Final

ENVIRONMENTAL ASSESSMENT FOR THE NASA LANGLEY RESEARCH CENTER MASTER PLAN, HAMPTON, VIRGINIA

Lead Agency: National Aeronautics and Space Administration (NASA)

Proposed Action: Implementation of the NASA Langley Research Center Master Plan

For Further Information:

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Date: June 2013

Abstract: NASA is proposing to implement the Master Plan at NASA Langley Research Center (LaRC) located in Hampton, Virginia. LaRC's Master Plan includes a 20-year revitalization strategy that expands and extends the New Town project work already underway and includes constructing new state-of-the-art facilities, renovating critical infrastructure, vacating and/or demolishing non-essential facilities, and performing other general infrastructure maintenance and improvement activities throughout the Center. The overarching goal of the Proposed Action is to sustain or enhance the Center's core capabilities, reduce the Center's footprint, and transform the remaining infrastructure to be energy efficient, sustainable, and adaptable to changing missions and societal needs. These goals are fundamental to ensuring that LaRC remains a critical research and development Center for NASA and the Nation well in to the 21st Century. This Environmental Assessment addresses the environmental impacts associated with the Proposed Action and the No-Action Alternative. The Proposed Action would have both adverse and beneficial impacts on environmental resources. Adverse impacts would be mitigated to the greatest extent practicable to minimize the effects on resources.

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1.0 BACKGROUND INFORMATION AND PURPOSE AND NEED

1.1 Introduction

This Environmental Assessment (EA) for the NASA Langley Research Center (LaRC) Master Plan was prepared in accordance with the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) (42 United States Code (U.S.C.) 4321 *et. seq*.), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (CFR) Parts 1500–1508), NASA's regulations (14 CFR Part 1216 Subpart 1216.3), and NASA Procedural Requirements (NPR) 8580.1A, "Implementing the National Environmental Policy Act and Executive Order 12114." Information contained in this EA would be used by NASA and the appropriate regulatory agencies to facilitate the NEPA decision-making process and to determine if the Proposed Action would significantly affect the quality of the natural or human environment. If the implementation of the Proposed Action is determined not to be significant, the NEPA decision-making process would conclude with a Finding of No Significant Impact.

1.1 Project 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. The cities of Hampton, Poquoson, Newport News, and York County form a major metropolitan statistical area around LaRC. LaRC is located within close proximity to several surface water bodies within the tidal zone of the Chesapeake Bay. The area to the east of LaRC is occupied by Joint Base Langley-Eustis (JBLE). Established in accordance with the 2005 Base Realignment and Closure Commission, JBLE is comprised of two military installations, Langley Air Force Base (LAFB) and Ft. Eustis. Since the installations are geographically separated by approximately 27 Km (17 miles), and LAFB is located immediately adjacent to LaRC, the installation will be referred to as "LAFB" throughout the remainder of this EA.

NASA LaRC is comprised of research facilities located in two areas which are 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 LAFB. The East Area is located on 8 hectares (20 acres) of land leased by NASA from LAFB. This area is the original 1917 portion of LaRC and contains several wind tunnels, research facilities, and administrative offices. The West Area occupies 309 hectares (764 acres) of land and contains the major portion of LaRC with the majority of the facilities located there. Figure 1.1 shows the regional location of LaRC.

Figure 1.1 - Regional Location of LaRC

1.2 Background Information on the Proposed Action

1.2.1 Master Plan

Each NASA Center must develop and maintain a Master Plan in accordance with NASA Policy Directive (NPD) 8800.12A, Master Planning for Real Property. Historically, Center Master Plans have documented the current state of the Center to include a description of its existing facilities, infrastructure, natural features, mission and capabilities. NEPA documentation typically was not prepared for the Master Plan since it served as a baseline of current conditions at the Center and did not include projects or actions.

Over the past decade, the Agency's approach to master planning has evolved to include establishing the Center's concept for the orderly management and future development of the Center's real property assets (including land, buildings, physical resources, and infrastructure), and ensuring that the future real property development of the Center effectively and efficiently supports portions of NASA's missions assigned to the Center. In addition to including the Center's goals and objectives, the Master Plan includes a future development concept and strategy to achieve those goals and objectives, as well as a process to re-evaluate and revise the plan. Since LaRC's current Master Plan includes projects and actions associated with future development at the Center, this EA is being prepared to analyze potential environmental impacts from implementing the plan.

LaRC's Master Plan is maintained by the Center's Master Planner located within the Center Operations Directorate. The Master Planner must ensure that the plan incorporates sufficient flexibility to address current conditions, planned future needs, and unplanned but predictable changes (e.g., funding adjustments or changes in resources or schedule). In order to provide flexibility, LaRC's Master Plan is a web-based compilation of various resources that provide a narrative, statistical, and graphic record of current capabilities and conditions (natural features, buildings, structures, utilities, transportation systems, and other improvements), as well as the Center's future development concept and strategy. Since LaRC's Master Plan website is only accessible to NASA employees, details on the pertinent parts of the plan are provided in Section 2.1, Proposed Action and Appendix A.

1.2.2 Planning and Decision Points

Over the past few years, the planning for LaRC's future has been increasingly influenced by growing concerns over the state of the Center's infrastructure. For several years now, NASA and LaRC have been encouraged by both the Executive (Office of Management and Budget) and Legislative (Congress) branches of the federal government to reduce infrastructure costs. Most recently, Congress reinforced this position with language in the NASA Authorization Act of 2012 stating that NASA was, "…holding onto facilities and capabilities scaled to another era." Further, the NASA guidance for formulating the FY14 budget specifically states infrastructure reduction goals: 1) continue implementation of Agency Facility Strategy to renew and sustain its capabilities in fewer, more efficient facilities; 2) reduce facility operating costs by 2% in FY14 ranging to 10% by FY18 through cost-effective closure, energy efficient improvements, and other means through the Agency's Technical Capabilities Forum; and 3) discontinue any

capability for which the Agency has no projected use during FY14-18 unless NASA's Administrator decides otherwise.

In response to the growing concerns, LaRC leadership decided in 2011-2012 to expedite previous plans to address aging infrastructure through a repair-by-replacement program called New Town and extend the plan to include all major Center assets (see Section 1.2.3 for a description of New Town). A Center-wide team, named ViTAL (Vibrant Transformation to Advance Langley), was commissioned to develop a long-term Center revitalization plan according to the infrastructure guidance provided from the Agency. The resulting comprehensive 20-year revitalization plan was incorporated into the LaRC's Master Plan, thus institutionalizing the long-term physical infrastructure strategy for the Center. The overarching goal of the plan is to sustain or enhance the Center's core capabilities through repair-by-replacement or renovation of existing buildings and infrastructure based on a credible business case. Specific goals include reducing the footprint of the Center, incorporating a healthy, pedestrian-friendly environment similar to a college campus, and transforming the remaining infrastructure to be energy efficient, sustainable, and adaptable to changing missions and societal needs. These goals are fundamental to ensuring that LaRC remains a critical research and development Center for NASA and the Nation well into the 21st Century.

Comprehensive information on LaRC's strategic approach and major master planning decision points can be found in the *LaRC 20-Year Center Revitalization Plan*, July 2012.

1.2.3 New Town Project

LaRC's New Town Project is a repair-by-replacement program that includes construction of five state-of-the-art facilities, renovation of two facilities and demolition of twenty-two abandoned and underutilized facilities. The "repair-by-replacement" approach involves correcting deficiencies in existing buildings by replacing the buildings when it is economically more advantageous than using those same funds to renovate the buildings. The original schedule to complete New Town included five phases, beginning in 2009 and lasting over fifteen years. Construction of the first New Town building (LaRC Headquarters) was completed in the spring of 2011 and construction of the second new building (Integrated Engineering Support Building) is currently in process. Several facility demolitions have been completed and the renovation activities are in the planning stages.

As noted above, Leadership decided to extend the New Town concept to include all major Center assets resulting in a Master Plan that includes a comprehensive 20-year revitalization strategy. In addition to including the various phases of the New Town Project, LaRC's Master Plan includes more robust phasing of activities, additional new construction, renovation, demolition, and other infrastructure upgrades. This EA addresses the potential effects of implementing all facets of LaRC's Master Plan.

1.3 Purpose and Need for the Proposed Action

The purpose of LaRC's Master Plan is to 1) document the current state of the Center and establish the vision and strategy for the future; 2) provide a comprehensive presentation of how assets relate to the technical community, the local community, and national policy; 3) serve as a guide for the sustainable development of the Center and its facilities and infrastructure; 4) reflect

the Center's concepts for stewardship of its environmental and cultural resources; and 5) integrate with and support the Center's planning and budgeting processes.

