occur in the large contiguous tract of forest along the western side of the Center. Brackish ditches occur primarily in the northern portion of the Center and empty directly into Brick Kiln Creek. The freshwater ditch system drains most of the central and western portions of LaRC; most of this system drains into the brackish ditches in the northern portion of the Center, and a small portion drains to the east directly into Tabbs Creek. A third freshwater drainage crosses the center of the pine forest in the southeast corner of the Center, emptying into the drainage ditch system of the LAFB airfield (NASA, 2021).

LaRC obtains water from Newport News Waterworks. LaRC is permitted to discharge nonhazardous industrial wastewater and sanitary sewage to the Hampton Roads Sanitation District sanitary sewer system. A Virginia Pollutant Discharge Elimination System permit authorizes NASA LaRC to discharge industrial process wastewater to the surface waters of Virginia at six outfall locations; the remaining ten outfalls contain only stormwater runoff. The Virginia Stormwater Management Program Municipal Separate Storm Sewer System (MS4) Permit requires that LaRC develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants from the Center to the maximum extent practicable (NASA, 2019). The Center has an Integrated Spill Contingency Plan that complies with the Spill Prevention, Control, and Countermeasure requirements of the U.S. Environmental Protection Agency's (EPA's) Oil Pollution Prevention Regulations. Past polychlorinated biphenyl (PCB) and polychlorinated terphenyl contamination in Tabbs Creek and storm sewer lines connected to Outfall 009 has been cleaned (NASA, 2021).

The Back River Is identified on the State's list of impaired waters due to high levels of fecal coliform that impact recreation and shellfish harvesting. A bacteria Total Maximum Daily Load (TMDL) of the Back River and tributaries was completed in spring 2018. LaRC discharges to Brick Kiln Creek, Tabbs Creek, and the Northwest Branch Back River, all of which are covered under this TMDL. LaRC has a Waste Load Allocation (WLA) for fecal bacteria, with the main source being wildlife. In addition, the U.S. EPA has established the Chesapeake Bay TMDL, which identifies necessary pollution reductions of nitrogen, phosphorus, and sediment across seven states, including Virginia. Federal facilities in the Chesapeake

Bay drainage area, including LaRC, are required to participate in the TMDL process and meet WLA reductions. LaRC submitted Phase 2 of the TMDL Action Plan in May 2018, which demonstrates the Center's plans for meeting TMDL reduction goals (NASA, 2021). LaRC has prepared a draft of Phase 3 of the TMDL Action Plan; the final Phase 3 Plan will be submitted to the Virginia Department of Environmental Quality (VDEQ) by November 1, 2024, for compliance with the MS4 Permit.

LaRC is actively working with the Chesapeake Bay Program's Federal Facilities workgroup and responds to data calls for updates to land cover and the implementation of BMPs that are used to track progress toward meeting the reduction goals under the Bay TMDL. LaRC will address this TMDL through the MS4 permit process over three permit cycles (15 years). BMP implementation on existing developed lands and areas of new construction are used by LaRC to achieve nutrient and sediment reductions and is required for TMDL and MS4 compliance (NASA, 2021).

Center surface water distributions can be found in Figure 5, Appendix A (Figures), with detailed surface water descriptions provided in the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

Groundwater

Groundwater in the Coastal Plain is present primarily in pores in the sediments. Thick sequences of porous and permeable strata form regional aquifers, and less permeable strata form confining units between the aquifers. Groundwater in the Virginia Coastal Plain is recharged principally by infiltration of precipitation and percolation to the water table. Most of the unconfined groundwater flows relatively short distances and discharges to nearby streams, but a small amount flows downward to recharge the deeper, confined aquifers. Typically, groundwater at LaRC can be encountered at a 1.5- to 2.1-meter (5-to 7-foot) depth. Groundwater at LaRC is often brackish because of Chesapeake Bay's proximity and marine deposits found in the soil. Groundwater movement at LaRC is tidally influenced at locations near Brick Kiln Creek and Tabbs Creek (NASA, 2021).

Due to residual PCB-contaminated soil at the Stratton Substation site, a Land Use Control (LUC) is in place and required groundwater monitoring continues. LUCs are also in place for the Construction Debris Landfill and Area E Warehouse areas. Over 50 shallow wells (depth less than 6 meters or 20 feet), intermediate wells (23 meters or 75 feet), and deep wells (depths greater than 29 meters or 95 feet) have been installed to identify/monitor contamination of groundwater at LaRC. Since 1995, samples collected from the monitoring wells at LaRC have not shown any groundwater contamination. The LaRC

EMO maintains the results of periodic groundwater level measurements and sample analysis (NASA, 2021).

Groundwater withdrawals have lowered water levels in Virginia Coastal Plain aquifers and have resulted in drawdown in the Potomac aquifer. LaRC is located within the regulated Eastern Virginia Groundwater Management Area (GWMA). Any entity located within a declared GWMA must obtain a permit to withdraw 300,000 gallons or more of groundwater in any one month (NASA, 2021).

Detailed groundwater and aquifer descriptions are provided in the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

4.3.2 Management Activities

The primary management approach for surface waters and groundwater at LaRC is to avoid conducting potentially harmful activities in areas that could impact water resources. During the initial environmental review process, ground-disturbing activities and those with the potential to cause or spread contamination are discouraged near water resources. If a project/action cannot be modified to entirely avoid impacts, the EMO determines the NEPA, permitting, and mitigation requirements for the action (see Appendix C: Key Natural Resources Laws, Regulations, and Policies).

LaRC maintains a GIS layer identifying the two levels of protection near water resources. The primary zone includes tidal wetlands, certain non-tidal wetlands and tidal shores, and a minimum 30-meter (100-foot) vegetated buffer area adjacent and landward of these features and along both sides of any water body with perennial flow. The secondary zone, which has less stringent restrictions, includes an additional 30-meter (100-foot) buffer extending beyond the inland limit of the primary zone (Figure 5, Appendix A: Figures). The LaRC land use planning policy is to avoid these areas to the maximum extent possible (NASA, 2021).

Additional requirements and practices that protect water resources at LaRC include the following:

Illicit Discharge Detection and Elimination (IDDE) Program. Illicit discharges are prohibited at the Center. The LaRC IDDE Handbook has written procedures to detect, identify, and address unauthorized non-stormwater discharges, including illegal dumping (NASA, 2024a).

Green Infrastructure. NASA LaRC implements green infrastructure, a type of Low Impact Development, to slow down and treat polluted stormwater runoff before it is discharged to local waterways. Green

infrastructure implemented at LaRC includes vegetated roofs, multiple bioretention and rain gardens, grass channels, pervious pavers, and tree box filters.

Best Management Practices (BMPs). Various BMPs are implemented at LaRC to prevent or mitigate stormwater and/or sewer system pollution. These practices include preventive maintenance, visual inspections, spill prevention and response, sediment and erosion control, good housekeeping, employee training, and recordkeeping and reporting. BMPs are also employed for pesticide and herbicide use. Land-disturbing and construction activities are carried out in compliance with appropriate state requirements.

Pollution Prevention Program/Good Housekeeping. The LaRC Pollution Prevention Program uses a variety of operational and maintenance BMPs to ensure that Center operations are accomplished in a way that minimizes or prevents pollutant discharges. Street sweeping and catch basin maintenance are the Center's preferred methods, as they collect debris prior to it being washed into the MS4 and discharged into local waterways. These BMPs are conducted quarterly and bi-annually, respectively. As needed, they are also done after events that result in heavy pollutants in the roadway (i.e., after heavy storms, around large construction projects).

Riparian Buffers. Riparian buffers encompass the vegetation from the edge of a steam bank out through the adjacent riparian zone. Some important riparian buffer functions include erosion control, pollutant treatment, wildlife habitat, and flood control. From 2009 to 2024, LaRC has reforested 2.3 hectares (5.6 acres) with a mix of native hardwoods and pines, primarily near waterways to increase riparian buffers. These projects are an inexpensive way for LaRC to earn credits toward pollution reduction goals for the Chesapeake Bay TMDL.

4.4 Soil and Geology Resource Management

4.4.1 Resource Description

NASA LaRC is in the Coastal Plain of southeastern Virginia. The Center sits on the rim of a 35-million-year-old crater, in an area of low topographic relief surrounded by a shallow estuarine environment. The LaRC area is designated as Seismic Risk Zone 1, which is an area with minor damage expected (NASA, 2021).

Soils at LaRC range in texture from clay and silt to fine gravel, with most of the soils being fine to medium sandy loam. The surface is a deposited loam from 0.6 meters (2 feet) to 1.8 meters (6 feet) in

depth. Most of the soils in the non-tidal wetland areas are Chicahominy silt loam and clay, Munden loamy fine sand, and fine sandy loam and sand, while those in the tidal areas are mainly Bohicket muck (NASA, 2021). Current information on soils at NASA LaRC is available at https://websoilsurvey.nrcs.usda.gov/app/.

LaRC is currently listed on the Superfund National Priorities List. Soils at former landfills were contaminated with waste solvents and paints, used batteries, scrap metals, pesticides, municipal wastes, chemicals, sanitary refuse, photo finishing wastes, medical wastes, and laboratory wastes. The EMO manages the investigation, response, and remedial activities of historically contaminated NASA sites at LaRC. The Restoration Program Manager maintains copies of investigation and remediation reports. The LaRC ERD contains a table with CERCLA sites that have been closed, as well as those still undergoing restoration activities (NASA, 2021); Figure 6 in Appendix A: Figures, shows the location of LaRC CERCLA sites.

Detailed soil and geology descriptions are provided in the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

4.4.2 Management Activities

Multiple requirements and systems are in place to address the two primary concerns for soils at LaRC—erosion and contamination. As projects are reviewed during the NEPA process, input is provided on requirements to minimize impacts to soils, including erosion control, spill prevention and containment, and revegetation upon completion of ground-disturbing work (see Appendix C: Key Natural Resources Laws, Regulations, and Policies). As discussed in Section 4.3 (Surface Water and Groundwater Resource Management), BMPs are implemented during construction and other ground-disturbing activities. Refer to the ERD's Soils and Minerals section for discussion of remedial actions in areas with contaminated soils (NASA, 2021).

4.5 Fish and Wildlife Management

4.5.1 Resource Description

The most recent biological survey of the Center was conducted in 2023 (NASA, 2023). Habitat and species surveys were also conducted in 1995 and 2009 (NASA, 1995) (NASA, 2009). Table 4.5.1-1 lists the number of amphibian, bird, fish, invertebrate, mammal, and reptile species that were documented at LaRC during these surveys.

Table 4.5.1-1. Number of Species Documented at LaRC

Survey	Amphibians	Birds	Fish	Invertebrates	Mammals	Reptiles
1995	16 (combined with reptiles)	118	34	NS	14	16 (combined with amphibians)
2009	3	25	NS	NS	3	4
2023	3	56	NS	NS	7	4

Sources: (NASA, 1995; NASA, 2009; NASA, 2023)
Key: LaRC = Langley Research Center. NS = not sampled.

Common mammals known to occur at LaRC include white-tailed deer, raccoons (*Procyon lotor)*, gray squirrels (*Sciurus carolinensis)*, and opossums (*Didelphis virginiana)*. Amphibian and reptile species found in the area include broad-headed skinks (*Plestiodon laticeps)*, Eastern box turtles (*Terrapene carolina carolina)*, and American green tree frogs (*Hyla cinerea)*, among others. Carolina wren (*Thryothorus ludovicianus*), Northern cardinal (*Cardinalis cardinalis*), tufted titmouse (*Baeolophus bicolor*), pine warbler (*Setophaga pinus*), and red-eyed vireo (*Vireo olivaceus*) were the most frequently encountered bird species. Numerous species of waterfowl and wading birds use the coastal marshes for foraging and/or roosting, including great blue herons (*Ardea herodias)*, great white egrets (*Egretta alba*), and white ibis (*Eudocimus albus*) (NASA, 2021).

Tidal creeks such as Tabbs Creek and Brick Kiln Creek support a diversity of aquatic and semiaquatic species. They are important spawning and nursery areas for a multitude of estuarine species, including some migratory species. Thirty-four fish species were collected during a 1995 survey in the LaRC area. All species collected were common to the lower Chesapeake Bay and its tributaries, including hogchoker (*Trinectes maculatus*), oyster toadfish (*Opsanus tau*), silver perch (*Bairdiella chrysoura*), spot (*Leiostomus xanthurus*), and croaker (*Micropogonias undulatus*) (NASA, 2019). The dominant invertebrate species are crustaceans and mollusks such as blue crab (*Callinectes sapidus*), wharf crab (*Sesarma reticulatum*), fiddler crab (*Uca pugnax*), grass shrimp *(Palaemonetes pugio*), and saltmarsh periwinkle (*Littoraria irrorata*). Juvenile quahogs (*Mercenaria mercenaria*) are commonly found throughout Tabbs Creek. Historically, Eastern oyster (*Crassostrea virginica*) and ribbed mussel (*Geukensia desmissa*) were present near the confluence of Tabb Creek and the Northwest Branch Back River, but oyster catches in recent years have declined most likely due to the virus Multinucleated Sphere Unknown (MSX) and the bacterium *Dermocestidium*. The consumption of shellfish from Tabbs Creek and portions of the Northwest Branch Back River and Southwest Branch Back River is prohibited by the Virginia State Department of Health due to high levels of bacteria (NASA, 2021).

Listings of the terrestrial and aquatic species that have been documented at LaRC are available in the appendices of the 2023 *Survey of Biological Resources and Threatened and Endangered Species at NASA Langley Research Center* (NASA, 2023) and the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

4.5.2 Management Activities

The wildlife management activities conducted at LaRC are focused on restoring and maintaining native wildlife populations and reducing human-wildlife conflicts. Management activities associated with these areas, such as bird and deer management, are covered under the following NRMP sections: Section 4.6 (Vegetation Management), Section 4.7 (Nuisance and Invasive Non-Native Species Management), Section 4.8 (Special Status Species Management), and Section 4.12 (Outreach and Education). Fishing is not permitted at LaRC, and no fish stocking or direct population management has been undertaken.

4.6 Vegetation Management

4.6.1 Resource Description

Coastal Virginia has a long history of human occupation, with repeated logging, farming, and urban development. Currently, approximately 58 percent (177 hectares [438 acres]) of the LaRC land area is classified as either Developed or Maintained, consisting of buildings/structures, paved areas, and areas of routinely maintained lawn and ornamental species. The large, forested areas on the western and southern portions of LaRC are primarily Coastal Plain Forest that is either dominated by hardwoods or evergreens or is transitional (Table 4.6.1-1). Most of the hardwood and pine secondary forests found on LaRC have well-developed canopies reflecting years of growth, with estimated forest ages ranging from 35 to 75 years old. Since the 2009 survey of the property, a few stands that are no longer maintained have shifted to hardwood--dominated Coastal Plain Forest, and there are a few acres of forest that have been replanted with coastal plain species (NASA, 2009; NASA, 2023). The Coastal Plain Forests on LaRC occupy relatively well-drained bottomland ecosystems that experience occasional flooding. In the northern and eastern portions of LaRC bordering water bodies, emergent vegetation is the dominant habitat, consisting primarily of wetland herbaceous species (Table 4.6.1-1) (NASA, 2023).

A 2023 survey of the Center documented 153 plant species, 72 of which were additions to the lists compiled in previous surveys; however, 100 of the species found during previous surveys were not observed during the 2023 inventory (NASA, 2009; NASA, 2023). Successional taxa such as loblolly pine

and sweetgum were common, and more established species such as oaks (*Quercus* spp.) and hickories were also widely distributed. The understory vegetation was generally sparse, perhaps a result of invasive non-native plant species (INPS) competition and extensive browsing by white-tailed deer, both which were observed during the surveys.

Table 4.6.1-1. Habitat Types Present at LaRC

Habitat Type	Acres	Description
Coastal Plain Forest (Hardwood Dominated)	117	Diverse occasionally flooded forests occupying relatively well-drained bottomlands. Characteristic tree species include sweetgum, sycamore (*Platanus occidentalis*), red maple, willow oak (*Quercus phellos*), and hickory (*Carya ovata*).
Coastal Plain Forest (Evergreen Dominated)	21	Diverse occasionally flooded forests occupying relatively well-drained bottomlands. Characteristic tree species include loblolly pine (*Pinus taeda*) and Eastern red cedar (*Juniperus virginiana*).
Coastal Plain Forest (Mixed)	2	Diverse occasionally flooded forests occupying relatively well-drained bottomlands. Characteristic tree species include loblolly pine, Eastern red cedar, sweetgum, tulip-tree (*Liriodendron tulipifera*), red maple, and sycamore.
Coastal Plain Forest (Planted)	3	Planted reforestation sites. Characteristic species include sweetgum, red maple, willow oak, tulip-tree, and Eastern red cedar.
Coastal Plain Forest (Maintained)	7	Forested urban areas characterized by a contiguous overstory of mature trees with minimal midstory vegetation and maintained understory vegetation. This classification includes only trees characteristic of the Coastal Plain Forest types, not ornamental landscaping species.
Coastal Plain Forest (Transitional)	21	Varies along a continuum, becoming more terrestrial or more aquatic depending on distance from the two primary habitats. Habitat can consist of a diverse group of trees, scrub/shrubs, and grasses that border wetland herbaceous vegetation. Characteristic transitional species vary with soil type, flooding regime, and microtopographic heterogeneity. This habitat type supports all Coastal Plain Forest species as well as estuarine and marine species.
Coastal Plain Forest (Stream-bottom/ Drainage–- Hardwood)	2	Diverse occasionally flooded forests occupying relatively well-drained bottomland ecosystems. Characteristic tree species include sweetgum, sycamore, red maple, willow oak, hickory, American elm (*Ulmus americana*), and black gum (*Nyssa sylvatica*).
Coastal Plain Forest (Stream-bottom/ Drainage – Evergreen)	2	Diverse occasionally flooded forests occupying relatively well-drained bottomland ecosystems. Characteristic tree species include loblolly pine and Eastern red cedar.
Emergent Vegetation	120	Borders water bodies on the northern and eastern portions of LaRC and is dominated by wetland herbaceous species.
Developed & Maintained Areas	438	Includes buildings, roads, parking lots, facilities, sidewalks, and the vegetated urban areas consisting of lawn and ornamentals that are routinely maintained.
Disturbed Areas	NA	Areas no longer in a natural state and not expected to return to native habitat. This includes a landfill remediation site overlain with a periodically maintained soil cover vegetated with grasses and shrubs and another site that was previously a stockpile location, which is dominated by the common reed (*Phragmites australis*).
Grass (Perimeter)	Minimal	A few areas along the fence line that consist of tall grass and other herbaceous species.

Source: (NASA, 2023)
Key: LaRC = Langley Research Center; NA = not available.

The aquatic communities found at LaRC are primarily discussed in Section 4.2.1 (Wetland and Floodplain Management, Resource Description), but floristic information is provided here. The tidal marshes, brackish ponds, and brackish ditch systems at LaRC are typically dominated by some combination of saltmarsh cordgrass (*Spartina alterniflora*), seashore saltgrass (*Distichlis spicata*), saltmeadow cordgrass (*Spartina patens*), and needlegrass rush (*Juncus roemerianus*). The palustrine freshwater ponds usually have an overstory of willow oaks, laurel oak (*Quercus laurifolia*), red maple, and black gum, with an intermediate shrub layer of wax myrtle (*Morella cerifera*), paw paw (*Asimina triloba*), fetterbush (*Leucothoe racemosa*), elderberry, and various herbaceous understory species, such as greenbrier (*Smilax* sp.) and poison ivy (*Toxicodendron radicans*). The emergent vegetation in most of the freshwater ditch systems is dominated by grass-leaf arrowhead (*Sagittaria graminea*), cespitose knotweed *(Polygonum cespitosum*), Virginia dayflower (*Commelina virginica*), lady's thumb (*Polygonum persicaria*), and Virginia bugleweed (*Lycopus virginicus*) (NASA, 2021).

Center vegetative community distributions can be found in Figure 7, Appendix A (Figures), with detailed vegetative community descriptions and plant species lists provided in survey reports (NASA, 1995; NASA, 2009; NASA, 2023) and the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

4.6.2 Management Activities

LaRC implements a replacement strategy for trees removed during construction or demolition projects. For each tree removed, a combination of trees totaling the diameter at breast height of the tree removed shall be planted (NASA, 2021). Species native to the region are to be used for the installation of new trees and plants, and planting is to be done in accordance with nursery standards prepared by AmericanHort (https://www.americanhort.org/education/american-nursery-stock-standards).

For bare-root seedling plantings, LaRC puts down weed matting and installs "Tree Grow Tubes" around trees for protection and to enhance growth. The tree tubes are also covered with bird netting fabric to prevent bird fatalities inside the tubes. The tube and bird netting are removed when the tree emerges from the tube. Larger sapling plantings require the installation of stakes for support and trunk fencing for deer protection. When possible, LaRC uses volunteers or the Grounds Maintenance and Pest Control contractor for reforestation planting and collaborates with the onsite Fire Department to assist with watering.

Most of the open fields at LaRC are small areas near buildings that are mowed too frequently to have much habitat value. However, the large open fields in the northern part of the Center are mowed at an

intermediate frequency that discourages woody vegetation succession and allows perennial grasses and forbs to flourish (NASA, 2021). Additionally, to reduce Center maintenance needs and obtain TMDL credits for land conversions, LaRC is allowing some historically mowed areas and demolition sites to grow wild and become meadows; however, they are not managed meadows and do not have any specific plantings or preparation done.

The entirety of LaRC has been designated a Tree City since 2010. To qualify for the Tree City USA designation, a site must apply annually and must meet the following four standards: 1) maintain a tree board or department, 2) have a tree care ordinance, 3) observe Arbor Day and have a proclamation, and 4) spend at least 2 dollars per capita on tree maintenance (https://www.arborday.org/programs/treecityusa/#standardsSection).

Implementation of standard BMPs for construction activities and grounds maintenance that address tree and plant protection improve the appearance, longevity, and overall health of the urban forest trees at the Center. It is recommended that tree pruning is performed only by trained personnel or qualified tree care professionals.

The care that newly planted materials receive is critical to their health and longevity. Ensuring adequate soil moisture immediately after planting and during the first two years of establishment is the key factor in planting success. Preventing damage from mowers, string trimmers, and deer rubbing is a significant problem for landscaping managers. Wounds in a tree's bark make it more susceptible to disease and pest infestations and reduce its chance of survival. Mulch can be an effective method of protecting trees from mower damage, when used properly. Placing trunk guards around the base of trees is another method of protecting them from damage. Flexible plastic trunk guards can be purchased from forest supply companies, or homemade trunk guards can be made from hardware cloth. The plastic guards are more practical because they expand as the tree grows. Care must be taken to remove guards as trees grow, as they can cause girdling and suckering when left in place too long.

The LaRC Green Infrastructure Maintenance Guide covers maintenance activities, responsible organizations, and required task frequency, if applicable, for practices that are either in use or likely to be used to maintain green infrastructure at LaRC (NASA, 2024b). Practices include the list below.

- Bioretention Systems (e.g., large scale, urban/small scale, rain gardens)
- Grass Channels
- Infiltration Practices

- Permeable Pavers
- Rooftop Disconnection
- Vegetated Roofs
- Tree Box Filters
- Reinforced Turf Systems

4.7 Nuisance and Invasive Non-Native Species Management

4.7.1 Resource Description

Nuisance and Pest Species

The most common nuisance animals at NASA LaRC are feral cats (*Felis catus*), squirrels, raccoons, and foxes (*Vulpes vulpes*), and the primary pest species are mosquitos (*Culicidae*), ants (Family Formicidae), and rodents (Order Rodentia) (Table 4.7.1-1). Canada geese, deer, coyotes (*Canis latrans*), and nutria (*Myocastor coypus*) have the potential to become a nuisance. Feral cats are of concern due to their impacts on bird populations. Some of these nuisance and pest species can contribute to the spread of diseases, rabies, and parasites. Mosquito--borne diseases found in Virginia include the West Nile virus and various forms of encephalitis. Mammalian species, especially deer, have been known to spread tick-borne diseases such as Lyme disease and Rocky Mountain spotted fever. At times, osprey (*Pandion haliaetus*) and other birds build nests in unfortunate locations, such as on loud-speakers and research structures.

Table 4.7.1-1. Nuisance Animal Species at LaRC: Extent and Priority Level for Control

Common Name	Scientific Name	Extent	Priority Level for Control
Feral cat	*Felis catus*	Rare	High
Gray squirrel	*Sciurus carolinensis*	Widespread	Low
Raccoon	*Procyon lotor*	Common	Low
Fox	*Vulpes vulpes*	Rare	Low
White-tailed deer	*Odocoileus virginianus*	Common	Medium
Canada goose	*Branta canadensis*	Common	High
Coyote	*Canis latrans*	Rare	Low
Nutria	*Myocastor coypus*	Not yet observed at LaRC	High (if/when present)

Source: (NASA, 2023)
Key: LaRC = Langley Research Center.

If a large population of Canada geese or deer was to become established at NASA LaRC, their fecal droppings would create unsanitary conditions and contribute fecal coliform bacteria and excess nutrients to surrounding waters, which could exceed the LaRC WLA for fecal bacteria for the Back River

TMDL. An increase in the number of resident geese and/or deer also poses a threat to the numerous aircraft missions occurring daily at LAFB (see Section 4.10, Bird/Wildlife Aircraft Strike Hazard (BASH) Management).

The Cultural Carrying Capacity (CCC) is defined as the maximum number of deer that can coexist compatibly with the local human population. The CCC is exceeded when humans complain of excessive deer-vehicle collisions or vegetation damage. Additionally, if deer become overpopulated, over-browsing will occur, which will result in a decline in the health of the deer herd. To support effective deer management, NASA LaRC receives population estimates from deer surveys conducted by the USDA-WS and LAFB. Population estimates typically range from 300 to 600 deer, annually (NASA, 2019).

Although nutria have been documented in southern Hampton Roads, the species has not yet been detected on LaRC property. Because the rooting behaviors of these large rodents can severely damage wetlands and marshes, they would be a high priority for control if found onsite (NASA, 2019).

Detailed nuisance species descriptions are provided in the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

Invasive Non-Native Plant Species

Due to the threat INPS can pose to the health and abundance of native plant and animal populations, Federal agencies have a mandate to prevent and minimize their spread (see Appendix C: Key Natural Resources Laws, Regulations, and Policies). INPS have been documented at the Center during ecological surveys and during routine management activities; however, no formal quantitative surveys of INPS coverage have been conducted. The 2023 biological survey documented 17 INPS, with Japanese stilt grass (*Microstegium vimineum*) and Japanese honeysuckle (*Lonicera japonica)* common in the understory throughout the focal sites. Another INPS of concern at LaRC, common reed (*Phragmites australis*), was documented along marsh, pond, and ditch edges (NASA, 2023). A dense and tall stand of common reed was present at focal site CA-18, with other invasive species such as tree-of-heaven (*Ailanthus altissima*) and Princess tree (*Paulownia tomentosa*) in surrounding areas. Table 4.7.1-2 lists the typical types of habitats on LaRC where INPS may occur.

The *Survey of Biological Resources and Threatened and Endangered Species at NASA Langley Research Center* provides additional information on the INPS documented on LaRC, including a map of the survey

focal areas and transects where they were found (NASA, 2023). Descriptions of Virginia Coastal Plain invasive plant species are available at https://www.dcr.virginia.gov/natural-heritage/ip.

Table 4.7.1-2. INPS at LaRC: Typical Habitats

Common Name	Scientific Name	Typical Habitats
Tree-of-heaven	*Ailanthus altissima*	Disturbed areas
Mimosa	*Albizia julibrissin*	Forests
Common dayflower	*Commelina communis*	Forests
Thorny olive	*Elaeagnus pungens*	Forests
Winged Euonymus	*Euonymus alatus*	Forests
Climbing Euonymus	*Euonymus fortunei*	Maintained forests
English ivy	*Hedera helix*	Forests
Sericea lespedeza	*Lespedeza cuneata*	Emergent vegetation, forests
Chinese privet	*Ligustrum sinense*	Forested stream bottom/drainage
Japanese honeysuckle	*Lonicera japonica*	Forests, disturbed areas, emergent vegetation, transitional forests
Japanese stiltgrass	*Microstegium vimineum*	Maintained forests, forested stream bottom/drainages, forests
White mulberry	*Morus alba*	Forests, disturbed areas
Princess tree	*Paulownia tomentosa*	Disturbed areas
Common reed	*Phragmites australis*	Disturbed areas; emergent vegetation; transitional forests; forests; along marsh, pond, and occasional ditch edges throughout
White poplar	*Populus alba*	Forests, disturbed areas
Sheep sorrel	*Rumex acetosella*	Open, disturbed areas and clearings
Johnson grass	*Sorghum halpense*	Forest edges

Source: (NASA, 2023)
Key: INPS = invasive non-native plant species; LaRC = Langley Research Center.

4.7.2 Management Activities

Nuisance and Pest Species Management

Building occupants/users should notify the EMO of nuisance wildlife. All nuisance wildlife incidents (whether real or perceived) shall be coordinated with the EMO, as well as appropriate disposition of the animal due to issues such as disease, to avoid potential violations of state and/or Federal laws. It is illegal in the State of Virginia to trap and relocate an animal to another area without proper licensing. The Grounds Maintenance and Pest Control contractor is responsible for providing services to set humane traps for the capture and removal of wild small nuisance animals. Captured animals shall be safely removed from the Center in accordance with State and local Animal Control regulations and reported to the Contracting Officer's Representative and the NRM. The EMO may also coordinate with the USDA-WS for assistance with the removal of wildlife and nuisance species.

LaRC works with LAFB and USDA-WS under a no-cost agreement for deer surveys and management. Surveys are conducted to determine whether the white-tailed deer population on NASA LaRC property is approaching nuisance levels. Potential management strategies (e.g., cullings) are discussed among LAFB, LaRC, and USDA-WS and then implemented by the USDA-WS (NASA, 2019). The fact sheet for invasive, nuisance, and protected species at LaRC provides photographs and best practices for nuisance species management (Appendix F: Natural Resource Fact Sheets).

Per 71 Federal Register 45964, landowners can remove Canada geese at airports, in agricultural areas, and in other areas where they are causing conflicts with human populations. The Nest and Egg Depredation Order is an additional tool that allows landowners to destroy resident Canada goose nests and eggs when necessary to resolve or prevent injury to people, property, agricultural crops, or other interests. Under this order, no permit is required, but the landowner must annually register with the USFWS to conduct this activity. USDA-WS manages geese for LaRC, including any required regulatory coordination and reporting. Nests and eggs may be taken only between March 1 and June 30.

Because migratory birds are protected by the MBTA, there are restrictions on disturbing these birds and their nests and eggs unless properly permitted by the USFWS (see Section 4.8.2, Special Status Species Management, Management Activities). If an active bird nest is discovered in an area that potentially interferes with operations, the NRM must be consulted immediately to determine appropriate action. The current approach is to remove the nest at the appropriate time when eggs or fledglings are not present. The Grounds Maintenance and Pest Control contractor shall maintain a record of all bird control applications, including the type of control used, date, building, requester, and any additional data required by regulatory agencies. The LaRC Migratory Bird Management fact sheet provides photographs and life history information for some of the migratory bird species that may be encountered at LaRC, as well as applicable regulations and requirements (Appendix F: Natural Resource Fact Sheets).

The EMO plans to continue to provide public outreach about wildlife and monitor areas where there is evidence of feeding these animals. Feeding wildlife on the Center is prohibited because it causes animals to lose their natural fear of humans, and it is a violation of certain Federal and state laws (NASA, 2019).

While nutria are not yet present at LaRC, it is important to monitor wetland and marsh areas and report any sightings to the VDGIF (NASA, 2019).

INPS Management

LaRC is not currently implementing targeted INPS control activities, but potential management approaches are being evaluated and the Grounds Maintenance and Pest Control contractor may address INPS as they are encountered during routine maintenance. One targeted management option is to focus initial efforts on INPS with high invasiveness potential that are localized and could potentially be eliminated, such as tree-of-heaven, winged euonymus (*Euonymos alatus*), Chinese privet (*Ligustrum sinense*), and Johnson grass (*Sorghum halepense*) (NASA, 2023). Common reed is more widespread and is difficult to control, as mechanical removal (i.e., cutting, mowing, and disking) encourages its spread—the rhizomes remain, and new plants rapidly emerge. The recommended action is to apply herbicides to stands of common reed and follow with mechanical removal of dead stalks (NASA, 2019). Although LaRC does not currently manage *Phragmites*, the Center does try to minimize its spread by cleaning equipment, disposing of it in the garbage, and avoiding ground disturbance where it is present. The fact sheet for invasive, nuisance, and protected species at LaRC provides photographs and best practices for INPS management (Appendix F: Natural Resource Fact Sheets).