Implementation of LaRC's Master Plan is needed to 1) continue strategic development of the Center's real property assets to support NASA's current and future mission; 2) support operational change at the Center; 3) facilitate coordination with Center programs, customers and stakeholders; 4) enable future budget requests to include Center requirements in support of programs; 5) ensure proper stewardship of real property assets of the Center, including buildings, other built systems and natural resources; and 6) assist LaRC in achieving agency policy under NEPA and the National Historic Preservation Act (NHPA) for productive harmony with the human environment.

1.4 Available Information and Assumptions

This EA is based on the LaRC Master Plan, dated May 2013, and best available information at the time of printing. Sources of information regarding the development and implementation of the LaRC Master Plan include strategic and facilities planning reports, presentations for briefings to NASA Headquarters (HQ) and local community planners and politicians. The information was provided by the Center's Revitalization Program Office Program Manager, LaRC's Master Planner and Facilities Engineering and Maintenance personnel. Additional sources of information include the NEPA documentation that was prepared for the New Town Project. The *Final Environmental Assessment for the New Town Project at NASA LaRC*, September 2008, addresses the construction of five new state-of-the-art facilities, renovation of two facilities, and demolition of twenty-two abandoned and underutilized facilities. Since the use of geothermal heating and cooling systems was not anticipated in the original New Town plans, LaRC prepared the *Supplemental EA for New Town at NASA LaRC, April* 2009, to address installation of geothermal ground source heating and cooling systems for the new buildings. The list of reports, presentations and EA's is provided in Chapter 4, References.

The primary driver for implementing the various stages of the Master Plan and the execution schedule is funding availability. While LaRC's annual budget funds the day-to-day operations at the Center, the funding for special projects such as those associated with new construction, major renovation and demolition are provided by NASA HQ. Along with the other nine NASA field Centers and three component facilities, LaRC must compete for limited funding from HQ for construction projects. Master planning is an ongoing process and the overall planning schedule for the proposed projects is not absolute. Modification may be made to priorities and specific implementation dates of future facility requirements. Additionally, since the Proposed Action is a long-range project that would last at least twenty years, specific facility requirements could change especially during the later stages of implementation. Even with these potential changes, the overall concept of development should remain intact. It is assumed that minor modifications to the plan or changes to the schedule would not affect the environmental impacts as described in this EA. In the event that major changes are made to the scope of implementing the Proposed Action, LaRC would prepare additional environmental documentation at that time.

Since the Proposed Action is a long-range project that would last at least twenty years, it is likely that Federal, state, and local regulations and other environmental requirements would evolve over time. Therefore, for the purposes of evaluating the environmental impacts in this EA it is assumed that LaRC would continue to comply with all environmental requirements that are

applicable at the time that the Master Plan activities are implemented. LaRC environmental staff would continue to monitor Federal, state and local regulations for changes that would require modifications to environmental procedures or operations at the Center. For example, in 10-15 years, stormwater permitting requirements for construction projects could be different from those cited in Section 3.4.1, but it is assumed that LaRC would comply with the stormwater permitting requirements that apply at the time of construction.

1.5 LaRC's Environmental and Energy Program

The Center's Environmental and Energy Program is managed by LaRC environmental staff working within the Center Operations Directorate. The main elements of the program are environmental compliance, management, and sustainability. LaRC environmental staff are responsible for reviewing LaRC's activities and projects 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.

Sustainability and Environmental Management

In executing its mission, LaRC has adopted the Agency sustainability policy which includes the following objectives:

- Increase energy efficiency
- Increase the use of renewable energy
- Conserve and protect water resources through efficiency, reuse, and stormwater management
- Eliminate waste, prevent pollution, and increase recycling
- Purchase sustainable technologies and environmentally preferable materials, products, and services
- Design, construct, maintain, and operate high-performance sustainable buildings
- Utilize power management options and reduce the number of LaRC data centers
- Evaluate Center climate change risks and vulnerabilities and develop mitigation measures to manage both the short and long-term effects of climate change on the Center's mission and operations
- Raise employee awareness and encourage each individual in the LaRC community to apply the concepts of sustainability to every aspect of his/her daily work to achieve these goals
- Maintain compliance with all applicable federal, state, local, or territorial law and regulations related to energy security, a healthy environment, and environmentally sound operations
- Comply with internal LaRC and NASA requirements and agreements with other entities

In addition to adopting NASA's sustainability policy, LaRC has an Environmental Management System (EMS) that conforms to the requirements of EO 13423, "Strengthening Federal Environmental, Energy and Transportation Management," and EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," as well as to guidance provided by NASA Procedural Requirement (NPR) 8553.1B, "NASA Environmental Management System." The

EMS serves as the management framework under which LaRC identifies, manages, and improves the sustainable practices identified in the EO goals. 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 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. In 2009, LaRC established an Environmental Management Committee (EMC), which reports to the Center's Executive Safety Council and is responsible for implementation of LaRC's EMS Program.

Environmental Review Process

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 Langley Procedural Requirement (LPR) 8500.1, Environmental and Energy Program Manual, and other relevant environmental laws, regulations, and Executive Orders. Complete documentation is required to ensure LaRC environmental staff can evaluate the proposed projects or actions for potential environmental impacts.

The first step in LaRC's environmental review process requires Project and Program Managers to complete the Langley Form (LF) 461, "Environmental Project Planning Form," which is a web-based form that is available to all Center employees. In addition to requiring a detailed description of the proposed action or project, it includes a series of "YES-NO" questions spanning various environmental media areas. Completed forms along with project documents are submitted electronically to the LaRC NEPA Manager who then coordinates review among LaRC environmental staff.

If the review determines that the project or proposed action is covered by a categorical exclusion (CatEx) as defined in 14 CFR 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, following waste disposal procedures, etc. would be listed on the LF 461 or REC, and LaRC environmental staff follow up to ensure all requirements are followed throughout the duration of the project.

If the review determines that the project or proposed action has the potential to produce environmental impacts, an Environmental Assessment (EA) would be required. In some cases during the impact review process, it would become apparent that the action would produce a significant environmental impact. In these cases, an Environmental Impact Statement (EIS) may be required. LaRC Project and Program Managers are responsible for ensuring that the project schedule and budget includes preparation of the appropriate NEPA documentation.

1.6 Outreach and Partnerships

LaRC's decision to expedite New Town and incorporate a 20-year revitalization strategy into the Center's Master Plan was not made in a vacuum. In addition to enlisting subject matter experts from all core competencies within the Center to help develop the plan, LaRC management held meetings with various outside groups and organizations to include officials from surrounding communities, local businesses and planning personnel, and representatives from Congress and the U.S. Senate. The meetings provided a forum for feedback on LaRC's revitalization initiatives as well as exchange of information related to future development within the Hampton Roads area to include issues associated with climate change (see Section 3.4.6 for a description of the Climate Change Workshop hosted by LaRC in 2011). Examples of groups and organizations that have been briefed on LaRC's revitalization strategy include: the City of Hampton, the VA Congressional Delegation, the Hampton Roads Aerospace Business Roundtable, the U.S. Army Corp of Engineers, the Society of Military Engineers, the City of Poquoson, James City County, the City of Newport News, York County, and the General Services Administration (GSA).

LaRC management and planning personnel have also worked regularly with the Agency's funding, planning and engineering managers during the evolution of LaRC's Master Plan from the conceptual design phase. The following NASA organizations and groups have been briefed on LaRC's Master Plan initiative: Administrator Charles Bolden, the Aeronautics Research Mission Directorate, LaRC's Contractor's Steering Committee, Agency Master Planners, Langley Alumni Association, NASA Headquarters Office of Procurement, Office of Chief Council and Small Business, LaRC Office of Chief Finance, and Agency Sustainability Officers.

In addition to outreach and coordination efforts, LaRC has entered into several key partnerships to ensure successful implementation of the Center's revitalization initiatives. Several phases of new construction associated with New Town are being implemented by an integrated project management team including LaRC, GSA and GSA contractors through an interagency agreement with GSA.

In December 2012, LaRC management reached an agreement with the Norfolk District, U.S. Army Corps of Engineers, to have the Corps support the Center's facility-engineering needs. The five-year Master Support Agreement lays the foundation for the Corps to assist LaRC in planning, design, engineering, project management, real estate, natural resource planning and other engineering support functions for the Center. LaRC is currently developing the first task order under the agreement for the Corps to implement storm hardening measures across LaRC including, but not limited to, storm sewer upgrades, perimeter flood barriers, utility tunnel upgrades, building hardening, electrical substation protection, and Heating, Ventilation and Air Conditioning (HVAC) system upgrades.