4.8 Special Status Species Management

4.8.1 Resource Description

The determination of special status species occurrence at LaRC was based on surveys conducted at the Center (NASA, 1995; NASA, 2009; NASA, 2023), in combination with the species list provided by a USFWS Information for Planning and Consultation (IPaC) report run for LaRC (USFWS, 2023) and the Species of Greatest Conservation Need, as listed in the *Virginia Wildlife Action Plan*, that may occur at LaRC (https://dwr.virginia.gov/wildlife/wildlife-action-plan/) (Table 4.8.1-1). No Federally designated critical habitat is present at the Center.

Although no listed species were observed during the 2023 field survey, LaRC likely provides habitat for some transient special status avian species on a seasonal basis. With its extensive open water areas and associated tidal flats, creeks, and marshes, the Chesapeake Bay is a major migratory flyway and provides important waterfowl nesting and wintering habitat. LaRC is located within Bird Conservation Region 30—New England/Mid-Atlantic Coast. MBTA Birds of Conservation Concern (BCC) that potentially use LaRC can be found at the USFWS Web site for BCC and are listed in the IPaC report run for LaRC. During

the 2023 survey, 5 bird species were identified that are on the USFWS BCC list and 14 species (11 bird and 3 reptile species) are listed as Species of Greatest Conservation Need for Virginia (NASA, 2023).

Table 4.8.1-1. Special Status Species with Potential to Occur at LaRC

Scientific Name	Common Name	Habitat[a]	Occurrence	Level of Protection	
				State	Federal
Amphibians					
Ambystoma mabeei	Mabee's salamander	Forested areas near ephemeral wetlands	Has not been documented onsite, but LaRC has potential habitat	T	-
Birds[b]					
Ammodramus henslowii	Henslow's sparrow	Grasslands and wetlands	Observed during 1994 survey but not in 2009 or 2023 surveys	T	-
Falco peregrinus	Peregrine falcon	Coastline areas	Has not been documented onsite, but LaRC has potential habitat	T	-
Haliaeetus leucocephalus)	Bald eagle	Forested areas adjacent to large water bodies	Have been observed hunting in marsh habitat on north end of LaRC	-	BGEPA
Laterallus jamaicensis ssp. jamaicensis[c]	Eastern black rail	Tidal marshes and grass	Has not been documented onsite, but marsh habitat on the north end of LaRC is potential habitat	E	T
Sterna nilotica	Gull-billed tern	Salt marshes and sandy beaches	Observed during 1994 survey but not in 2009 or 2023 surveys	T	-
Insects					
Danaus plexippus[c]	Monarch butterfly	Grasslands	Observed onsite in grassy fields	-	C
Mammals					
Myotis septentrionalis[c]	Northern long-eared bat	Roosting: oak, maple, and understory species (i.e., sassafras [*Sassafras albidum*], redbud [*Cercis canadensis*]) Upland forest live or dead trees in cavity, crevices, and under bark Foraging: cluttered conditions under forest canopy in uplands (paths, edges, harvest areas)	Have not been documented onsite, but forested areas and human structures at LaRC are potential habitat	T	E
Perimyotis subflavus[c]	Tricolored bat	Roosting: deciduous forest, especially in oaks	Have not been documented onsite, but forested areas at LaRC are potential habitat	E	PE

Table 4.8.1-1. Special Status Species with Potential to Occur at LaRC (continued)

Scientific Name	Common Name	Habitat[a]	Occurrence	Level of Protection	
				State	Federal
		Upland or riparian live or dead trees; found in dead (seldom live) leaf clusters Foraging: forested streams with open spaces, edge habitats, uplands, and bottomlands			
Plants					
Asclepias purpurascens	Purple milkweed	Sandy soils in prairies and dry open woodlands	Has been documented onsite along roadside	-	-
Reptiles					
Crotalus horridus	Canebrake rattlesnake	Forests and cane thickets with logs or leaf litter	Has not been documented onsite, but potential habitat is present	E	-
Malaclemys terrapin terrapin	Northern diamond-backed terrapin	Exclusively estuarine, brackish water, saltwater estuaries, and tidal marshes. May nest in sandy soils or fill dirt.	Observed at stormwater outfalls and tidal marshes; one instance of nesting behavior at B1256 demolition site	SGCN - Tier 2a	-

Sources: (NASA, 2023; USFWS, 2023)
Notes:
(a) No critical habitat has been designated on LaRC for any Federally listed species.
(b) All wild birds in the United States, except resident game species and non-native species, are protected under the Migratory Bird Treaty Act. LaRC may provide habitat for transient Federally listed avian species on a seasonal basis.
(c) Species is listed on IPaC report for LaRC.
Key: - = not listed; BGEPA = Bald and Golden Eagle Protection Act; C = candidate; E = endangered; IPaC = Information for Planning and Consultation; LaRC = Langley Research Center; PE = proposed endangered; SCGN = Species of Greatest Conservation Need; T = threatened.

Identified locations and additional information on special status species are provided in the 2023 *Survey of Biological Resources and Threatened and Endangered Species at Langley Research Center* (NASA, 2023). The fact sheet for invasive, nuisance, and protected species at LaRC provides photographs and best practices for protected species (Appendix F: Natural Resource Fact Sheets).

4.8.2 Management Activities

LaRC focuses on the protection of special status species through restrictions on activities that may impact their habitats, primarily through avoidance. Personnel managing projects or performing modifications to real property, landscaping, or other vegetation that may impact valuable habitats (i.e., wetlands) must coordinate with the EMO and the NRM prior to performing any activity in these areas to ensure that the activity is properly evaluated, and potential negative impacts are minimized.

Determination of the potential for special status species to be affected occurs as part of a project's NEPA review (see Section 1.3.3, Environmental Planning Process). As necessary, NASA conducts analyses

and consultations with the USFWS or other regulators and communicates resulting requirements to project proponents (see Appendix C: Key Natural Resources Laws, Regulations, and Policies). Implementation of project-specific requirements is primarily the responsibility of project proponents while they are conducting their activity. As much as possible, the Natural Resources Program provides in-person briefings on natural resource requirements identified during the NEPA review, including preconstruction briefings with construction crews. These briefings provide an opportunity to review operations, species locations, and requirements prior to project initiation and to make adjustments or conduct species surveys as necessary. Additionally, LaRC personnel and contractors are instructed to contact the EMO if any of the species listed in Table 4.8.1-1 are sighted.

LaRC has a registered monarch butterfly (*Danaus plexippus*) waystation/pollinator garden near the LaRC Garden Club (Figure 8, Appendix A: Figures). Such waystations provide milkweed (*Asclepias* spp.) and other flowering plants that monarchs require for larval hosts and nectar (https://www.monarchwatch.org/waystations/). This site includes an informational sign and is maintained by volunteers.

If a bald eagle (*Haliaeetus leucocephalus*) roost becomes established at NASA LaRC, signs advising people to remain clear of the area should be placed 183 meters (200 yards) from the roost, and further coordination with the USFWS and the VDGIF should occur to ensure all conservation recommendations are being followed. To avoid disturbing nesting bald eagles, the VDGIF *Management of Bald Eagle Nests, Concentration Areas, and Communal Roosts in Virginia: A Guide for Landowners (2012)* recommends 1) keeping a distance between the activity and the nest (distance buffers), 2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and 3) avoiding certain activities during the breeding season (VDGIF, 2012). Therefore, the attraction of additional bald eagles to the NASA LaRC property is not encouraged, as that may conflict with the implementation of BASH initiatives on LAFB (NASA, 2019).

Another concern regarding birds onsite is the MBTA restriction on disturbing migratory birds and their active nests unless properly permitted by the USFWS. Ospreys and other migratory birds are protected under the MBTA. It is unlawful to take, kill, or possess any migratory bird, including active nests and eggs. A nest is considered active only when eggs or young are present. Osprey nests are commonly found around LaRC and can disrupt operations or research missions if there are eggs or young osprey present in the nest. Migratory bird nests can be removed without a permit if the nest is inactive. An inactive nest is defined as a nest without any eggs or dependent (flightless) young and includes nests

under construction. In most instances, osprey nests are considered inactive from September 16 through April 1. Any bird nest that interferes with LaRC activities should be reported to the NRM to assess the status of the nest and determine subsequent actions (i.e., nest protection, contact licensed wildlife rehabilitator) (NASA, 2019). The LaRC Migratory Bird Management fact sheet provides photographs and life history information for some of the migratory bird species that may be encountered at LaRC, as well as applicable regulations and requirements (Appendix F: Natural Resource Fact Sheets).

LaRC requires that tree clearing projects with the potential to affect nesting bats adhere to time of year restrictions and be observant for potential nests. As needed, the NRM consults with the USFWS for potential impacts and necessary mitigations. Species of particular concern include the rare northern long-eared bat (*Myotis septentrionalis*) and tricolored bat (*Perimyotis subflavus*), which may forage and nest onsite in the spring, summer, and fall. The fact sheet for invasive, nuisance, and protected species at LaRC provides some best practices for protected species, such as the requirement to coordinate with the NRM on activities proposed in or near habitats where these species may occur, including maintenance activities and landscaping modifications (e.g., tree/shrub removal) (Appendix F: Natural Resource Fact Sheets).

Beyond project-specific reviews and impact avoidance, ongoing management activities, such as nuisance species and INPS control and tree planting, are beneficial to special status species by improving the habitats that support them (see Section 4.7, Nuisance and Invasive Non-Native Species Management, and Section 4.6, Vegetation Management).

4.9 Coastal Resource Management

4.9.1 Description

The Coastal Zone Management Act (CZMA) addresses actions affecting coastal zones and requires that Federal actions be consistent with state and local coastal zone management plans. The Virginia Coastal Zone Management Program oversees activities occurring in or affecting its coastal zone and is based on a network of agencies implementing a set of statutes protecting coastal resources. The VDEQ coordinates state review of activities affecting coastal zone resources for consistency with the program. This authority is referred to as “Federal Consistency.” Federal activity in a coastal zone requires preparation of a Coastal Zone Consistency Determination (see Appendix C: Key Natural Resources Laws, Regulations, and Policies).

4.9.2 Management Activities

Activities and projects at LaRC must be carried out in a manner that is consistent to the maximum extent practicable with CZMA applicable enforceable policies. LaRC must submit a Coastal Zone Consistency Determination to VDEQ in the early planning stages for any activity that has reasonably foreseeable coastal effects. Because any action at LaRC that directly affects the coastal zone would also be subject to NEPA, any necessary consistency review is addressed in the NEPA documentation submitted to the State Clearinghouse for review. NASA activities at LaRC that are likely to require consistency determinations include the following:

- Any project subject to state or Federal dredge and fill permitting review;
- Any point or new nonpoint source discharge to surface waters; and
- Major industrial expansion or development projects.

4.10 Bird/Wildlife Aircraft Strike Hazard (BASH) Management

4.10.1 Description

The purpose of a BASH management program is to identify and mitigate bird and other wildlife hazards to air operations. The JBLE BASH Plan details management and control measures for wildlife and vegetated areas within the flight line area to minimize impacts to aircraft (U.S. Air Force, 2019). JBLE contracts with the USDA-WS to manage its BASH program.

4.10.2 Management Activities

Located adjacent to JBLE-Langley's airfield, LaRC must maintain awareness of how onsite activities could contribute to BASH concerns at the airfield. Vegetation control at Outfall 001 (and upland ditch) is a key management activity to limit BASH issues. Since deer freely travel between JBLE and LaRC, especially at the taxiway/runway areas, a partnership already exists for JBLE/USDA-WS personnel to cull deer on NASA property. LaRC has a no-cost agreement with the USAF for BASH geese mitigation and deer surveys and culls**.** It is recommended that NASA LaRC work with JBLE to ensure that any efforts to attract birds to the Center would not conflict with the BASH program.

As needed to reduce safety and health concerns and reduce BASH risk, USDA-WS conducts Canada goose dispersal and lethal removal at NASA LaRC (see Section 4.7, Nuisance and Invasive Non-Native Species Management). If deemed necessary, additional management concepts described in the JBLE BASH Plan would be incorporated at NASA LaRC and be implemented by USDA-WS.

4.11 Wildland Fire Management

4.11.1 Description

Wildland fire management includes both prescribed fire and wildfire response. Prescribed fire is a management tool that has a variety of applications in natural resources management. Most commonly, prescribed fire is used to control hazardous fuel loads (i.e., accumulated vegetation) and improve habitat quality through the control of undesirable vegetation, such as INPS. Prescribed burning should only be conducted by trained and experienced personnel. Due to the safety and liability issues associated with burning, extensive planning and coordination is required to ensure compliance with all applicable Federal, state, and local laws and regulations, as well as NASA policies. Additionally, the impact on all resources should be considered, including, but not limited to, wildlife, protected species and habitats, forest cover type, riparian areas, air quality, and aesthetics.

4.11.2 Management Activities

Although NASA does not conduct prescribed burns on LaRC, due to the risk of wildfires, this NRMP includes discussion of wildland fire. There are no formal agreements or protocols for wildland fires at LaRC. The typical approach for ensuring wildland fire coverage for a property the size of LaRC would be the development of Memoranda of Agreement or Mutual Aid Agreements with nearby organizations with wildland fire capabilities. In the event of a wildfire onsite, the NASA LaRC Fire Department would respond, with support from the City of Hampton as needed.

Prescribed fire has been considered for common reed control, but burns do not appear to reduce the growing ability of the common reed unless the roots are burned, and the common reed can cause spot fires more than 30.5 meters (100 feet) away from the primary burn area. It is difficult to successfully burn the roots because a layer of mud, soil, and/or water usually covers the rhizomes. While burning does destroy dead stalks, providing other vegetation an opportunity to grow, it also encourages rapid new growth from the unaffected rhizomes. For these reasons, fire is not currently being used for common reed control (NASA, 2019).

4.12 Outreach and Education

4.12.1 Description

Outreach and education related to natural resources cover topics such as the importance of wetlands, threats from INPS, interactions with young or injured wildlife, and issues with feeding wildlife.

4.12.2 Management Activities

LaRC currently distributes information on environmental topics and issues through methods including, but not limited to, environmental training, safety briefings (i.e., Safety Share), internal and public facing LaRC environmental Web sites, signs, and periodic outreach and special events. Environmental education related to natural resources is provided to onsite personnel and contractors on an as-needed basis. Other outreach and education activities include:

- Public education on good wildlife practices (e.g., avoid deer, don't feed cats);
- Langley Garden Club—opportunity for outreach;
- Availability of gardening plots for retirees to rent;
- Wildlife Stars: quarterly distribution of conservation information on the LaRC public facing Web site;
- Articles on TMDLs and Chesapeake Bay; and
- Periodic environmental training of onsite personnel and contractors.

NASA LaRC utilizes its public environmental Web site to make citizens and property owners aware of the sensitive nature of the habitats at the Center and ways that they can reduce impacts to these ecosystems. One additional area for outreach is increasing awareness of LaRC's Tree City USA designation by updating signage around the Center.

For Earth Day, LaRC EMO hosts virtual events or promotes events sponsored by EMD. NASA LaRC also partners with JBLE-LAFB on activities such as litter cleanups, Clean the Bay Day, shoreline plantings, nature trail restoration, and building frog ladders for stormwater catch basins.

LaRC has developed a comprehensive community relations program under the Center's Superfund program. Since 1993, NASA LaRC has conducted multiple outreach activities to inform the public about cleanup of contaminated areas at the Center and create avenues for citizen input into the decision-making process. The LaRC Superfund program and related outreach activities are described in the NASA LaRC Community Relations Plan. In addition, LaRC has developed an Environmental Justice Implementation Plan. Both plans outline the Center's community outreach strategies, which help to ensure that outreach efforts continue to target groups that constitute a representative cross-section of the local population (NASA, 2021).

4.13 GIS and Data Management

4.13.1 Description

LaRC has implemented a GIS portal that serves as a valuable resource for geospatial data related to LaRC and facilities management. Current natural resources GIS data are maintained by the LaRC GIS team and incorporated into many planning documents and elements for LaRC, including the Center's Master Plan. Natural resources data layers include mapping of tree locations and health, green infrastructure locations, stormwater mapping and drainage basins, flooding and sea level rise predictions, wetlands, and more.