Additionally, the LaRC Geographic Information System (GIS) Team is currently partnering with the City of Poquoson to develop flood impact and climate change analysis tools to assist the Center and the City in long-term planning and development initiatives. A similar partnership is planned in the near future with the City of Hampton.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The Proposed Action is implementation of LaRC's Master Plan, which includes a 20-year revitalization strategy that expands and extends the New Town project work that began in 2009. The Proposed Action would include constructing new state-of-the-art facilities, renovating critical infrastructure, vacating and/or demolishing non-essential facilities, and performing other general infrastructure maintenance and improvement activities throughout the Center. Figure 2.1 shows an overview of the major infrastructure changes associated with the Proposed Action.

Full implementation of the Proposed Action would:

- Remove 116,129 m² (1.25M ft²) of inefficient old infrastructure;
- Add 59,458 m² (640K ft²) of new LEED certified energy efficient buildings
- Reduce LaRC's footprint by 55,742 m² (600K ft²);
- Save $105M in maintenance and utilities costs to include an annual 3% reduction in energy consumption and an annual 2% reduction in water consumption;
- Eliminate of $141M in deferred maintenance (maintenance that should be performed but is not due to budgetary constraints);
- Establish a core campus that promotes operational synergy and efficiency;
- Ensure that LaRC continues to retain and attract a highly qualified workforce and maintains or increases employment levels at the Center. .

As noted in Section 1.4, the primary driver for implementing the various stages of LaRC's Master Plan is funding availability. Even partial implementation of the plan would result in consolidation and revitalization of a portion of LaRC's resources, which would have positive operational consequences at the Center over the long term.

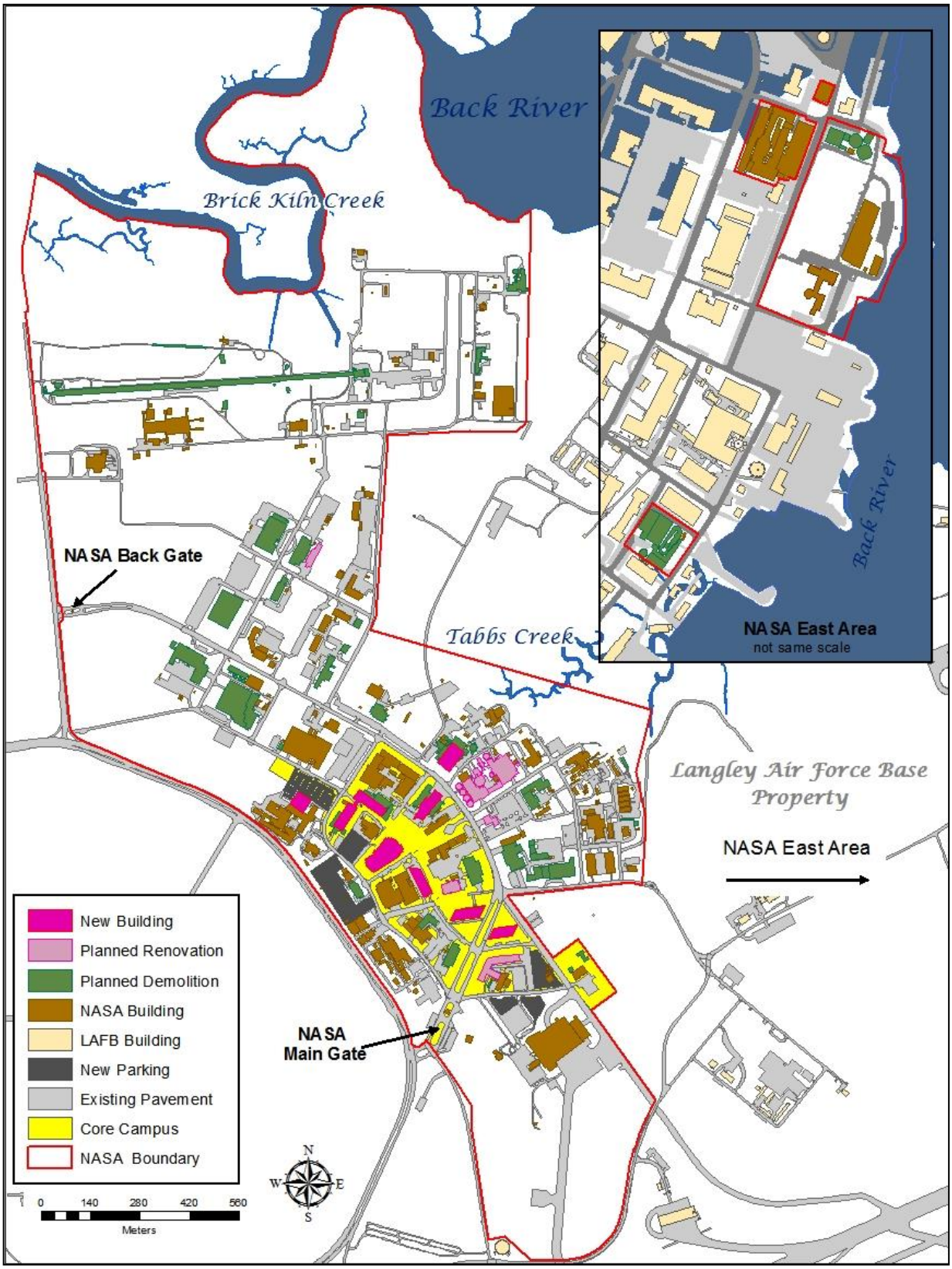

Figure 2.1 - Overview of the Proposed Action

General descriptions of activities associated with the Proposed Action are described below and a list of specific activities is included in Appendix A.

Construction – General activities associated with constructing new buildings and structures include site preparation and excavation; construction of the foundation, structural components and the building shell; completion of the interior spaces, support equipment and utilities; and final grading and landscaping. The majority of new construction would be concentrated in the central core of the Center on previously disturbed soils. Existing proportions of building massing, materials, and details would be taken into consideration and re-interpreted. The overall design approach of new buildings would follow a contemporary modern aesthetic, but would be contextual with the existing buildings within the Center's core campus. Vast usage of glass (to maximize daylight exposure inside), with white metal panels (echoing white existing structures such as vacuum spheres) along with some use of brick in-fills would fit well with the existing environment. This approach would allow for the creation of important additions to the existing campus that reflect the current scale and rhythm of LaRC, but with a modern interpretation. The existing pedestrian spine would be reinforced and expanded and an uninterrupted sequence of large open spaces would be filled predominantly with landscaping trees (mostly existing) and some paving. New trees would screen parking lots from the pedestrian spine.

New construction would employ sustainable design principles and comply with sustainability standards mandated by Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* and other Federal, State and local requirements. In addition to incorporating climate change adaptation strategies, new building designs would meet at least the Silver standard established by the Leadership in Energy and Environmental Design (LEED) Green Building Rating System. In the initial planning phases of new construction projects, conceptual design plans would be submitted to the Virginia State Historic Preservation Office (SHPO) for review and comment.

Any construction activities that disturb 232 square meters (2,500 square feet) or more would require coverage under the General Permit for Discharges of Stormwater from Construction Activities, and a Stormwater Pollution Prevention Plan (SWPPP) and Erosion and Sediment Control (ESC) Plan would be prepared. In accordance with Section 438 of the Energy Independence and Security Act (EISA) requirements, construction activities with a footprint that exceeds 465 square meters (5,000 square feet) would employ Low Impact Development (LID) strategies to replicate predevelopment hydrology of the site.

Renovation - Building renovation involves modifications to existing buildings in which major structural components such as the foundation, structural walls, outer shell, and roof support structure remain mostly intact. Depending on the scope of the project, many other existing components may remain intact. Building renovation could often involve some demolition of building interiors and other components followed by construction/installation of new components and equipment. In general, building renovation could include improvements to exterior architecture and interior spaces; replacement of heating, ventilation and air conditioning systems or equipment; and replacement or upgrades of electrical, plumbing, fire alarm and information technology infrastructure. It is anticipated that building renovations would

incorporate climate change adaptation strategies and would meet at least the LEED Silver standard. Additionally, design plans for renovation projects would be submitted to the Virginia SHPO for review and comment.

Demolition - Demolition projects typically include identifying hazardous and salvageable/recyclable materials; developing a demolition plan; disconnecting utilities and securing the site with fencing; removing and disposing of hazardous chemicals and materials located within the building; draining oil or fluid filled equipment; removal of artifacts (e.g., air and spacecraft models); salvaging any unique architectural elements for future re-use or display; demolishing structures; and performing final site cleanup, grading, and site re-vegetation. Demolition of buildings and structures would follow a deconstruction approach whereby materials such as concrete, brick, metals, and other building components would be salvaged for recycling or reuse.

Similar to the requirements for new construction, stormwater permitting and a SWPPP and ESC Plan would be required for those demolition projects that disturbed 232 square meters (2,500 square feet) or more of soil. Consultation with the Virginia SHPO regarding building demolitions would be carried out in accordance with the Section 106 agreement completed in 2010, *Programmatic Agreement Among the SHPO and the Advisory Council on Historic Preservation (ACHP) for Management of Facilities, Infrastructure and Sites at NASA LaRC.*

For demolition projects located in LaRC's East Area, LaRC Project Managers would include LAFB planning personnel in the pre-project planning and implementation phases of the demolitions.

As noted in Section 1.4, since the Proposed Action is a long-range project lasting twenty years, the list of projects and activities associated with implementing LaRC's Master Plan is not absolute and is almost certain to change over time. This includes the current list of specific buildings proposed for demolition.

Vacating/Closing Buildings – Activities associated with vacating or closing buildings would be similar to the initial stages of demolition projects to include removing and disposing of any hazardous chemicals or materials located within the building, disconnecting or securing certain utilities, draining oil or fluid filled equipment, removing items or equipment for possible re-use, and removing artifacts (e.g., air and spacecraft models). LaRC has a facility closure process that defines the roles and responsibilities for various Center organizations including Safety, Logistics Management, Security, and Environmental. The process includes each organization performing a walkthrough of the facility and completing checklists to ensure all aspects of the closure process are addressed. Following closure, with the exception of fire alarms/emergency services, maintenance and utilities are reduced or eliminated, and the facility is secured to prevent unauthorized access and injury to personnel.

Building and Site Access – Activities associated with building and site access include removal, repair and installation of roadways, sidewalks and permanent and temporary parking lots. Any projects that involve asphalt paving would utilize emulsified asphalt and adhere to time-of–year restrictions in accordance with the *Regulations for the Control and Abatement of Air Pollution* (9

VAC 5-40-5490 et. seq.) The design and construction of new permanent parking lots and modifications to existing lots would comply with Section 438 of EISA and employ LID strategies to maintain, to the extent technically feasible, the predevelopment conditions of each site. LaRC's parking lot planning, design and maintenance strategies include but are not limited to hydraulic and hydrologic evaluation, geotechnical assessment, pavement design, stormwater storage/infiltration/release design, erosion and sediment control, pollution prevention technology, and sustainable design and construction to meet the substantive requirements of EISA. To the maximum extent possible, design plans for both the new parking lots, and upgrades to existing lots would include a base condition of 27% pervious pavers, 14% vegetation, and 59% pavement. Depending on the total size of the project's footprint, stormwater permitting and a SWPPP and ESC Plan would be required. Temporary parking lot installation would involve minor grading for stormwater management, if necessary, and removal of sod to create a firm base for crusher run material and wheel stops would be installed to define parking spaces. For projects involving pavement removal, salvageable materials (e.g, concrete, asphalt) would be recycled to the maximum extent practicable.

Excavation and digging activities – Typical projects requiring excavation and digging include new construction, installing or modifying underground utility lines, repairing steam tunnels, installing or modifying parking lots and sidewalks, and removing foundations associated with demolition. In accordance with LaRC policy, any project that involves excavation deeper than six inches would require a digging permit and projects would be reviewed by the LaRC environmental staff to ensure that no archaeological resources would be impacted by the excavations. Depending on the total size of the project's footprint, stormwater permitting and a SWPPP and ESC Plan would be required.

Landscaping modifications – Typically associated with a large construction project, activities associated with landscaping modifications include planting or removing trees and vegetation, and modifying the landscape grade. As part of the environmental project review process, LaRC environmental staff would provide feedback to project planners on Center requirements associated with vegetation and landscaping to include incorporating native species for new plantings.

Utility upgrades and installation – Typical projects include relocation and/or replacement of underground utilities either buried or conveyed through tunnels and aboveground electric service and substations. Utilities include water, sanitary and storm sewer systems, service air, natural gas lines, and high voltage electric service. Steam is conveyed through insulated pipes contained within underground tunnels and covered trenches that run throughout the Center. The majority of underground utility repair or installation projects at LaRC involve excavation following existing utility lines, however some installation activities may include excavation and clearing of vegetation in areas not previously disturbed by construction. As noted for excavation and digging activities, projects would be reviewed by LaRC environmental staff to ensure appropriate permitting is in place. The permitting process ensures no known archaeological resources would be impacted by excavations associated with underground utility work and any resources discovered during excavation would be properly protected and investigated. Activities associated with aboveground utility projects include replacing transformers, upgrading substations and electric power supplies, upgrading or replacing heating and cooling equipment

and systems, replacing lighting and alarm systems, and installing utility metering. Projects would be reviewed by the LaRC environmental staff to ensure items such as transformers and light ballasts potentially containing Polychlorinated Biphenyls (PCBs) are properly managed, and that utility replacement and upgrades are consistent with LaRC's energy conservation goals.

Other infrastructure upgrades – Examples of other infrastructure projects include storm hardening of facilities and utilities to include storm sewer upgrades, perimeter flood barriers, utility tunnel upgrades, electrical substation protection, and HVAC system upgrades.

2.2 No-Action Alternative

Under the No-Action alternative, LaRC would not implement the revitalization activities associated with the Master Plan. The Center would continue to operate the buildings and infrastructure currently in use at the Center and many facilities would remain abandoned or underutilized. With limited resources to perform routine and preventive maintenance, LaRC's aging buildings and infrastructure would be operated under a "run to failure" maintenance approach. This reactive rather than proactive approach could result in expensive, unplanned, and rushed repairs which could potentially compromise the Center's operational and research capabilities.

The No-Action alternative would not facilitate LaRC's goal of improving current and future mission performance capability. Additionally, the No-Action alternative would forego the opportunity to streamline the Center's infrastructure and refocus limited resources on the infrastructure that would meet LaRC's mission requirements.

2.3 Alternatives Eliminated From Further Consideration

The following alternatives were considered by LaRC during the planning stages to expand and extend New Town and incorporate a 20-year revitalization strategy into the Master Plan. Detailed analysis is provided in LaRC's 20-Year Center Revitalization Plan, July 2012.

Maintaining status quo - represents the No-Action Alternative and is included in this EA.

Renovating existing facilities (with no new construction or other infrastructure upgrades) – it was determined that this alternative would not meet the Center's identified needs, because most of the existing buildings are poorly suited as candidates for renovation. Many of the facilities would have to be "virtually demolished" during renovation because the major systems and layout of the facilities are outdated and inefficient. The costs and payback period for renovation of existing facilities, in addition to the potential displacement and disruption to employees resulted in this alternative being eliminated from further consideration. Renovations that are included as part of the Proposed Action strategy were chosen based on a credible business case (e.g., they are located near LaRC's core, the size and layout are suitable for upgrades and enhancements, and their post renovation purpose and function would be similar).

Constructing all new facilities (with no demolitions, renovations or other infrastructure upgrades) - it was determined that this alternative would not meet the need to cost effectively and efficiently modernize LaRC's core. This alternative would result in a much higher cost and

it is highly unlikely that the Agency would provide LaRC with funding to construct all new facilities. As such, this alternative was eliminated from further consideration

Lease of private sector space off campus – this alternative was eliminated from further consideration as it did not meet the Center's needs. This alternative would neither modernize the Center, nor reduce the Center's infrastructure and operations and maintenance costs. It would fragment the Center's workforce and prevent a collaborative work environment, which is a fundamental part of LaRC's means of maintaining necessary expertise. Additionally, since LaRC is a secure federal facility, off-site facilities would impose increased security requirements.

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3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter provides information on the existing environmental conditions at LaRC and the environmental impacts of the Proposed Action and the No-Action Alternative. For the New Town aspects of the Proposed Action, information from the two previous New Town EAs are incorporated by reference and are available at: http://environmental.larc.nasa.gov/nepa/

NASA LaRC would evaluate the environmental impacts provided in this EA at least every five years and if appropriate, preparation of additional environmental documentation would be considered at that time.