4.13.2 Management Activities

LaRC has been extremely proactive in developing and utilizing tools to assist in effective environmental management. The GIS portal, which allows data overlay with utility layers and other facility management tools, serves as a valuable resource for the NRM. These tools empower decision making by providing valuable insights for project siting, helping to avoid sensitive areas and minimize adverse impacts on natural resources. Environmental Program Managers are actively involved in facility project design phases, utilizing spatial data to inform decisions related to trees, water resources, vegetation, and habitat areas. Additionally, EMO leverages GIS data to visualize flood-prone areas and assess potential climate change impacts. Interactive tools within the maps are also beneficial. For example, the NRM can utilize the GIS Portal to create a planning map for a reforestation activity that shows project boundaries, topographic information, stormwater flow, and all underground utilities.

Maintaining accurate data is integral to ensuring these tools are effective. Whenever environmental GIS data require updates, the NRM or another environmental Program Manager can submit a ticket to the GIS Team.

4.14 Climate Change and LaRC Natural Resources

4.14.1 Climate

The LaRC area generally has mild winters and warm, humid summers. Daytime high temperatures during the winter are usually near 10 degrees Celsius (°C) (50 degrees Fahrenheit [°F]), with nighttime lows near 0°C (32°F). A maximum temperature of 27°C (81°F) and a minimum temperature of -20°C (-4°F) are the extremes recorded during the winter season. Daytime highs during the summer are usually in the middle to upper 20s°C (80s°F), with nighttime lows generally around 20°C (68°F). Maximum

temperatures up to 40°C (104°F) and minimum temperatures as low as 6°C (43°F) are the extremes recorded during this period (NASA, 2021). The growing season at LaRC is April 1 through October 31.

Precipitation is well distributed throughout the year, with an annual average of 120 centimeters (47 inches). Monthly totals have ranged from less than 0.6 centimeters (0.25 inches) to greater than 38 centimeters (15 inches), with minimums in July and August and maximums in November and April. The highest daily total, 15 centimeters (greater than 6 inches) occurred in September 1972. Nearly 40 days each year have thunderstorm activity, which is close to the average for the state. In winter, some of the precipitation occurs as snow. The average snowfall is about 23 centimeters (9 inches) a year, but total snowfall is extremely variable, ranging from none to nearly 114 centimeters (45 inches).

Hurricanes and other tropical disturbances seldom move close enough to affect LaRC. In most cases, when they arrive in this area, they have decreased in strength to less than hurricane intensity; however, they may still cause considerable damage from high winds and heavy rains. Category II and III hurricanes have been recorded a few times in the last 60 years. Category IV hurricanes have been recorded in the area twice in the last 400 years. Tornadoes are quite rare. Thunderstorms, accompanied by lightning and high winds, are much more frequent and produce the greatest amount of storm damage in the area (NASA, 2021). Nor'easters are more common than hurricanes and have also caused historic damage to LaRC. These storms may occur at any time of the year but are most frequent and most violent between September and April. Nor'easters are typically accompanied by heavy rain or snow and can cause severe coastal flooding, coastal erosion, and hurricane-force winds.

Additional climate descriptions are provided in the LaRC ERD located at https://environmental.larc.nasa.gov/nepa/.

4.14.2 Climate Change Modelling for LaRC

By deploying climate change models for precipitation, temperature, extreme weather events, and other pertinent factors, the NASA Climate Adaptation Science Investigators (CASI2) workgroup established resilience decision indicators for LaRC for use in assessing climate vulnerabilities and developing climate adaptation responses for facilities, operations, and natural areas (see Table 4.14.2-1). The following subsections discuss potential climate change effects and strategies to improve the climate resilience of natural resources on LaRC.

Table 4.14.2-1. LaRC Climate Resilience Decision Indicators and Potential Effects to Natural Resources

Factor	Projected Change	Potential Effects to Natural Resources
Climate zone (American Society for Heating, Refrigeration, and Air-Conditioning Engineers)	Potential zone shift	Habitat transition and modification Species distribution shifts Physiological stress on plants and animals Spread of invasive species Increased competition for water, food, and shelter Water quality degradation Wildfires Vegetation and soil loss Nutrient cycling alteration
Heating degree days	Decrease	
Cooling degree days	Increase	
Number of days with heat index	Increase	
Drought potential	None	
Extreme flood events	Increase	
Water inundation	Increase	

Source: CASI data for LaRC (Controlled Unclassified Data).
Key: CASI = Climate Adaptation Science Investigators; LaRC = Langley Research Center.

4.14.3 Natural Resources and Climate Change Resiliency

As a coastal facility, LaRC faces risks from flooding due to sea level rise and storm surge. Investments in resiliency planning are well underway to meet climate change impacts. Efforts include mapping and modeling for storm surge and sea level rise and the use of these data to plan for storm response, as well as retreating from areas subject to rising sea levels. The Center is also actively monitoring land subsidence and sharing these data with Hampton Roads stakeholders.

The Center's resiliency approach uses natural and constructed green infrastructure with a goal of improving the health of the Back River and the Chesapeake Bay. The first strategy is protecting the existing wetlands and forests that cover more than a third of the site. Additionally, as buildings are removed from areas predicted to be affected by rising sea levels, LaRC is planting and restoring the former building sites at the edges of existing forests and wetlands. To date, about 2 hectares (5 acres) have been reforested, with additional acreage in line for restoration.

To reduce stormwater challenges, the Center has a requirement that new construction cannot increase the overall square footage of the built landscape. Also, any new buildings must be constructed to have a base flood elevation above projected sea level rise. On developed areas of the Center, constructed green infrastructure is being used to capture and treat stormwater runoff. There are more than 30 stormwater management facilities on the campus, including permeable pavement, a green roof, tree-box filters, rain gardens, and bioretention cells. LaRC also requires the use of native plant species, prohibits irrigation or fertilizer use, and stipulates that all trees that are removed must be replaced at a suitable location (in collaboration with the NRM).

Although it appears that there are many potential planting areas for trees on the Center, much of the landscape is reserved for future buildings or has underground utility lines, thus prohibiting tree planting. Instead, the EMO evaluates the possibility of establishing non-tree native habitat in these areas, such as meadow or coastal shrubs, that provide habitat and stormwater benefits, do not conflict with utilities, and can be removed when new development occurs. NASA has already converted approximately 0.8 hectares (2 acres) to meadow/open space and will continue to explore additional opportunities.

As a research institution, NASA LaRC is open to sharing its methods, practices, and lessons learned with the city and other stakeholders in Hampton to be a resource as resiliency work continues across the city. In April 2024, the NASA EMO and Strategic Partnerships Office presented to the Hampton Resilience Team. The Hampton Resilience Team includes Hampton's Community Development Department and the Green Infrastructure Center, with which the City of Hampton is partnering to plan and implement the citywide Natural Infrastructure Resilience Plan. The presentation provided a snapshot of NASA's efforts and lessons learned for coastal resiliency. Topics included Langley's interactive maps and planning tools, green infrastructure development and maintenance, reforestation activities, and other strategic planning initiatives by NASA. The Hampton Resilience Team was impressed by NASA's proactive strategies and requested a tour for city officials and leadership to showcase NASA's efforts and resiliency contributions to the Hampton Roads community. Hampton also is including NASA's ongoing efforts in the city's upcoming Natural Infrastructure Resilience Plan.

5. Recordkeeping and Reporting

5.1 Recordkeeping

To support natural resources management at the Center, the LaRC Natural Resources Program maintains the required records shown in Table 5.1-1. Certain records must be maintained to meet reporting requirements, while other records are solely for NRMP implementation. Recordkeeping requirements are dictated by NPR 1441.1E, *NASA Records Management Program Requirements*, and LaRC-specific requirements. Primary records for natural resources include the NRMP, site-wide and project-specific species and habitat surveys/monitoring (i.e., wetlands, invasive species, special status species), wetland permits, Biological Assessments and Biological Opinions, and correspondence with agencies when seeking their concurrence or approval of a permit.

Table 5.1-1. LaRC Recordkeeping Requirements

Record Name	Purpose/Driver	Record Location
LaRC Natural Resources Management Plan	Endangered Species Act, Clean Water Act	LaRC EMO SharePoint (*Environmental/Programs/Natural Resources* folder)
Endangered Species Act section 7 consultations	Endangered Species Act	LaRC EMO SharePoint (*Environmental/Programs/Natural Resources* folder)
Natural resources surveys (i.e., species status species, habitats, invasive non-native species)	Endangered Species Act	LaRC EMO SharePoint (*Environmental/Programs/Natural Resources* folder)
Wetland delineation surveys	Clean Water Act	LaRC EMO SharePoint (*Environmental/Programs/Natural Resources* folder)
Approved Jurisdictional Determinations	Clean Water Act	LaRC EMO SharePoint (*Environmental/Programs/Natural Resources* folder)
Wetland permits	Clean Water Act	LaRC EMO SharePoint (*Environmental/Programs/Natural Resources* folder)

Key: EMO = Environmental Management Office; LaRC = Langley Research Center; NASA = National Aeronautics and Space Administration.

5.2 Reporting

Table 5.2-1 lists internal and external reporting requirements that support the Natural Resources Program; these are required on either a set frequency or are specifically triggered upon observation or occurrence. This list includes reporting by NASA to outside entities, reporting by certain groups/project managers to the LaRC Natural Resources Program, and reporting that is required from the Center to NASA EMD. For the annual EMD data call, information on special status species, wetlands, and WOTUS will be gathered from IPaC and the NWI database, respectively, as well as additional sources such as onsite surveys and observations. Most ESA section 7 consultations require an annual report summarizing implementation of terms and conditions. LaRC does not currently have any active consultations with the USFWS.

Table 5.2-1. LaRC Reporting Requirements

Report Name/ Data Requirement	Report Recipient	Frequency/ Due Date	Format	Purpose/Driver
Wetlands and Waters of the United States Inventory	NASA Headquarters	Annual/January	NETS	Environmental Management Division requirement
Habitat Inventory				
Special Status Species Inventory				
Invasive and Nuisance Species Inventories				
Tree City USA	Tree City USA	Annual/ December 31	In accordance with guidance at: https://www.arborday.org/programs/treecityusa/	LaRC Natural Resources Management recognition initiative
USFWS Virginia Canada Goose Depredation Permit (JBLE permit MBPER0014753) (Responsible organization: USDA-WS)	USFWS	Annual/As specified by permit requirements	In accordance with permit requirements	71 Federal Register 45964, Nests and Egg Depredation Order
VDWR Official Kill Permit for deer/turkey that pose threats to aircraft (JBLE permit GFK22020314)	VDWR	Annual/As specified by permit requirements	In accordance with permit requirements	Kill permit for deer/turkey that pose threats to aircraft

Key: JBLE = Joint Base Langley-Eustis; LaRC = Langley Research Center; NASA = National Aeronautics and Space Administration; NETS = NASA Environmental Tracking System; USA = United States of America; USDA-WS = United States Department of Agriculture-Wildlife Services; USFWS = United States Fish and Wildlife Service; VDWR = Virginia Department of Wildlife Resources.

Appendix E (Responsibility Assignment RACI Matrix) provides a responsibility assignment matrix illustrating the level of participation by various stakeholders in completing LaRC natural resource reporting requirements, as indicated by these four key responsibility types: Responsible, Accountable, Consulted, and Informed (Table E-1, Responsibility Assignment (RACI) Matrix for LaRC Natural Resources Reporting Requirements).

6. Goals and Objectives

This section provides a consolidated view of the natural resources management direction described in Section 4 (Natural Resources Program Elements). Table 6-1 lists the objectives for each of the LaRC Natural Resources Program goals, along with their associated resource areas and drivers. The goals and objectives in Table 6-1 will be adjusted over time using an adaptive management approach as NASA's mission and the ecological conditions at the Center change.

Table 6-1. LaRC Natural Resources Program Goals and Objectives

Goals	Objectives	Resource Area(s)	Driver(s)[a]
Goal 1. Address natural resources considerations early and efficiently in project planning.	Objective 1.1. Provide timely, comprehensive guidance on natural resource matters associated with a wide variety of facilities and Research and Development activities.	All	Mission Support, Stewardship
	Objective 1.2. Meet with LaRC Strategic Infrastructure Planning Team (SIPT) to incorporate natural resources requirements into the LaRC Master Plan and other planning documents.	All	Mission Support, Resiliency
	Objective 1.3. Evaluate and recommend mitigation strategies for natural resource areas such as trees, wetlands, endangered species, migratory birds, and wildlife.	All	Mission Support, Stewardship
	Objective 1.4. Advocate for a GIS-based Environmental Resource Document to facilitate guidance on natural resource matters at the Center.	All	Mission Support, Resiliency
Goal 2. Foster cooperation with external organizations on natural resources.	Objective. 2.1. Collaborate with external agencies and organizations, including JBLE and the City of Hampton Resiliency Team, to identify opportunities for enhancement of data collection, training, and management activities.	All	Regulatory, Stewardship, Resiliency
	Objective. 2.2. Identify opportunities for participation in local universities, "green" groups, and other local groups.	All	Stewardship
	Objective 2.3. Maintain good working relationship with JBLE/USDA-WS for collaboration on deer and turkey population control and nuisance species management.	Wildlife Mgt., BASH Mgt.	Mission Support, Regulatory, Stewardship
Goal 3. Protect and enhance native habitats and species populations for ecosystem health, water quality improvement, connectivity, and climate resilience.	Objective. 3.1. Conduct biological surveys to document protected species occurrences, identify potential threats (i.e., invasive plants, nuisance animals), and evaluate recommended mitigations.	Protected Species, Wetlands, Invasives	Regulatory, Stewardship
	Objective 3.2. Evaluate LaRC's potential habitat for the northern long-eared bat, tricolored bat, and eastern black rail.	Protected Species	Regulatory, Stewardship
	Objective 3.3. Prioritize areas on Center in need of invasive species control and advocate for management.	Invasives	Regulatory, Stewardship

Table 6-1. LaRC Natural Resources Program Goals and Objectives (continued)

Goals	Objectives	Resource Area(s)	Driver(s)[a]
	Objective 3.4. Work with the Grounds Maintenance and Pest Control contractor to identify and implement measures to protect special status species and habitats, and to prevent the spread of invasive species.	Protected Species, Invasives	Regulatory, Stewardship
	Objective 3.5. Advocate for replacement of missing native landscaping to properly maintain green stormwater infrastructure. Evaluate the landscaping plan to identify opportunities to increase or improve green spaces.	Water, Veg. Mgt.	Regulatory, Stewardship, Resilience
	Objective 3.6. Identify priority areas for habitat protection and enhancement benefiting water quality, migratory species, pollinators, and/or other Federally protected species (e.g., riparian tree planting, wetland buffer expansion/protection).	Protected Species	Regulatory, Stewardship, Resilience
	Objective 3.7. Maintain LaRC Tree City USA certification.	Water, Veg. Mgt.	Stewardship
Goal 4. Minimize negative human-wildlife interactions and ecological impacts of nuisance species.	Objective 4.1. Implement measures to deter birds from resting and nesting on poles, buildings, and other structures that may interfere with NASA missions or cause BASH concerns.	Nuisance Species, Protected Species, BASH Mgt.	Mission Support, Regulatory
	Objective 4.2. Educate LaRC personnel on negative impacts from feral cats; implement measures to discourage feeding feral cats.	Nuisance Species	Stewardship
	Objective 4.3. Increase awareness of migratory bird requirements and potential nuisance species at LaRC by providing readily accessible fact sheets with images.	Protected Species, Nuisance Species	Mission Support, Regulatory, Stewardship
	Objective 4.4. Implement architectural design standards aimed at reducing bird fatalities from glass window collisions and bird colonization on gravel roofs.	Protected Species, Wildlife Management	Mission Support, Stewardship
Goal 5. Improve understanding of natural resources at LaRC.	Objective 5.1. Integrate LaRC-specific natural resources training (i.e., protected species, invasive species, wildlife encounters, migratory bird restrictions, native plantings) into existing Environmental trainings.	All	Mission Support, Regulatory, Stewardship
	Objective 5.2. Educate LaRC personnel on wildlife interactions, concerns, and reporting. Emphasize education in the spring when young wildlife is abundant around facilities.	Protected Species	Mission Support, Regulatory, Stewardship
	Objective 5.3. Identify training opportunities for Natural Resources Manager that support LaRC natural resources management.	All	Stewardship
	Objective 5.4. Participate in the Natural Resources Council and CASI2 workgroup to stay abreast of current natural resources issues and support development of LaRC-specific climate resiliency strategies.	All	Stewardship

Table 6-1. LaRC Natural Resources Program Goals and Objectives (continued)

Goals	Objectives	Resource Area(s)	Driver(s)[(a)]
	Objective 5.5. Include language about natural resources requirements in contracts for onsite work, projects, grounds maintenance, pesticide management, and other activities with the potential to impact natural resources, including a listing of responsibilities; implement process to ensure compliance.	All	Mission Support, Regulatory, Stewardship
	Objective 5.6. Provide training opportunities to the Grounds Maintenance and Pest Control contractor that support LaRC natural resources management.	All	Mission Support, Regulatory, Stewardship

Note:
(a) Regulatory drivers include laws and regulations such as the Endangered Species Act; Clean Water Act; Rivers and Harbors Act; Bald and Golden Eagle Protection Act; Migratory Bird Treaty Act; various Executive Orders related to wetlands, floodplains, invasive species, migratory birds, and climate change; and the Presidential Memorandum for pollinators.
Key: BASH = Bird/Wildlife Aircraft Strike Hazard; GIS = geographic information systems; INPS = invasive non-native plant species; JBLE = Joint Base Langley-Eustis; LaRC = Langley Research Center; Mgt. = Management; NASA = National Aeronautics and Space Administration; SIPT = Strategic Infrastructure Planning Team; USA = United States of America; USDA = United States Department of Agriculture; Veg. = Vegetation.