3.1 Description of Affected Environment

Information on the existing environment focuses on those environmental resources potentially subject to impacts. This chapter provides a general summary of the current conditions. More detailed information on each of LaRC's environmental resource areas is contained in the 2012 LaRC Environmental Resource Document (ERD). Required by NASA Procedural Requirements (NPR) 8580.1A, Implementing the National Environmental Policy Act and Executive Order 12114, the ERD provides a detailed and comprehensive baseline of current environmental conditions at the Center. The ERD is updated at a minimum of every five (5) years or as Center conditions change. NASA's NEPA Program promotes incorporating ERDs by reference in order to streamline NEPA documentation. LaRC's ERD is available at:
http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

3.2 Description of Environmental Impacts

For each environmental resource area, an impact assessment is provided for construction activities associated with the various phases of the Proposed Action, which includes new construction, renovation, abandonment, demolition, and other general infrastructure upgrades. The term "Construction Impacts" is used as a general descriptor for all infrastructure changes associated with the Proposed Action

An impact assessment is also provided for post-construction operation at the Center following completion of the various phases associated with the Proposed Action. The term "Operational Impacts" is used as a general descriptor for assessing impacts from Center operations in each environmental resource area.

Impacts are defined in general terms and are qualified as adverse or beneficial, and as short-term or long-term. For the purposes of this EA, beneficial impacts would improve resources/conditions and adverse impacts would deplete or negatively alter resources/conditions. In terms of duration, short-term impacts are generally considered those impacts that would have temporary effects. For example, air quality impacts from fugitive dust associated with construction would be considered short-term as they would only last for the duration of the construction activities. Long-term impacts are generally considered those impacts that would result in permanent effects. For example, the loss of vegetation or the increase in traffic associated with new development would be considered long-term.

The following defines the thresholds of change for the intensity of impacts:

- ***Negligible*** -would not be detectable and would have no discernible effect.
- ***Minor*** - would be slightly detectable, but would not have an overall effect.
- ***Moderate*** - would be clearly detectable and could have an appreciable effect.
- ***Major*** - would have a substantial, highly noticeable effect.

3.3 Resources Eliminated from Further Analysis

Several resources were not evaluated in this EA because it was determined unlikely that implementation of either the Proposed Action or the No-Action alternative would have any impact on these areas of concern. A brief explanation is provided below.

Soils and Geology. Implementation of the No-Action alternative would have no impact on soils and geology. Since the majority of the activities associated with the Proposed Action would involve existing structures and previously developed areas, it is anticipated that any impacts to soils and geology would be negligible and these resources were eliminated from further analysis.

Population. The No-Action alternative would have no impact on the population of the communities surrounding LaRC. It is anticipated that any increase in the local population as a result of the Proposed Action would be negligible and as such, this resource was eliminated from further analysis.

Environmental Justice. Low-income populations and minority populations that are subject to environmental justice considerations are not located within or near the location of the Proposed Action. Since implementation of either the Proposed Action or the No-Action alternative would have no impact on low-income populations or minority populations, this resource was eliminated from further analysis.

Wild and Scenic Rivers. None of the waterways within the LaRC property qualify for the provisions of the Wild and Scenic Rivers Act, therefore, this resource was eliminated from further analysis.

Virginia Coastal Zone Programs. The following Virginia DEQ enforceable programs and policies are not applicable to the Proposed Action as associated activities would not have any effect on the resources. Additionally, the No-Action alternative would not have any effect on the resources. The programs and policies include:

> Fisheries Management. Implementation of either the Proposed Action or the No-Action alternative would have no impact on the conservation and enhancement of finfish and shellfish resources or the promotion of commercial and recreational fisheries.
>
> Subaqueous Lands Management. Implementation of either the Proposed Action or the No-Action alternative would not involve encroachment into, on or over state-owned subaqueous lands.

Dunes Management. Implementation of either the Proposed Action or the No-Action alternative would not impact sand covered beaches or sand dunes because none exist at LaRC.

Shoreline Sanitation. Implementation of either the Proposed Action or the No-Action alternative would not involve installation of septic tanks.

Other Virginia Coastal Zone Program areas that are applicable to the Proposed Action are addressed in Section 3.4.3.

3.4 Physical Environment

3.4.1 Water Resources

Surface Waters

LaRC is located within the coastal basin of the Back River, a tributary of the Chesapeake Bay. The Center operates under four water discharge permits that limit the types and quantities of pollutants discharged, and establish monitoring and record keeping requirements. These permits include: (1) two Virginia Pollutant Discharge Elimination System (VPDES) permits that specify the allowable discharges, pollutant limitations, and monitoring requirements for discharging effluent to surface waters; (2) a Municipal Separate Storm Sewer System (MS4) permit that requires LaRC to develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants in stormwater to the maximum extent practicable; and (3) a Hampton Roads Sanitation District (HRSD) Permit for the discharge of nonhazardous industrial wastewater and sanitary sewage to the HRSD sanitary sewer system.

LaRC has few water pollution sources due to the relatively low level of industrial operations at the Center. The major pollutants are the chemicals used to treat the boilers and cooling towers, and these are discharged in accordance with LaRC's permits. LaRC employs various Best Management Practices (BMPs) to prevent or mitigate stormwater and/or sewer system pollution from facility activities.

Groundwater

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

Groundwater movement at LaRC is tidally influenced at locations near Brick Kiln Creek and Tabbs Creek. A total of 41 shallow wells (depth up to 6m or 20 ft), 7 intermediate wells (22.9m or 75 ft), and 5 deep wells (depths over 29m or 95 ft) have been installed over the years to identify/monitor potential contamination of groundwater at and near several National Priorities List sites at LaRC. The wells are sampled periodically and LaRC environmental staff maintain all records regarding monitoring well sampling events.

Additional information on LaRC's water resources is available in Chapter 3 of LaRC's ERD: http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts
Construction activities could result in minor short-term adverse impacts to the surface water resources of LaRC and the surrounding environment. Soil disturbance during construction activities may produce a minor and temporary increase in suspended solids in the stormwater runoff. In order to mitigate any adverse impacts, LaRC would ensure that construction contractors prepare a SWPPP and ESC Plan, and secure a Virginia Stormwater Management (VSMP) General Permit for Stormwater Discharges from Construction Activities. Silt fences, storm drain inlet and outlet protection, and other appropriate standard construction practices would be implemented in accordance with applicable erosion and sediment control requirements. During construction, the contractor's performance and adherence to the permits and plans would be monitored by LaRC environmental staff and a construction inspection team which includes two Virginia Department of Conservation and Recreation (DCR) certified inspectors. Any new systems or equipment that consume water and/or generate wastewater would be evaluated prior to their installation and LaRC would ensure that all new water discharge sources would be compliant with applicable regulations and LaRC permits.

A description of groundwater impacts associated with the installation of geothermal wells for heating and cooling new buildings is included in Section 3.10 of the New Town Supplemental EA: http://environmental.larc.nasa.gov/files/2013/03/Final-EA-New-Town-geothermal-systems.doc

Operational Impacts
Following completion of construction activities, Center operations would be carried out in accordance with LaRC's water permits and applicable requirements for preventing impacts to surface waters and groundwater. LaRC environmental staff would continue to review water usage and discharge operations to identify opportunities for conserving water and minimizing wastewater pollutants. It is anticipated that moderate long-term beneficial impacts to water resources could occur. The increased groundwater filtration associated with the overall reduction in impervious surface area and the LEED and LID design of new and renovated infrastructure (e.g., water retention basins, green roofs) would result in reduced stormwater runoff at the Center.

No-Action Alternative
Under the No-Action Alternative, no impacts to groundwater are anticipated. The potential exists for minor adverse impacts to surface waters around LaRC as the Center's infrastructure would continue to age and possibly become compromised which could result in releases of pollutants to surrounding surface waters. Additionally, stormwater permitting is evolving along with Chesapeake Bay cleanup efforts to require reductions in the imperviousness of permitted sites. Implementation of the No-Action alternative would obviate the opportunity to reduce impervious area, reduce runoff, and increase open green space at LaRC.

3.4.2 Wetlands and Floodplains

Wetlands

According to the U.S. Fish and Wildlife Service National Wetlands Inventory, approximately 66 hectares (163.2 acres) total of scrub shrub, emergent and forested wetlands are present in LaRC's West Area.

Floodplains

Due to its proximity to the Chesapeake Bay and Back River, all of LaRC's East Area and approximately one-third of LaRC's West Area are within the 100-year floodplain. The stillwater elevation for the 100-year floodplain for LaRC is estimated by the Federal Emergency Management Agency (FEMA) to be 2.6 meters (8.5 feet) above mean sea level (MSL). FEMA has estimated 100-year floodwater levels with accompanying waves at about 3.3 meters (11 feet) above MSL near the Center. The stillwater level for the 500-year floodplain is 2.9 meters (9.8 feet) above MSL.

Additional information on LaRC's wetlands and floodplains is available in Chapter 4 of LaRC's ERD: https://sites-e.larc.nasa.gov/environmental/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts

Construction activities could have a negligible short-term adverse impact on wetlands at LaRC. The location of wetlands at LaRC in relation to the construction activities is shown in Figure 3.1. While no new construction would take place in or adjacent to wetland areas, several demolition activities are planned at sites adjacent to wetland areas. LaRC would ensure that demolition activities comply with 14 CFR 1216.2 (NASA regulations on Floodplain and Wetland Management). In addition to implementing the BMPs associated with obtaining permit coverage for General Permit for Discharges of Stormwater from Construction Activities, LaRC would minimize the risk of affecting the wetlands during demolition activities by fencing off the areas to ensure heavy equipment is restricted from entering wetland areas.

Construction activities could have a negligible short-term adverse impact on the floodplains at LaRC. The location of floodplains at LaRC in relation to the construction activities is shown in Figure 3.2. While activities associated with new construction would not occur within floodplain areas, several demolition activities are planned within the 100-year floodplain area in LaRC's East Area and in the northern portion of the West Area. LaRC would ensure that demolition activities comply with EO 11988 (Floodplain Management) and 14 CFR 1216.2 (NASA regulations on Floodplain and Wetland Management). Additionally, LaRC would obtain any required permits, all demolition debris would be removed, and the sites would be graded and re-vegetated to restore the natural and beneficial functions of the floodplains to the maximum extent possible. This approach is consistent with and furthers the purpose of EO 11988.

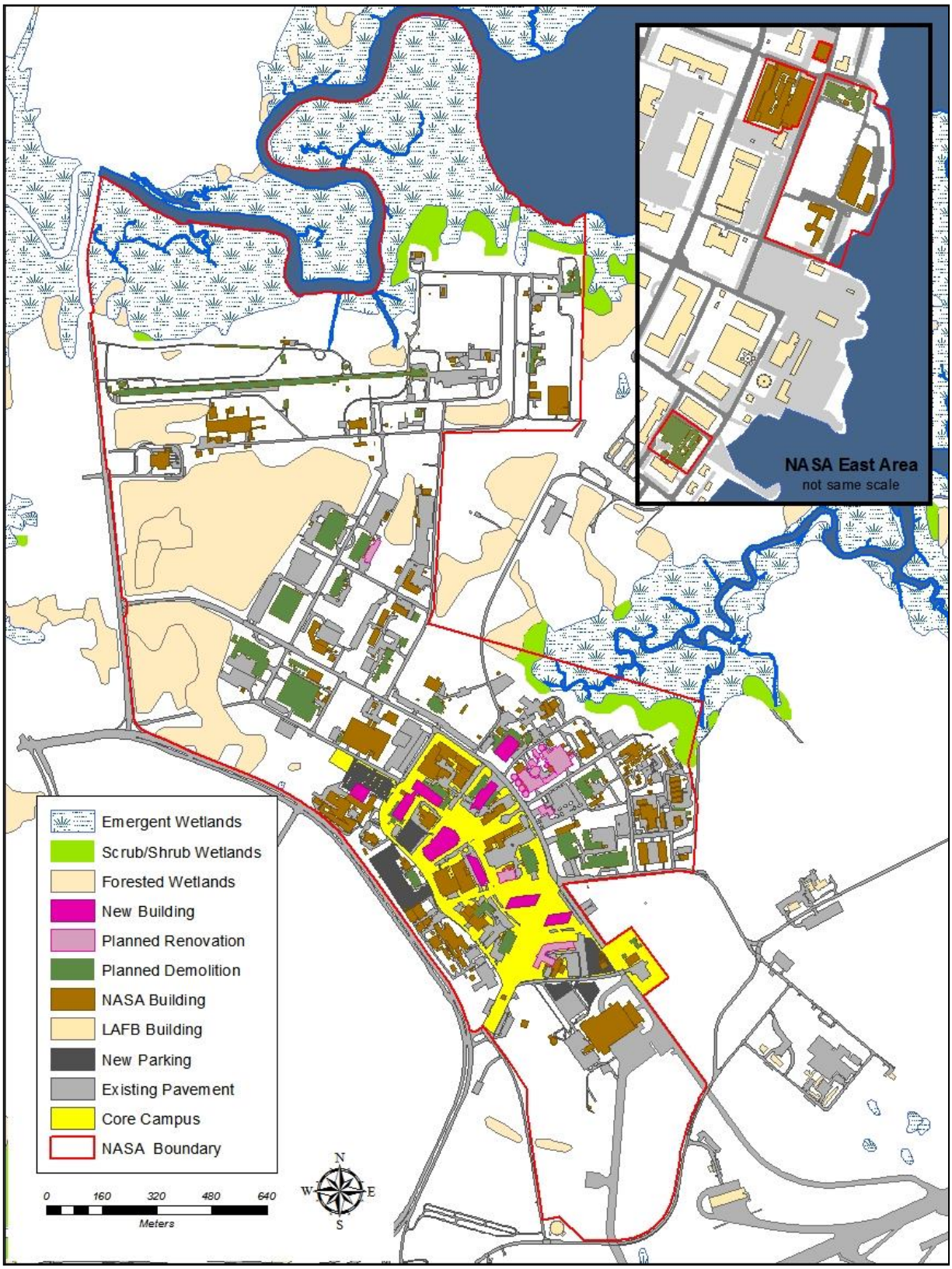


Figure 3.1 - Location of Wetlands at LaRC

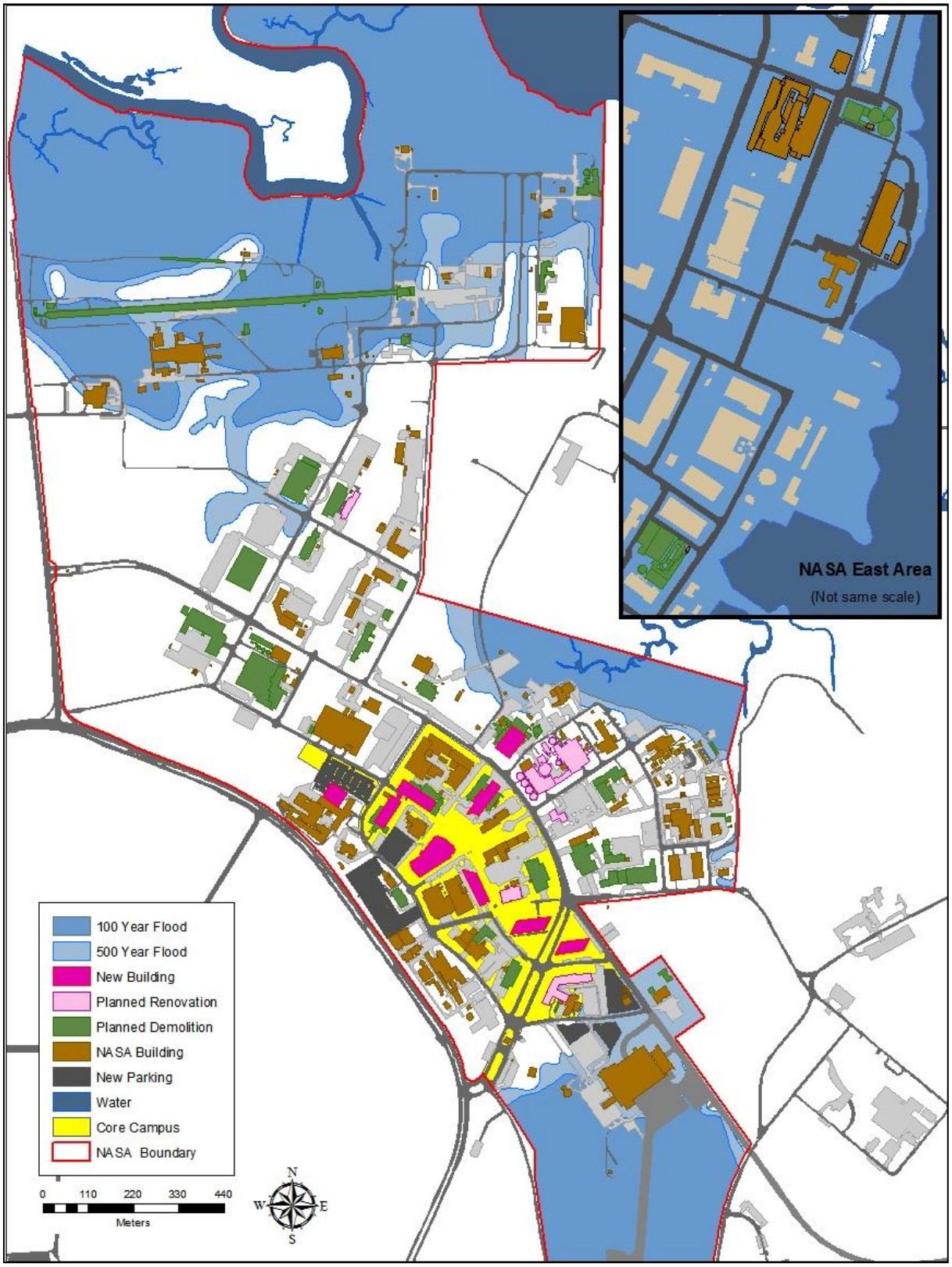


Figure 3.2 - Location of Floodplains at LaRC

Operational Impacts
Following completion of construction activities, it is anticipated that Center operations would have a minor long-term beneficial impact on wetland and floodplain resources. The LID design associated with new construction and the reduced impervious area resulting from the removal of buildings and infrastructure would improve the groundwater hydrology of adjacent wetlands as well as provide for improved filtration and flow of floodwaters. Additionally, the Center's reduced footprint and storm-hardened buildings would result in infrastructure being less vulnerable to flooding.