7. Work Plan and Implementation Monitoring

7.1 Work Plan

To support achievement of the goals and objectives in Table 6-1, LaRC developed a work plan composed of prioritized projects. The priority level for implementation (Priority Level 1, 2, or 3, in order of importance) is determined by the degree to which a project prevents noncompliance with requirements of natural resources laws, regulations, and EOs; enhances protected species conservation and natural resources stewardship; and supports accomplishment of the Center's mission.

- A Priority Level 1 ranking corresponds to projects that are necessary to meet regulatory requirements or are necessary to reduce risk to mission(s) or enable the Center's ability to meet its operational goals, including natural resources management. Projects that would provide a substantial benefit to natural resources, and upon which other projects rely, may also be ranked Priority Level 1.
- A Priority Level 2 ranking corresponds to projects that would have at least a moderate benefit to natural resources and upon which other projects rely or that could reduce risk to mission(s) or would improve the Center's ability to meet its operational goals. The potential consequence for failing to accomplish the project should not be substantial.
- A Priority Level 3 ranking corresponds to projects that would have a minor benefit to natural resources or which could enhance the Natural Resources Program. Failing to accomplish Priority Level 3 projects would not preclude achievement of other projects and would result in only minor, acceptable consequences.

As the management activities implemented at the Center are subject to funding availability and changes in the Center's mission, LaRC plans to focus primarily on Priority Level 1 projects over the five-year period of this NRMP (fiscal year [FY] 2025 to FY 2029). Priority Level 2 projects are further out on the time horizon for funding consideration, as they are either dependent upon accomplishment of Priority Level 1 projects or have a lower priority compared to Priority Level 1 projects. Although Priority Level 3 projects are of lower priority and have no projected timeline, they have been retained to reflect the value of their implementation if applicable funding were to become available. Note that failure to accomplish the projects in Table 7-1 does not necessarily constitute noncompliance with a specific regulation or directive.

Table 7-1. LaRC Natural Resources Program Work Plan

Goal/ Objective #	Projects	Priority Level	Office of Primary Responsibility	Implementation Schedule (FY)	Estimated Cost	Funding Source
1.2.	Project 1.2.1. Incorporate natural resources requirements into the LaRC Master Plan.	1	EMO	FY25	$0	N/A
2.2.	Project 2.2.1. Support the Old Dominion University TickBot research at LaRC. Obtain data annually to share with LaRC stakeholders.	1	EMO	FY25, FY26, FY27, FY28, FY29	$0	N/A
3.2.	Project 3.2.1. Research survey needs for populations of the northern long-eared bat, tricolored bat, and eastern black rail.	1	EMO	FY25	$0	N/A
	Project 3.2.2. Identify and advocate for funding listed species surveys, as needed.	2	EMO	FY26	$20k	EMO
3.5.	Project 3.5.1. Identify and advocate for replacement vegetation in empty landscaping and bioretention beds.	1	COD	FY26	$10k	COD
3.6.	Project 3.6.1. Re-establish volunteer-coordinated maintenance in the Monarch Waystation. Update signage and plant bedding materials, as needed.	2	EMO	FY25	$500	EMO
	Project 3.6.2. Identify and complete a reforestation area (if needed for TMDL credits).	1	EMO	FY28 (Spring)	$15k	EMO
3.7.	Project 3.7.1. Submit Tree City USA application; maintain standards annually.	2	EMO	FY25, FY26, FY27, FY28, FY29	$0	N/A
4.1.	Project 4.1.1. Install an osprey deterrent on speaker system at the traffic circle as a pilot project. Evaluate the device's effectiveness.	3	EMO	FY25	$100	EMO
4.3.	Project 4.3.1. Print, laminate, and distribute fact sheets (Migratory Birds; Invasive, Nuisance, and Protected Species) to Grounds Maintenance and Pest Control Contractor.	1	EMO	FY25, FY27, FY29	$50	EMO
4.4.	Project 4.4.1. Update LaRC architectural design standards for windows and roofs to reduce bird fatal glass window collisions and bird colonization on gravel roofs.	2	EMO	FY25	$0	EMO
5.2.	Project 5.2.1. Educate LaRC personnel on wildlife interactions, concerns, and when to notify the NRM. Emphasize education in the	1	EMO	FY25, FY26, FY27, FY28, FY29	$0	EMO

Table 7-1. LaRC Natural Resources Program Work Plan (continued)

Goal/ Objective #	Projects	Priority Level	Office of Primary Responsibility	Implementation Schedule (FY)	Estimated Cost	Funding Source
	spring when young wildlife is abundant around facilities.					
5.6.	Project 5.6.1. Provide training to the Grounds Maintenance and Pest Control contractor, in conjunction with the LaRC Water Program biannual training.	1	EMO	FY25, FY27, FY29	$0	EMO

Key: $ = U.S. dollar; COD = Center Operations Directorate; EMO = Environmental Management Office; FY = fiscal year; LaRC = Langley Research Center; N/A = not applicable; NRM = Natural Resources Manager; USA = United States of America.

7.2 Implementation Monitoring

The LaRC Natural Resources Program and EMO would internally track project planning and execution (Table 7-1). Any compliance risks would be elevated through the appropriate mechanisms. For most projects, progress would be measured by the amount of acreage treated, planted, or otherwise managed each year. Information to be tracked for each project would include the following, at a minimum: management actions conducted; name of permit, consultation, or plan (if applicable); party that conducted the work; dates of work; spatial data; status of remaining work to be done; and monitoring and sampling protocols employed.

8. References

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Appendix A Figures

This appendix provides overview and resource-specific maps for natural resources at Langley Research Center (LaRC). Where appropriate, a link to the latest LaRC Environmental Resources Document (ERD) is also provided, as the ERD maps are regularly updated.

Refer to *LaRC ERD Figure 1-1, Regional Location,* found at https://environmental.larc.nasa.gov/nepa/.

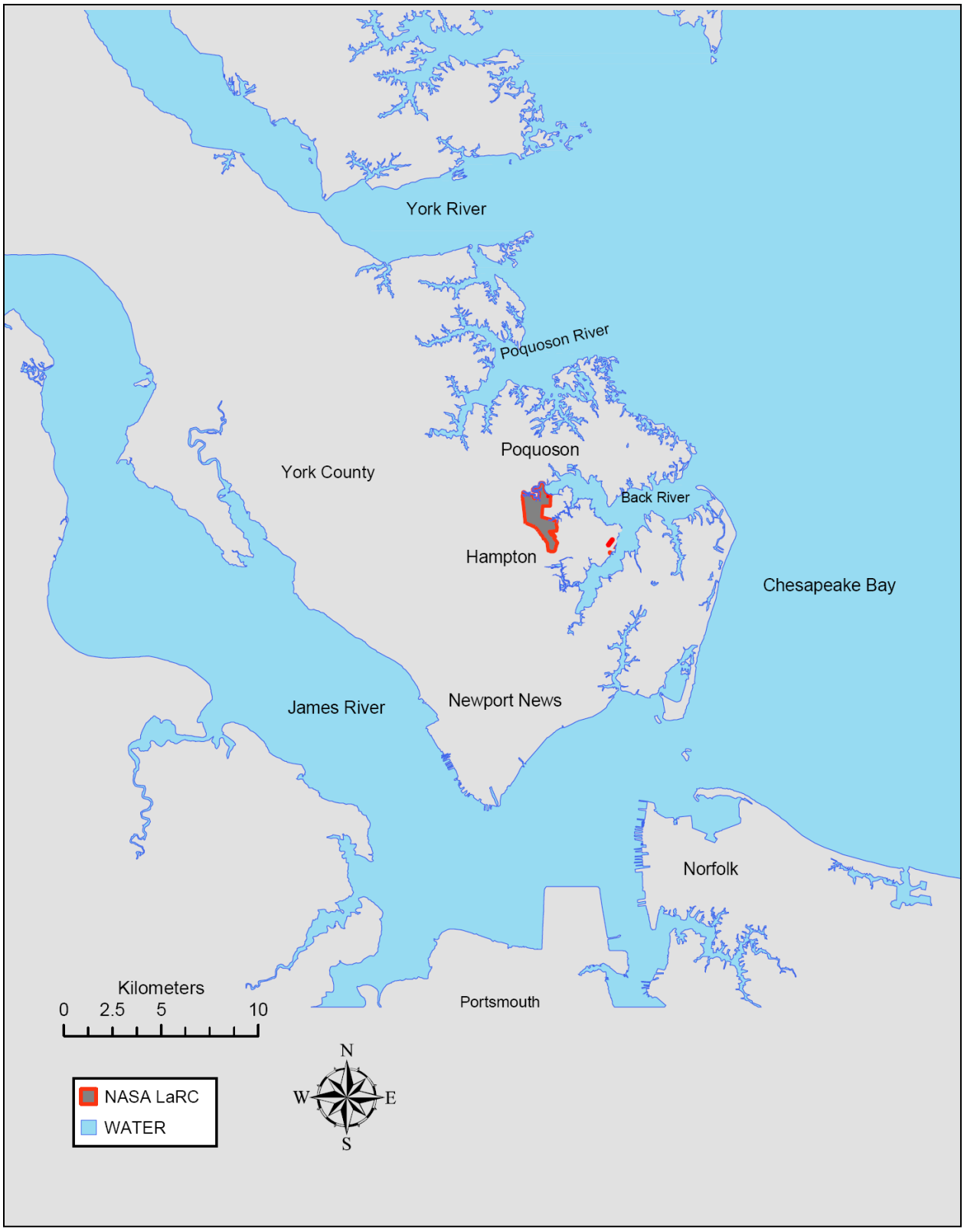
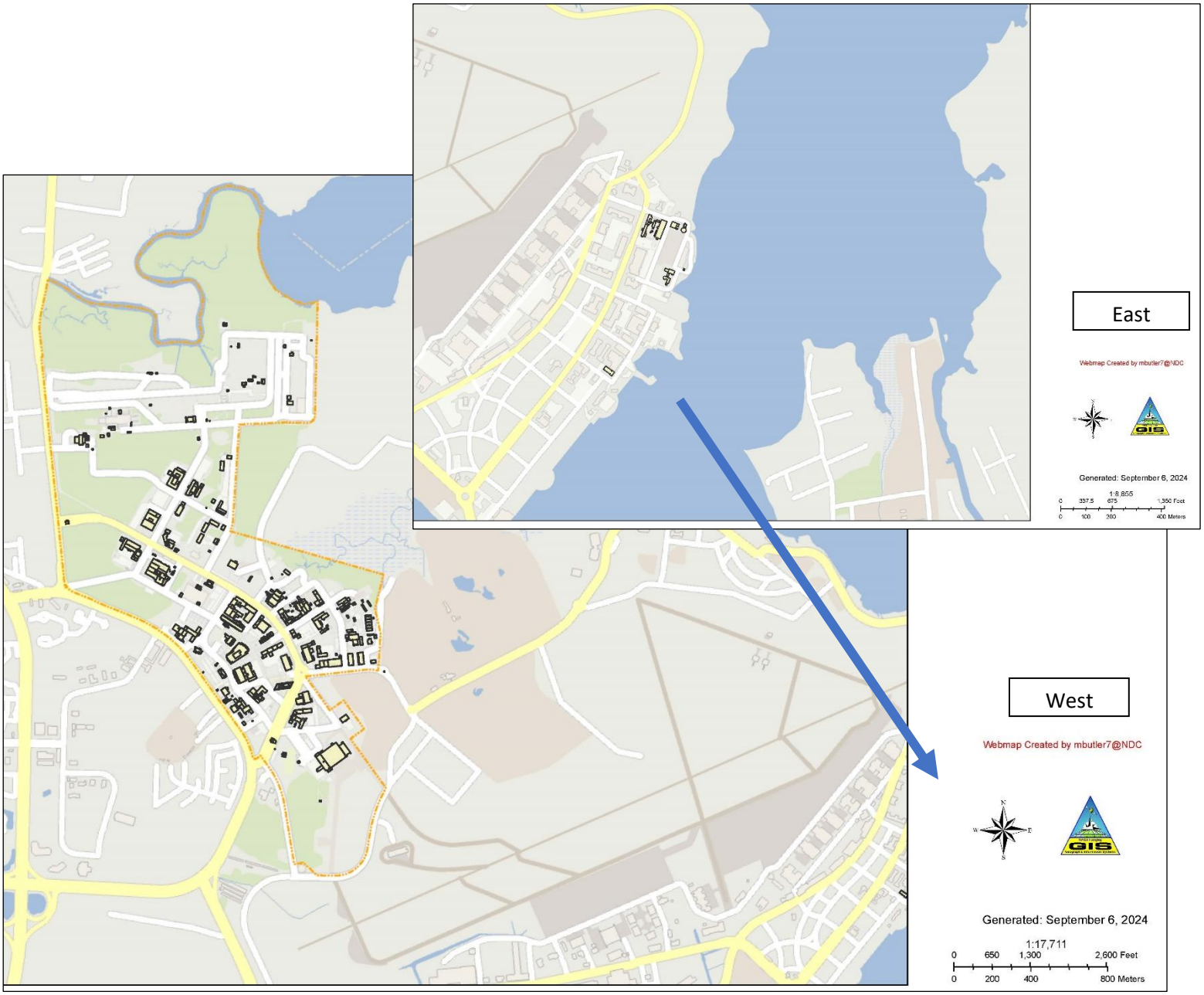


Figure 1. Regional Location of LaRC

Refer to *LaRC ERD Figure 1-2, LaRC West and East Area Overview Map,* found at https://environmental.larc.nasa.gov/nepa/.

Figure 2. LaRC West Area and East Area Overview



Refer to *LaRC ERD Figure 4-4, NASA LaRC Wetlands—West Area,* found at https://environmental.larc.nasa.gov/nepa/.