No-Action Alternative
Under the No-Action Alternative, there would be no impacts to wetland resources at LaRC. A No-Action Alternative would leave existing, aging infrastructure located within the 100- and 500-year floodplains vulnerable to flooding.

3.4.3 Coastal Zone Management/Federal Consistency Determination

This section provides information for LaRC's Federal Consistency Determination (FCD). Some of the information may be redundant to other sections in this chapter however, for purposes of following DEQ's recommended outline for FCDs, the information is repeated.

LaRC is located within the coastal zone of the Commonwealth of Virginia. Federal agency activities within the coastal zone must be carried out in a manner that is consistent to the maximum extent practicable with the applicable enforceable policies. As mentioned in Section 3.3, the following Virginia Coastal Zone Management Policies (VCP) do not apply to the Proposed Action and No-Action Alternatives: Fisheries Management, Subaqueous Lands Management, Dunes Management, and Shoreline Sanitation. The remaining applicable VCP policies are described below.

Tidal and Non-Tidal Wetlands – The purpose of the wetlands management program is to preserve tidal wetlands, prevent their despoliation, and accommodate economic development in a manner consistent with wetlands preservation. According to the U.S. Fish and Wildlife Service National Wetlands Inventory, approximately 66 hectares (163.2 acres) total of scrub shrub, emergent and forested wetlands are present in LaRC's West Area.

Coastal Lands Management Program - regulates land development in the Chesapeake Bay Resource Protection Areas (RPAs) and Resource Management Areas (RMAs). RPAs include tidal shores, tidal wetlands, and non-tidal wetlands that are contiguous to and connected by surface flow to tidal wetlands and perennial streams, and a 30-meter (100-foot) buffer located landward of these features. RMAs include floodplains, highly erodible soils, highly permeable soils, steep slopes, and areas 30 meters (100 feet) landward of an RPA. Both RMA and RPA features exist at LaRC.

Point Source Air Pollution Control – The program implements the federal Clean Air Act to provide a legally enforceable State Implementation Plan for the attainment and maintenance of the National Ambient Air Quality Standards. LaRC has a State Operating permit that establishes emission limits for specific stationary air pollution sources as well as Center-wide emission

limits. The Center is not required to have a Title V Federal Operating Permit. LaRC qualifies as a synthetic minor source because its air emissions are limited below the prescribed thresholds by its air permit. The Center's air permit contains enforceable conditions that limit the amount of air pollutants that LaRC may emit.

Non-point Source Water Pollution Control - Virginia's Erosion and Sediment Control Law requires soil-disturbing projects to be designed to reduce soil erosion and to decrease inputs of chemical nutrients and sediments to the Chesapeake Bay, its tributaries, and other rivers and waters of the Commonwealth. For any soil disturbing projects at the Center, LaRC environmental staff review design plans to ensure appropriate permits are secured and controls implemented.

Point Source Water Pollution Control - Point source pollution control is accomplished through the implementation of the National Pollutant Discharge Elimination System (NPDES) permit program established pursuant to §402 of the federal Clean Water Act and administered in Virginia as the VPDES permit program. NASA LaRC operates under VPDES permit #VA0024741 which regulates discharges from storm water runoff and industrial operations, and VPDES permit #VA6750198 which regulates discharges from the Langley Exchange car wash operation.

Construction Impacts

Wetlands – The location of wetlands at LaRC in relation to the construction activities is shown in Figure 3.1. While the majority of activities are not located in or near any wetlands, several demolition activities are planned at sites adjacent to wetland areas. In addition to implementing the BMPs associated with obtaining permit coverage for General Permit for Discharges of Stormwater from Construction Activities, LaRC would minimize the risk of affecting the wetlands during demolition activities by fencing off the areas to ensure heavy equipment is restricted from entering wetland areas.

Coastal Lands Management – The location of LaRC's RMAs and RPAs in relation to the construction activities are shown in Figure 3.3. While the majority of activities are not located in or near any RMAs or RPAs, several demolition activities are planned at sites adjacent to a RPA and on the edge of a RMA. In accordance with the VA DCR's stormwater management requirements, demolition contractors would be required to submit a SWPPP and an ESC Plan, and secure a VSMP General Permit for Stormwater Discharges from Construction Activities. During demolition activity, the contractor's performance and adherence to the permits and plans would be monitored by the LaRC environmental staff's construction inspection team which includes two DCR certified inspectors. Following demolition, the areas located within the RMA and RPA would be planted with indigenous vegetation to restore the buffer zones.

Point Source Air Pollution Control – Construction activities would result in emissions from vehicle/equipment exhaust and from fugitive dust. These effects would be minor and short-term. In relation to the large number of personal and Government vehicles operating on the Center, the additional emissions resulting from construction vehicles would be negligible. In addition, fugitive dust would be minimized by using control methods outlined in 9 VAC 5-50-60 et. seq. of the Virginia Regulations for the Control and Abatement of Air Pollution. These precautions

may include the use of water for dust control, covering of open equipment for conveying materials, prompt removal of spilled or tracked dirt from paved streets, and removal of dried sediments resulting from soil erosion.