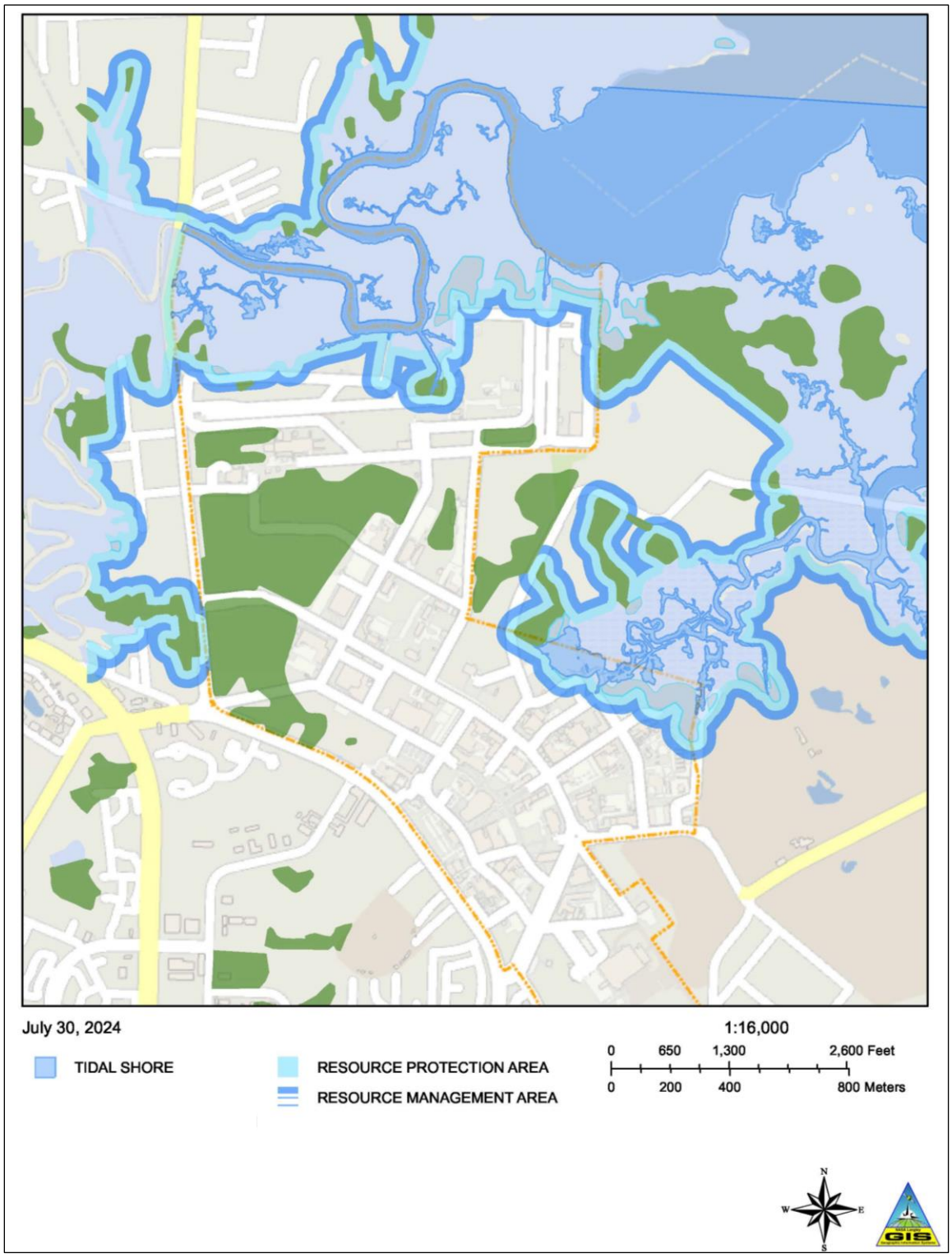


Figure 3. Wetlands at LaRC—West Area

Refer to *LaRC ERD Figure 4-5, Floodplains at LaRC,* found at https://environmental.larc.nasa.gov/nepa/.

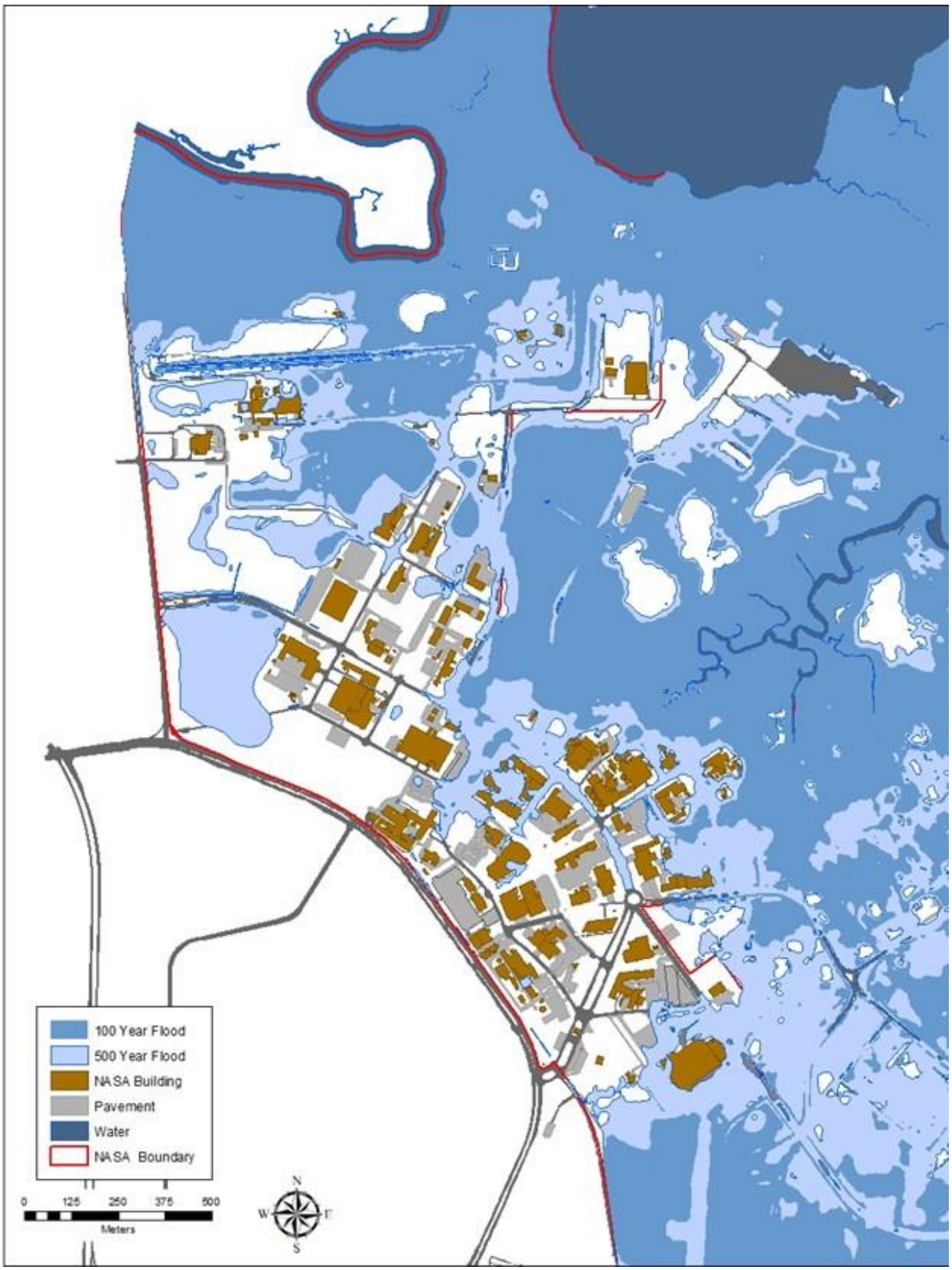


Figure 4. Floodplains at LaRC

Refer to *LaRC ERD Figure 4-3, Land Similar to RPAs and RMAs at LaRC,* found at https://environmental.larc.nasa.gov/nepa/.

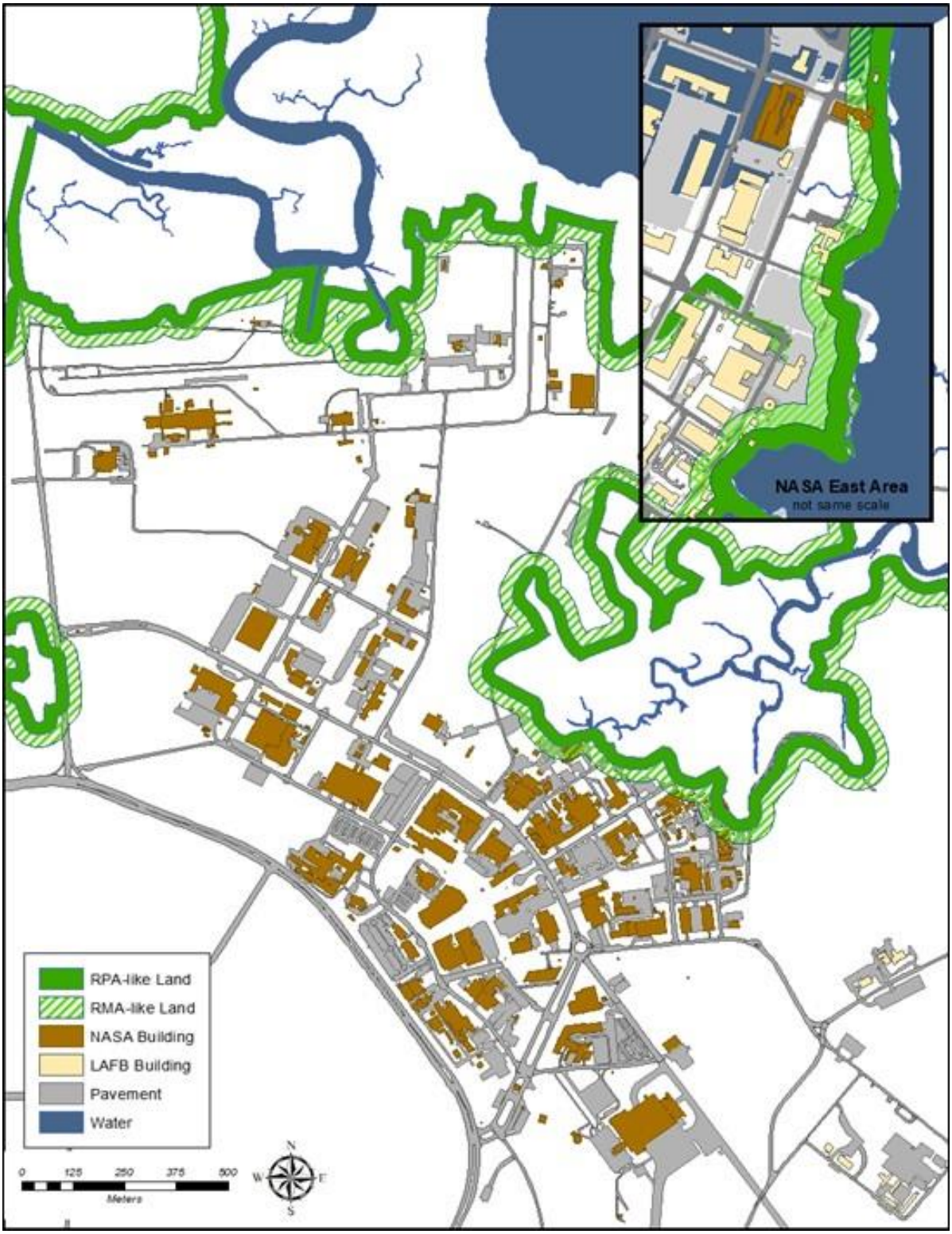


Figure 5. Water Ways and Buffers at LaRC

Refer to *LaRC ERD Figure 16-1, CERCLA Sites at NASA LaRC,* found at https://environmental.larc.nasa.gov/nepa/.

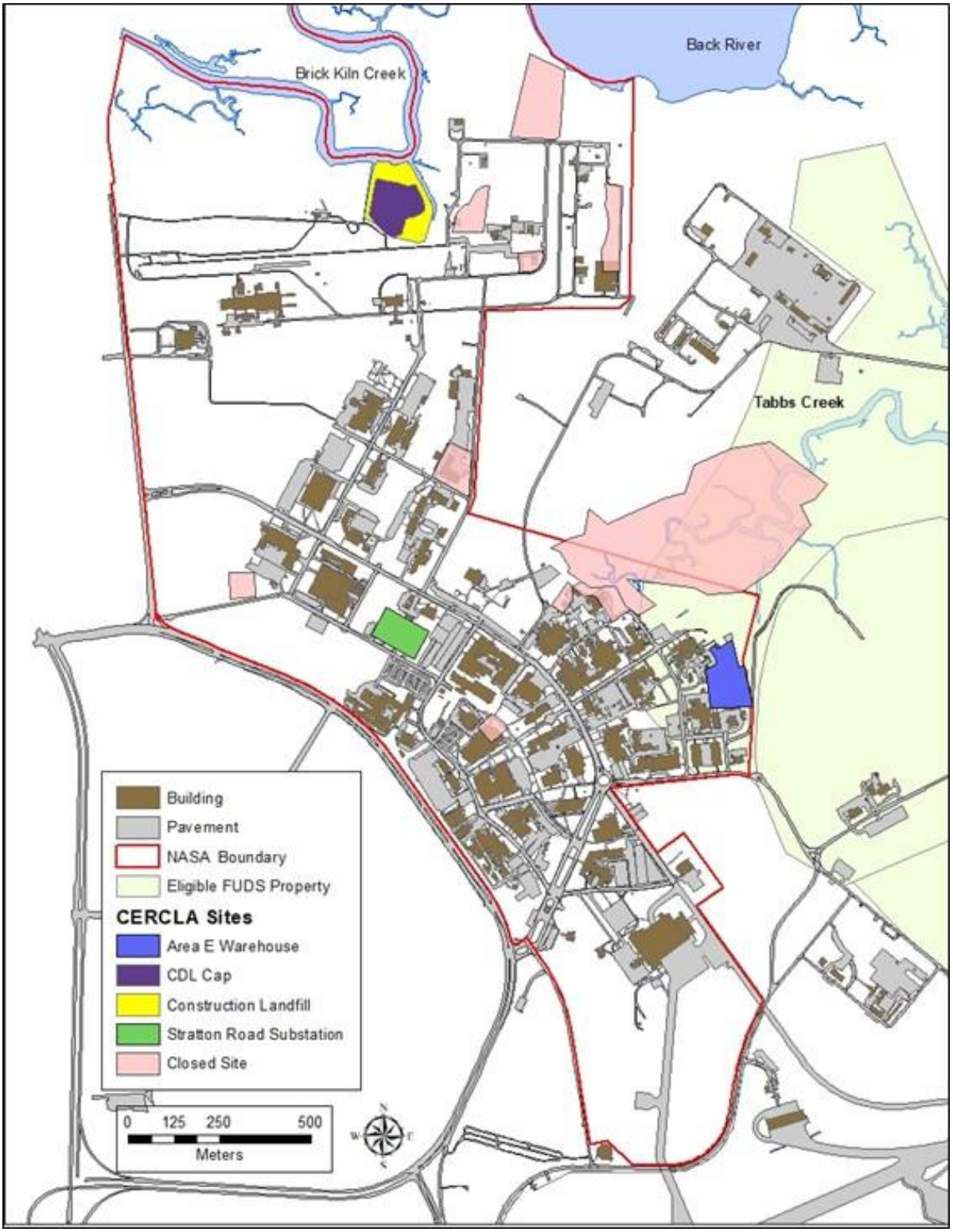


Figure 6. CERCLA Sites at LaRC

Refer to *LaRC ERD Figure 5-1, General Habitat Types,* found at https://environmental.larc.nasa.gov/nepa/. An updated version with minor updates is available in the 2023 *Survey of Biological Resources and Threatened and Endangered Species at NASA LaRC* (Figure 2, 2023 Habitat Classification for NASA LaRC).

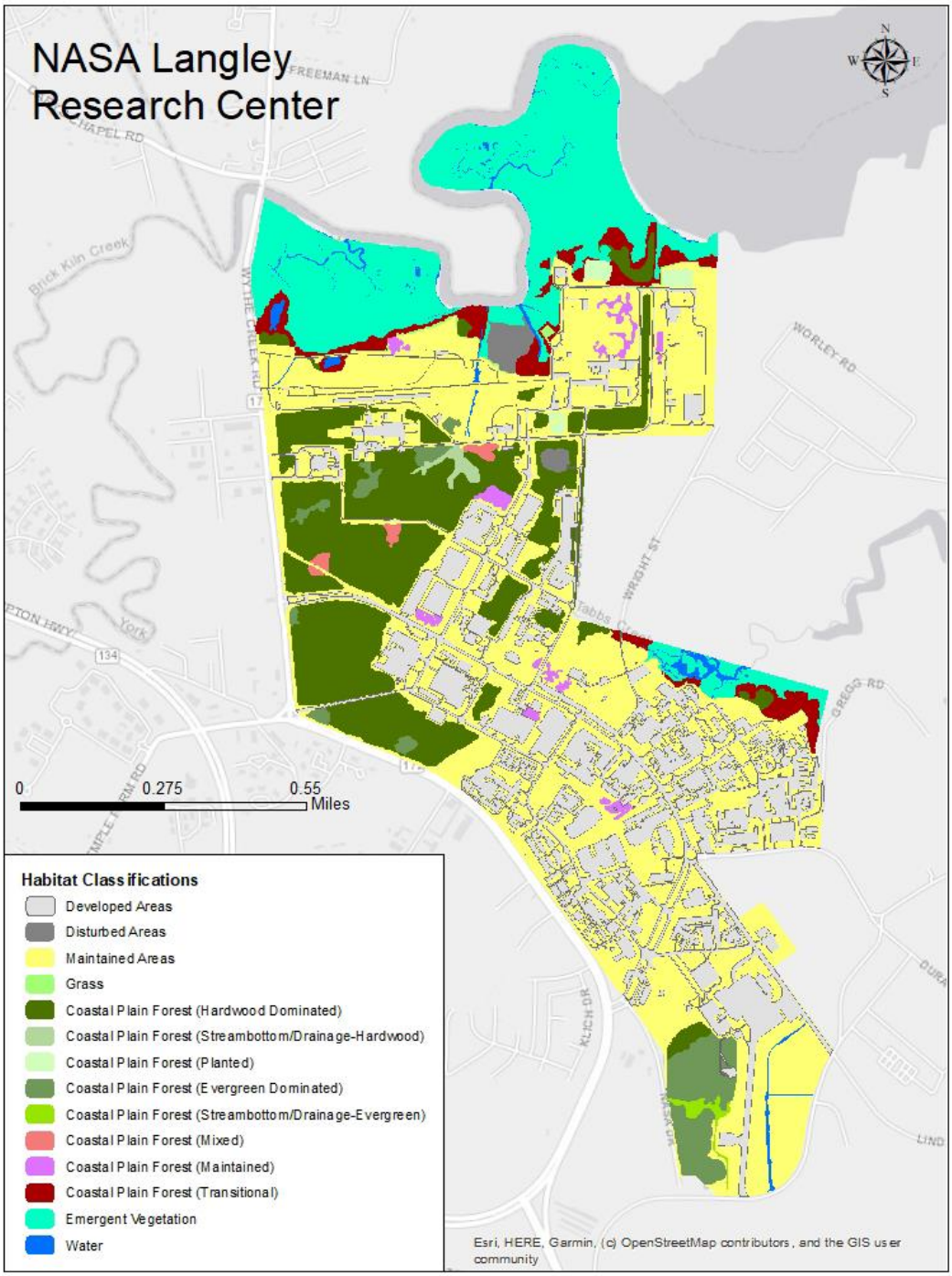


Figure 7. Vegetative Communities at LaRC

Figure 8. Monarch Butterfly Waystation/Pollinator Garden at LaRC

Appendix B Definitions

Bird/Wildlife Aircraft Strike Hazard (BASH or WASH). Safety hazards posed to aircraft due to collisions with wildlife.

Biological Assessment. Document prepared by Federal agencies per section 7(a)(2) of the Endangered Species Act (ESA) 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 U.S. (United States) 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. Document typically includes mandatory terms and conditions to minimize take of listed species.

Candidate Species. Species for which the USFWS or National Marine Fisheries Service has sufficient information on its biological status and threats to propose it as threatened or endangered under the ESA but for which development of a proposed listing is precluded by other higher-priority listing activities.

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 Aspects. Elements of NASA's activities, products, or services that can interact with the environment. These are elements over which NASA has control and which it can manage. Aspects are ranked as high, medium, low, or very low priority.

Environmental Assessment (EA). 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 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. Any change to the environment, whether adverse or beneficial, wholly or partially resulting from NASA's activities (past, present, or future), products, or services. Environmental impacts are changed by the management of environmental aspects. An environmental impact results in or affects safety and health, a natural or cultural resource, a cost to NASA, the NASA mission, reputation or stakeholder relationship, or an environmental legal/regulatory implication.

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.

Environmental Management System (EMS). A system that incorporates people, procedures, and work practices into a formal structure to ensure that the important environmental impacts of the organization are identified and addressed; it promotes continual improvement by regularly evaluating environmental performance, involves all disciplines throughout the Center as appropriate, and actively involves senior management.

Environmental Objective. An overall environmental goal arising from the environmental policy that the Center sets for itself to achieve and that is quantified where practicable.

Environmental Target. A detailed performance requirement, quantified where practicable, established to meet the environmental objectives.

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. Areas of land that are prone to flooding and are typically the lowland and relatively flat areas adjoining inland and coastal waters. The base floodplain shall be used to designate the 100-year floodplain (flood that has a 1 percent chance of being equaled or exceeded in size in any given year). The critical action floodplain is defined as the 500-year floodplain (flood that has a 0.2 percent chance of being equaled or exceeded in size in any given year). A critical action is any activity for which even a

slight chance of flooding would be too great, such as storing highly toxic materials. The 100-year and 500-year floodplains are mapped on Federal Emergency Management Agency Flood Insurance Rate Maps.

Groundwater. The water present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of groundwater.

Integrated Pest Management. A coordinated approach to pest control intended to prevent unacceptable levels of pests, while causing the least possible hazard to people, property, and the environment and using the most cost-effective means.

Invasive Non-Native Species. An introduced organism that becomes overpopulated and harms its new habitat, causing ecological, environmental, and/or economic damage.

Jeopardy Opinion. A specific type of Biological Opinion produced by the USFWS as a result of a formal, interagency, section 7 consultation, which states that the proposed action is reasonably expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

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 approving or authorizing is a tenant. In that case, the NEPA proponent may be a tenant.

Nuisance Species. A vertebrate or invertebrate animal, pathogen, parasite plant, weed, or similar or allied organism that can cause disease or damage to crops, trees, shrubs, grasses, or other plants or humans, animals, or property and includes both native and non-native species.

Pest. A harmful, destructive, or nuisance insect, fungus, rodent, nematode, bird, snail, weed, or parasitic plant or a harmful animal species that the state director of agriculture, or his authorized representatives, declares to be a pest, except viruses, bacteria, or other microorganisms on or in living animals, including man.

Pesticide. Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest or is intended for use as a plant regulator, defoliant, desiccant, or any nitrogen stabilizer, with certain exceptions.

Prescribed Fire (Prescribed Burning). Intentional ignition of grass, shrub, or forest fuels for specific purposes according to predetermined conditions. Prescribed burns are conducted to enhance and restore habitats, promote and benefit threatened and endangered species that are dependent on fire-adapted ecosystems, aid in control of invasive plants, and aid in control of vegetation or hazardous fuel loads to reduce wildfire threat and protect critical infrastructure.

Proposed Species. Species that has been proposed in the Federal Register for listing under the ESA.

Remediation. Restoration of a site (soil, surface water, or groundwater) that has been contaminated by the release of hazardous substances to the environment.

Special Status Species. Any species that has protections as defined in either the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, or state laws related to protected species.

Storm Surge: Unusual rise of water caused by a storm that is greater than the predicted astronomical tide.

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 permit.

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 1) water saturation, 2) duration of saturation, and 3) vegetation, as defined by the USFWS and the U.S. Army Corps of Engineers. These areas may be inundated by surface water 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, swamps, sloughs, river overflows, wet meadows, and natural ponds.

Waters of the United States (WOTUS). Threshold term in the Clean Water Act that establishes the geographic scope of Federal jurisdiction under the Act. The U.S. Environmental Protection Agency and the U.S. Department of the Army define WOTUS in regulations (https://www.epa.gov/wotus/current-implementation-waters-united-states).

Appendix C Key Natural Resources Laws, Regulations, and Policies

This appendix summarizes key laws, regulations, and policies for the management of natural resources at NASA Centers. Table C-1 at the end of this appendix cross-references each natural resources element with applicable laws, regulations, and policies related to the natural resource.

Water and Soil Resources

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.

Clean Water Act (CWA) – The CWA establishes the basic structure for regulating discharges of pollutants and dredged and fill material into waters of the United States (WOTUS) (see Appendix B: Definitions) and for regulating quality standards for surface waters. The United States (U.S.) Environmental Protection Agency (EPA) and the U.S. Department of the Army define WOTUS in the following regulations (https://www.epa.gov/wotus/current-implementation-waters-united-states). Section 404 (*Permit Programs under CWA*) requires permits for discharge of dredged or fill material into navigable waters or wetlands (see Appendix B: Definitions). As authorized by Section 402 of the CWA, the National Pollutant Discharge Elimination System (NPDES) Permit Program controls water pollution by regulating point sources (i.e., pipe, ditch) that discharge pollutants into WOTUS. Section 401 requires a Water Quality Certification for actions within state waters. The U.S. EPA has delegated its authority to implement and enforce the provisions of Section 303 (*Water Quality Standards and Implementation Plans*) and Section 402 (*National Pollutant Discharge Elimination System*) to the individual states.

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 extent practicable, taken steps to avoid wetland impacts, minimized potential impacts on wetlands, and provided compensation for any remaining unavoidable impacts through appropriate mitigation.

CWA Section 404 requires compliance with several other environmental laws and regulations. The U.S. Army Corps of Engineers (USACE) cannot issue an individual permit or verify the use of a general permit

until the requirements of the National Environmental Policy Act, the Endangered Species Act (ESA), and the National Historic Preservation Act have been met. In addition, the USACE cannot issue or verify any permit until a Water Quality Certification, or a waiver of certification, has been issued pursuant to CWA Section 401.

EO 11988, Floodplain Management – EO 111988 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.

Rivers and Harbors Act of 1899 – Section 10 of the Act requires that fill or excavation within navigable waters be approved by the USACE.

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

Soil and Water Resources Conservation Act – This Act provides the U.S. Department of Agriculture 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 states that before issuance of a permit for the impoundment (with certain exemptions), diversion, or other control or modification of any body of water, consultation is required with the U.S. Fish and Wildlife Service (USFWS) and the appropriate state agency exercising jurisdiction over wildlife resources to conserve those resources.

Energy Independence and Security Act of 2007 – Section 438 identifies requirements to limit the offsite impacts of stormwater runoff from Federal development projects. Regardless of location, if more than 465 square meters (5,000 square feet) of land is being redesigned, reconfigured, or reconstituted in any manner that diverges from the area's current use and composition, Section 438 would be applicable.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – CERCLA, otherwise known as "Superfund," provides the Federal government with authority to regulate and respond to releases of hazardous substances, and to develop long-term solutions for major hazardous waste problems.

Climate Change

EO 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis – This EO highlights the need to use science to improve resilience to climate change impacts, decrease greenhouse gas emissions, and prioritize environmental justice.

EO 14008, Tackling the Climate Crisis at Home and Abroad – This EO calls on agencies to increase resilience to climate change impacts and bolster adaptation, focusing on the most pressing climate vulnerabilities.

Pesticide Use

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Facilities – This Act governs the registration, distribution, sale, and use of pesticides in the United States. In brief, under FIFRA, Federal facilities are required to conduct the following:

- Sell or distribute pesticides only as set forth in Section 12 of FIFRA.
- Properly follow pesticide labeling instructions.
- Use any pesticide under an experimental use permit consistent with the provisions of the permit.
- Ensure that applicators are properly trained and, wherever necessary, certified to use restricted use pesticides and are using appropriate personal protective equipment.
- Properly manage pesticide storage facilities.
- Dispose of pesticide residues and waste in accordance with required and recommended procedures.
- Maintain records of applications of restricted use pesticides, except when applied by a certified applicator who is a private contractor.

Invasive Non-Native Species

EO 13112, Invasive Species, as amended by *EO 13751, Safeguarding the Nation from the Impacts of Invasive Species* – The purpose of this EO is to prevent the introduction of invasive species; provide for their control; and minimize the economic, ecological, and human health impacts that invasive species cause.

Noxious Weed Control and Eradication Act of 2004 – This Act provides for the control and management of non-indigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.

Plant Protection Act – This Act provides for the prevention of introduction of plant pests into the United States or the dissemination of plant pests within the United States.

Pollinators

Presidential Memorandum 79 Federal Register Number 121 (June 24, 2014), *Creating a Federal Strategy to Promote Health of Honey Bees and Other Pollinators* – Section 3 of this memorandum states that future landscaping projects at Federal facilities shall, to the maximum extent appropriate, use plants beneficial to pollinators, limit mowing practices, and avoid the use of pesticides in sensitive pollinator habitats.

Special Status Species and Habitats

Endangered Species Act (ESA) – This Act protects threatened and endangered species of fish, wildlife, and plants and their designated critical habitats. Per section 7(a)(1) of this law, Federal agencies must seek to conserve threatened and endangered species and use their authorities in furtherance of the ESA. Section 7(a)(2) of the ESA requires that Federal agencies consult with the USFWS and/or National Marine Fisheries Service (NMFS) 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.

Migratory Bird Treaty Act (MBTA) – The MBTA 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.

EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds – This Act requires Federal agencies to protect migratory birds and their habitats.

Bald and Golden Eagle Protection Act (BGEPA) – The 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.

Marine Mammal Protection Act (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. Consultation with the NMFS is required for actions that may result in take of a marine mammal.

Essential Fish Habitat (EFH) Provisions of the Magnuson-Stevens Fishery Conservation and Management Act – The Magnuson-Stevens Act promotes the protection of EFH in the review of Federal activities and projects conducted under Federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. NASA must consult with the NMFS for any actions that may adversely affect EFH identified under the Magnuson-Stevens Act.

Coastal Zone Management

Coastal Zone Management Act (CZMA) – This Act was 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 NPDES permits for activities affecting land or water use in coastal zones, unless the permit applicant certifies that the proposed activity complies with the state coastal zone management program.

Coastal Barrier Resources Act – This Act limits Federal expenditures and financial assistance that have the effect of encouraging development on designated coastal barriers.

Additional Applicable Laws, Regulations, and Executive Orders Specific to Virginia and the Chesapeake Bay

- EO 13508, *Chesapeake Bay Protection and Restoration*
- Virginia Wetlands Act
- Virginia Submerged Lands Act
- Chesapeake Bay Preservation Act
- Virginia Water Protection Permit
- Ground Water Management Act of 1992 (Code of Virginia, Title 62.1, Chapter 25)
- Groundwater Withdrawal Regulations through the Groundwater Withdrawal Permitting Program
- Virginia ESA
- Virginia Endangered Plant and Insect Species Act

Table C-1. Key Laws, Regulations, and Policies Related to Natural Resource Management at LaRC

Regulation	Resource Area										
	Wetlands/Floodplains Mgt.	Surface Water/ Groundwater Mgt.	Soils/Geology Mgt.	Fish and Wildlife Mgt.	Vegetation Mgt.	Invasives/Nuisance Species Mgt.	Special Status Species Mgt.	Coastal Resource Mgt.	BASH Mgt.	Wildland Fire Mgt.	Outreach and Education
Clean Water Act	X	X	X		X			X			
EO 11990, *Protection of Wetlands*	X							X			
EO 11988, *Floodplain Management*	X							X			
Rivers and Harbors Act of 1899		X									
Safe Drinking Water Act		X									
Soil and Water Resources Conservation Act		X	X								
Fish and Wildlife Coordination Act		X		X			X				
Energy Independence and Security Act of 2007		X									
Comprehensive Environmental Response, Compensation, and Liability Act	X		X								
EO 13990, *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*	X	X		X		X	X	X			
EO 14008, *Tackling the Climate Crisis at Home and Abroad*	X	X		X		X	X	X			
Federal Insecticide, Fungicide, and Rodenticide Act					X	X					
EO 13112, *Invasive Species* (as amended by EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*)					X	X					
Presidential Memorandum 79 Federal Register Number 121 (June 24, 2014), *Creating a Federal Strategy to Promote Health of Honey Bees and Other Pollinators*					X						
Noxious Weed Control and Eradication Act of 2004						X					
Plant Protection Act						X					
Endangered Species Act							X	X			
Migratory Bird Treaty Act				X	X		X		X		
EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*				X	X		X		X		
Bald and Golden Eagle Protection Act							X		X		
Marine Mammal Protection Act							X				

Table C-1. Key Laws, Regulations and Policies Related to Natural Resource Management at LaRC (continued)

Regulation	Resource Area										
	Wetlands/Floodplains Mgt.	Surface Water/ Groundwater Mgt.	Soils/Geology Mgt.	Fish and Wildlife Mgt.	Vegetation Mgt.	Invasives/Nuisance Species Mgt.	Special Status Species Mgt.	Coastal Resource Mgt.	BASH Mgt.	Wildland Fire Mgt.	Outreach and Education
Magnuson-Stevens Fishery Conservation and Management Act				X			X				
Coastal Zone Management Act								X			
Coastal Barrier Resources Act								X			

Key: BASH = Bird/Wildlife Aircraft Strike Hazard; EO = Executive Order; LaRC = Langley Research Center; Mgt. = management.

Appendix D Additional Management Plans, Agreements, and Key Documents

Table D-1 provides a list of additional management plans, agreements, and documents pertinent to natural resources management at Langley Research Center.

Table D-1. Additional Management Plans, Agreements, and Key Documents for LaRC

Document Title	Location
Consultations and Mitigation Plans	
None currently active	
Memoranda of Understanding/Agreement	
2021 USDA Animal and Plant Health Inspection Service Wildlife Services Form 12A, Work Initiation Document for Wildlife Damage Management. Nuisance Species Management on LaRC	Contact the EMO
Associated Management/Action Plans	
2021 Back River TMDL Action Plan, NASA LaRC, MS4 Permit #VAR040092	https://environmental.larc.nasa.gov/water/back-river-tmdl/
Chesapeake Bay TMDL Action Plan Phase 3, NASA LaRC, MS4 Permit #VAR040092	https://environmental.larc.nasa.gov/wp-content/uploads/sites/26/2023/09/CB-Action-Plan_NASA-LaRC_2023_DRAFT.pdf
Other Key Environmental Documents	
Environmental and Energy Program Manual, Langley Procedural Requirements 8500.1.	Contact the EMO
NASA Langley Environmental Requirements, Section 01 35 40.00 99.	Contact the EMO
2023 Survey of Biological Resources and Threatened and Endangered Species at NASA LaRC (NASA, 2023)	Contact the EMO
2009 NASA LaRC Habitat Classification and Wildlife Survey Report (NASA, 2009)	Contact the EMO
1995 Baseline Biological Survey of Terrestrial and Aquatic Habitats at NASA LaRC, with Special Emphasis on Endangered and Threatened Flora and Fauna (NASA, 1995)	Contact the EMO
Wetland Investigations at NASA LaRC, Hampton, Virginia AMRL Technical Report No. 800 (NASA, 1991a)	Contact the EMO
Wetland Investigations at NASA LaRC, Addendum to AMRL Technical Report No. 800 (NASA, 1991b)	Contact the EMO
Wetland Survey of Forested Lands Adjacent to Buildings 1209, 1250 and 1251 at NASA LaRC, Final Report, AMRL Technical Report No. 891 (NASA, 1992)	Contact the EMO
Wetlands Delineation Survey, NASA LaRC, Hampton, Virginia (NASA, 2005)	Contact the EMO
2019 Integrated Natural Resources Management Plan, NASA LaRC (NASA, 2019).	Contact the EMO

Key: AMRL = Applied Marine Research Laboratory; EMO = Environmental Management Office; LaRC = Langley Research Center; MS4 = Municipal Separate Storm Sewer System; NASA = National Aeronautics and Space Administration; No. = Number; TMDL = Total Maximum Daily Load; USDA = United States Department of Agriculture.

Appendix E Responsibility Assignment RACI Matrix

A RACI Matrix is a responsibility assignment matrix that illustrates the level of participation by various stakeholders in completing tasks or deliverables for a project, process, or program. RACI is an acronym derived from four key responsibility types: 1) Responsible, 2) Accountable, 3) Consulted, and 4) Informed. Natural resources work at NASA often requires the integration of multiple organizations and may be supported by individuals performing multiple and disparate roles across projects. The RACI matrix serves as a tool to clarify and define roles and facilitate coordination in a complex project environment.

R (Responsible) – Those who do the work to achieve the task.

A (Accountable) – The one ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible.

C (Consulted) – Those who have a stake in the project outcome due to potential impacts to their work; these stakeholders often provide input and feedback throughout the project.

I (Informed) – Those who receive information on project progress but do not require detailed involvement or need to be consulted.

Table E-1 is a RACI matrix for natural resource reporting requirements at Langley Research Center. Table 5.2-1 lists the drivers for each of the reporting requirements shown in Table E-1.

Table E-1. Responsibility Assignment (RACI) Matrix for LaRC Natural Resource Reporting Requirements

Process or Task	NRM	Water Resources Manager	EMO Director	Grounds Maintenance and Pest Control	Facilities Department	LAFB	USDA-WS	NASA EMD
Annual Reporting to EMD for LaRC Wetlands and Waters of the United States	R	C	I	-	-	-	-	A
Annual Reporting to EMD for LaRC Habitats	R	-	I	-	-	-	-	A
Annual Reporting to EMD for LaRC Special Status Species	R	-	I	-	-	-	-	A
Annual Reporting to EMD for LaRC Invasive and Nuisance Species	R	-	I	C	-	-	C	A
Annual Tree City USA Report/Application	R	-	A	C	I	-	-	-

Table E-1. Responsibility Assignment (RACI) Matrix for Select LaRC Natural Resource Reporting Requirements (continued)

Process or Task	NRM	Water Resources Manager	EMO Director	Grounds Maintenance and Pest Control	Facilities Department	LAFB	USDA-WS	NASA EMD
Annual Reporting for Canada Geese Permit	C	-	I	-	I	A	R	-
Annual Reporting for Deer and Turkey Kill Permit	C	-	I	-	I	A	R	-

Key: A = Accountable; C = Consulted; EMD = Environmental Management Division; EMO = Environmental Management Office; I = Informed; LAFB = Langley Air Force Base; LaRC = Langley Research Center; NASA = National Aeronautics and Space Administration; NR = Natural Resources; NRM = Natural Resources Manager; R = Responsible; USA = United States of America; USDA-WS = United States Department of Agriculture-Wildlife Services.

Appendix F Natural Resource Fact Sheets

Fact sheets were developed for the following key natural resources topics at Langley Research Center:

- Invasive, Nuisance, and Protected Species
- Migratory Bird Protections

These fact sheets are to serve as reference guides for Grounds Maintenance and Pest Control personnel, Facilities managers, and others who may encounter these species. The fact sheets include photographs, descriptions, legal drivers, requirements, and best practices.

National Aeronautics and Space Administration
Langley Research Center (LaRC)

Invasive and Nuisance Species at LaRC

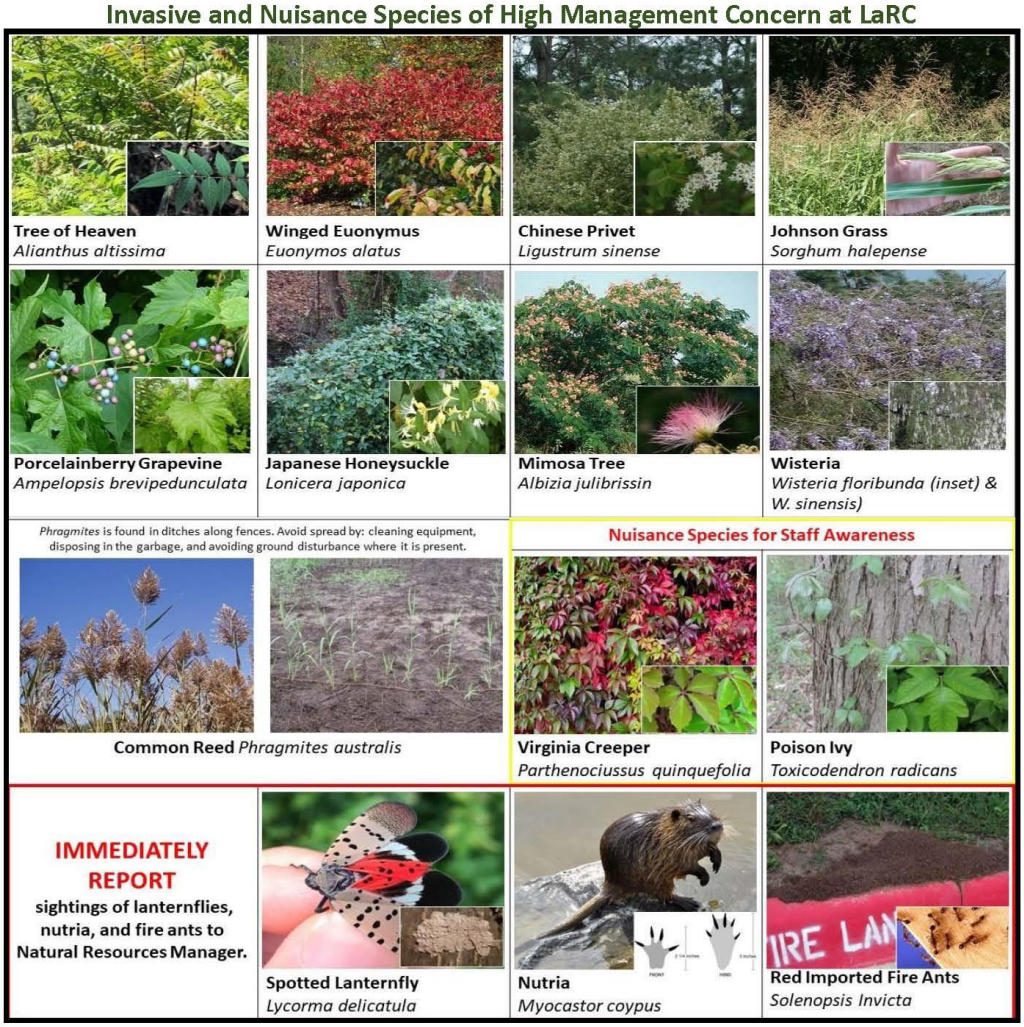
Definitions

Invasive: A non-native species causing economic or environmental harm or harm to humans.
Nuisance: A species causing property damage or management issues, presents a public safety threat, or is an annoyance; can be a native or nonnative species.
Executive Order 13112, Invasive Species: Agencies must take efforts to control invasive species and minimize their impacts.

Best Practices

Invasive and nuisance species disperse rapidly, so early detection and treatment are vital. Minimize activity in infested areas and clean all vehicles and equipment used in these areas. Use certified weed-free fill and landscaping materials to reduce spread. Do not dump weeds and clippings on the ground, dispose in landfill.

Invasive and Nuisance Species of High Management Concern at LaRC



Species-specific control techniques are available at https://dof.virginia.gov/forest-management-health/forest-health/invasive-plants-in-virginia/

Invasive, Nuisance, and Protected Species Fact Sheet, NASA Langley Research Center (LaRC), LaRC NRM: **757-864-4174**

National Aeronautics and Space Administration
Langley Research Center (LaRC)

Protected Species at LaRC

Management Requirements

- Immediately report sightings of protected species to Natural Resources Manager (NRM).
- Coordinate with the NRM on activities proposed in or near places where these species may occur including maintenance activities and landscaping modifications (e.g., tree/shrub removal)
- Do not approach or disturb protected species.
- Receive NRM approval prior to any tree or vegetation removal.
- Habitats may include forested areas, grasslands, tidal marshes, and other wetlands.
- Bats may roost and nest in live or dead trees such as oaks, maples, and understory species such as redbuds.
- Do not disturb active bird nests with eggs or young.

Protected Species that May Occur at LaRC

Eastern Black Rail (SE, FT)
Laterallus jamaicensis

Gull-billed Tern (ST)
Gelochelidon nilotica

Henslow's Sparrow (ST)
Centronyx henslowii

Peregrine Falcon (ST)
Falco peregrinus

DO NOT DISTURB
Nests with eggs or fledglings

Report nest sightings to NRM
Bald eagle nest (BGEPA)

Northern Long-eared Bat (ST, FE) *Myotis septentrionalis*

Tricolored Bat (SE, PE Sept 2024) *Perimyotis subflavus*

Canebrake Rattlesnake (SE)
Crotalus horridus

Diamond-backed Terrapin (SGCN) *Malaclemys terrapin*

Purple Milkweed
Asclepias purpurascens

Monarch Butterfly (FC)
Danaus plexippus

Mabee's Salamander(ST)
Ambystoma mabeei

REGULATORY COMPLIANCE
Riparian forest restoration supports regulatory compliance with the Clean Water Act at LaRC and habitat for rare plant and animal species and migratory birds protected under any of the following laws/regulations:

- Endangered Species Act
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- Virginia Endangered Species Act
- Virginia Endangered Plant and Insect Species Act

A violation of any state or federal regulation may be punishable by fines or imprisonment

Table Key: ST = State Threatened / SE= State Endangered / FT = Federally Threatened / FE = Federally Endangered / C = Federal Candidate / PFE = Proposed Federal Endangered / EXPN = Experimental Population / BGEPA = protected by the Bald and Golden Eagle Protection Act

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Migratory Bird Protections at LaRC

Migratory Birds

The term *migratory birds* includes almost all wild, native birds found in the United States, excluding the European starling, feral pigeon, house sparrow, and resident game birds (i.e., quail, wild turkey, grouse); game birds are managed by each State.

Legal Protections

Migratory birds are afforded protection under the following:

- Migratory Bird Treaty Act (MBTA)
- Executive Order (EO) 13186: Responsibilities of Federal Agencies to Protect Migratory Birds
- Bald and Golden Eagle Protection Act (BGEPA)
- 4 Virginia Administrative Code (VAC) 15-35. Birds: Incidental Take of Bird Species

Per the **MBTA**, it is unlawful to pursue, kill, capture, hunt, trade, sell, or transport most native bird species found in the United States, including eggs, young, and active nests, without proper authorization from the U.S. Fish and Wildlife Service (USFWS).

EO 13186 directs Federal agencies to avoid or minimize the adverse impact of their actions on migratory birds.

The **BGEPA** prohibits anyone without proper authorization from the USFWS to wound, kill, capture, trap, molest, collect, disturb, shoot at, pursue, poison, sell, buy, or transport bald or golden eagles, including their nests and eggs.

A violation of the MBTA or the BGEPA is punishable by fines and/or imprisonment.

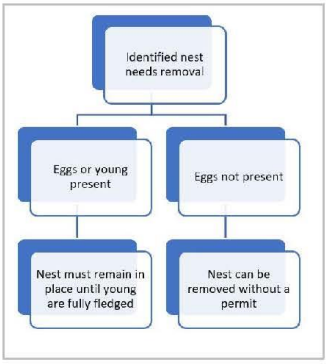
Nests Near Projects or Facilities

If you find a bird nest in your work area, notify the LaRC Natural Resources Manager (NRM) (757-864-4174) before any further action is taken. The MBTA makes it illegal to destroy or disturb nests with eggs or young in them, meaning the removal of an active nest is prohibited, even if it is in an inconvenient location or creating a mess. Typically, a nest is considered active when the first egg is laid and remains active until fledged young are no longer dependent on the nest. You must wait until all young birds have left before you can remove the nest. If waiting is not possible, you must work with the NRM to ensure regulatory compliance. **Personnel must coordinate with the LaRC NRM prior to any nest removal activities.**

Information on fledgling periods and other nesting aspects can be found at: https://nestwatch.org/learn/general-bird-nest-info/nesting-cycle/

Bird Nest Removal Decision Tree

Once a nest is identified, the NRM must be notified immediately. Upon notification, NRM will make decisions regarding the bird nest's removal and notify any applicable parties.



Examples of Nests and Eggs at LaRC


Ground Nest with Killdeer Eggs


Hummingbird Nest (approx. 2 in in diameter)


Gray Catbird Cup Nest with Eggs

Migratory Bird Management Fact Sheet, NASA Langley Research Center (LaRC), LaRC NRM: **757-864-4174**

National Aeronautics and Space Administration
Langley Research Center (LaRC)

Migratory Bird Protections at LaRC

Migratory Birds at LaRC

Below are some examples of birds protected by the MBTA that may be found at LaRC.

Over 1,100 migratory bird species are protected under the MBTA
Find the full species list here:
https://www.fws.gov/law/migratory-bird-treaty-act-1918

Examples of Common Birds Protected by the MBTA

Eastern Bluebird *Sialia sialis*	Gray Catbird *Dumetella carolinensis*	Killdeer *Charadrius vociferus*	Hummingbird *Trochilidae*	Peregrine Falcon *Falco peregrinus*
Red Bellied Woodpecker *Melanerpes carolinus*	Red Tailed Hawk *Buteo jamaicensis*	Red Shouldered Hawk *Buteo lineatus*	Songbirds *Includes warblers, thrushes, finches, sparrows, and vireos.*	

Osprey

Osprey (*Pandion haliaetus*) are a common presence at LaRC, often building sizable nests on tower structures near large bodies of water. Breeding pairs typically repair and use the same nest year after year. Since these raptors can live up to 25 years, nest locations may endure over decades.

Personnel must notify the LaRC NRM if an osprey nest may require removal.

Osprey usually lay eggs in April and incubate them for about five weeks. Young osprey are mostly featherless, taking on a fluffy appearance by the time they fledge around seven to nine weeks after hatching. Fledglings are capable of sustained flight by July, but they typically depend on their parents for up to two more months before striking out on their own.

Adult Osprey	Adult Osprey on Nest	Osprey Chicks	Osprey Fledgling

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