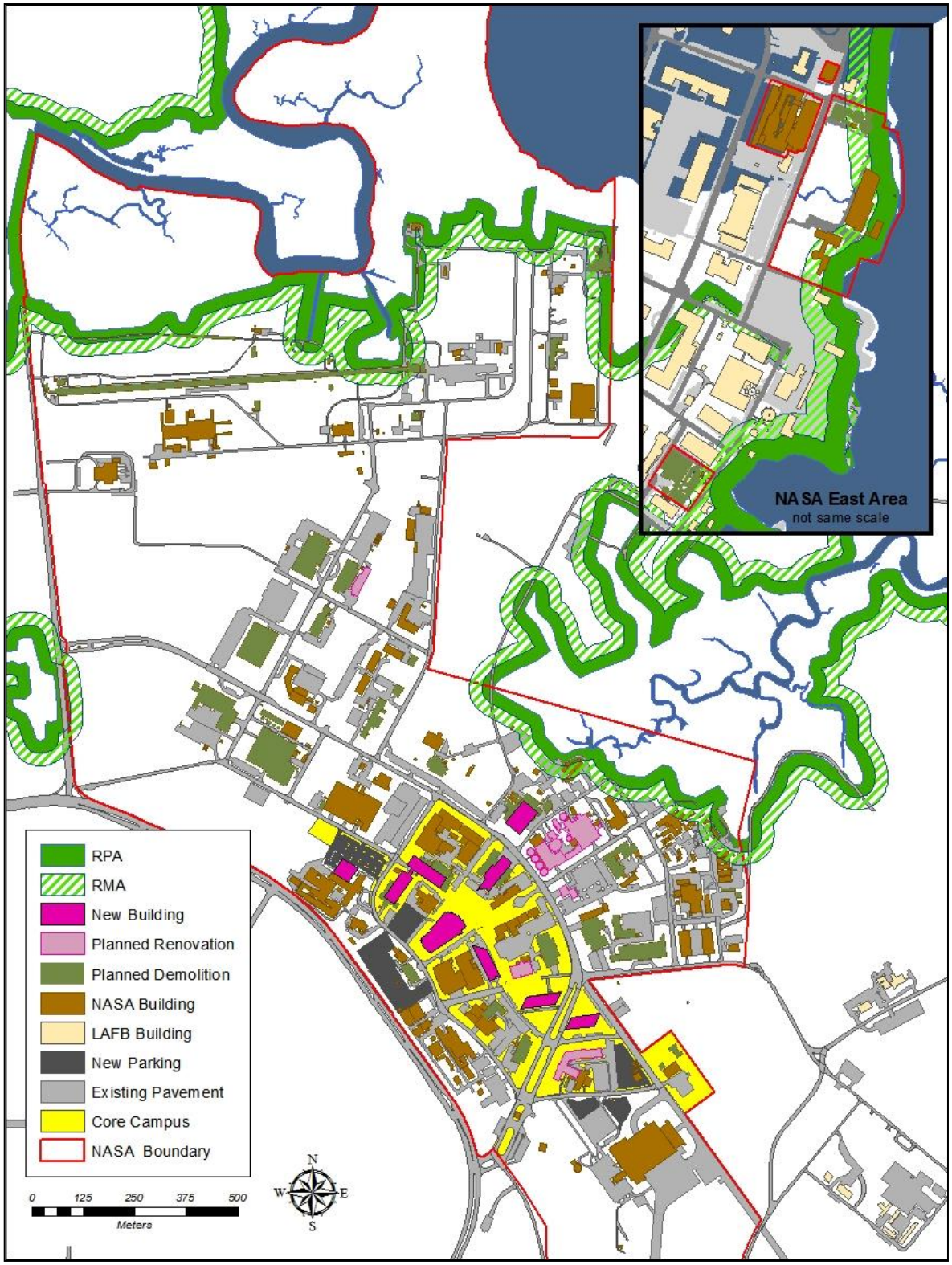


Figure 3.3 - Location of RMAs and RPAs at LaRC

Non-point Source Water Pollution Control – For construction activities that disturb 232 square meters (2,500 square feet) or more, construction contractors would be required to submit a SWPPP and ESC Plan, and secure a VSMP General Permit for Stormwater Discharges from Construction Activities. During construction, the contractor's performance and adherence to the permits and plans would be monitored by LaRC environmental staff and a construction inspection team which includes two DCR certified inspectors.

Point Source Water Pollution Control - Construction contractors would be required to comply with LaRC's water permit requirements to ensure that no point source pollution occurs. Construction activities would be monitored by LaRC environmental staff and the construction inspection team to ensure compliance with permits.

Consistency Determination
LaRC has determined that construction activities associated with the Proposed Action would be consistent with the applicable enforceable policies of the VCP.

3.4.4 Noise

The fighter aircraft operating from LAFB are by far the dominant and most widespread noise source in the area. The noise contour map from the latest Air Installations Compatible Use Zone report prepared by LAFB shows LaRC's West Area located within the 65-70 decibel (dBA). The dBAs are calculated using the "Ldn" parameter, which is preferred by the EPA for assessing environmental noise impacts. Ldn levels up to 65 dBA are generally considered acceptable for residences. Primary noises generated at LaRC include the wind tunnels, the compressor stations, and the substations. Noise level surveys conducted on the various wind tunnels during peak operating mode have identified noise levels ranging from 45 to 80 dBA. The daily operation of motor vehicles in and around LaRC is considered a minor source of noise.
Due partly to the uniqueness of LaRC's wind tunnels, a lack of major residential development within the surrounding area, and the fact that LaRC and LAFB have preceded most residential developments in the area, there have not been significant complaints regarding noise from LaRC operations.

Additional information on noise at LaRC is available in Chapter 14 of LaRC's ERD:
http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts
Heavy equipment and machinery used during construction activities would cause temporary increases in noise at and near the construction areas and along traffic corridors. The high noise levels would be intermittent over a long term (more than 20 years). Compared to noise generated by aircraft, noise produced by the construction activities would generally be more impulsive, relatively lower in magnitude, and spread out during the day. Table 3.1 shows examples of sound levels produced by construction equipment at a distance of 15.2 meters (50 feet). In accordance with LaRC's Safety Program, construction workers within the immediate project area would be required to wear appropriate hearing protection. It is anticipated that areas surrounding construction sites would experience nuisance noise. As such, the higher noise levels generated by construction activities may result in minor short-term adverse impacts on

pedestrians walking near project sites and on occupants of buildings located adjacent to project sites.

Table 3.1 - Examples of Noise Levels Generated by Construction Equipment

Equipment	Typical Noise Level (dBA) at 15.2 meters
Backhoe	80
Concrete Mixer	85
Mobile Crane	83
Bull Dozer	85
Generator	81
Jack Hammer	88
Dump Truck	88

Operational Impacts
Following completion of construction activities, it is anticipated that noise levels associated with Center operations would be consistent with current levels. Any new projects or activities that have the potential to generate high noise levels would be reviewed by LaRC environmental staff as well as LaRC industrial hygiene staff prior to project startup. As such, it is anticipated that there would be no impact to noise levels resulting from Center operations.

No-Action
Under the No-Action alternative, there would be no change in noise levels at the Center.

3.4.5 Air Quality

The Virginia DEQ administers the state's air Operating Permit Program. LaRC has a State Operating permit that establishes emission limits for specific stationary air pollution sources as well as Center-wide emission limits. The Center is not required to have a Title V Federal Operating Permit. LaRC qualifies as a synthetic minor source because its air emissions are limited below the prescribed thresholds by its air permit. The Center's air permit contains enforceable conditions that limit the amount of air pollutants that LaRC may emit. Specific permit requirements vary according to the air pollution source, but they generally include physical, operational, record keeping and reporting requirements. LaRC is located within the Hampton Roads Intrastate Air Quality Control Region (AQCR) which is an ozone maintenance and emission control area for nitrogen oxides (NOx) and volatile organic compounds (VOCs).

Additional information on LaRC's air program is available in Chapter 2 of LaRC's ERD:
http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts
Construction activities would result in a slight increase in emissions from vehicle and equipment exhaust and from fugitive dust; however the activities would be intermittent and staggered over a long period of time. Compared to the emissions from the large number of personal/Government vehicles and equipment operating on the Center, it is anticipated that the additional emissions resulting from construction activities would result in minor short-term adverse impacts on air quality at LaRC.

Fugitive dust emissions generated during construction activities would be minimized by using control methods outlined in the Virginia Regulations for the Control and Abatement of Air Pollution (9 Virginia Administrative Code 5-50-90). These precautions may include the use of water for dust control, covering of open equipment for conveying materials, prompt removal of spilled or tracked dirt from paved streets, and removal of dried sediments resulting from soil erosion. Additionally, any asphalt paving projects would utilize emulsified asphalt and adhere to time-of–year restrictions in accordance with the *Regulations for the Control and Abatement of Air Pollution* (9 VAC 5-40-5490 et. seq.)

Since the Hampton Roads AQCR is an ozone maintenance area, the emissions of ozone precursor pollutants (VOCs and NO_x) were calculated for the construction activities using the *US Air Force Conformity Applicability Model (ACAM) 4.5.0.* As shown in Table 3.2, construction activities would not be subject to the General Conformity Rule of the Clean Air Act because emissions of applicable pollutants would not exceed annual de minimis thresholds, nor would they be regionally significant (i.e. 10% of regional emissions inventory). A summary of the air conformity analysis is included in Appendix C.

Table 3.2 – Air Conformity Applicability

Pollutant	Maximum Emissions from Construction Activities	De Minimis Threshold	10% of Regional Emissions Inventory
NO_x	5 tons per year	100 tons per year	1,351 tons per year
VOCs	1 ton per year	100 tons per year	357 tons per year

Any stationary air emission sources installed during construction activities would be added to LaRC's *Stationary Source Permit to Operate* from the Virginia DEQ. LaRC would ensure that new equipment or systems that result in air emissions would comply with the Federal Clean Air Act as enforced by the Virginia State Implementation Plan and the State Air Control Board (Code of Virginia § 10-1.1300).

Construction activities would not involve open burning. Construction debris would be recycled to the maximum extent possible as described in Section 3.4.8.

Operational Impacts

Following completion of construction activities, Center operations would be carried out in accordance with LaRC's air permit. Any projects and activities that involve installation or modification of equipment and operating systems that may involve air emissions would be reviewed by LaRC environmental staff as part of the Center's environmental project planning process. The improved efficiency of new and upgraded infrastructure could result in minor long-term beneficial impacts to air quality at LaRC.

No-Action

Implementation of the No-Action alternative could result in a minor long-term increase in air pollutant emissions as the Center would continue to operate aging and inefficient infrastructure.

3.4.6 Greenhouse Gas Emissions and Climate Change

The bulk of LaRC's greenhouse gas (GHG) emissions are tied to energy use, especially the use of electricity, steam and fuels to operate the Center and heat and cool buildings. An evaluation of LaRC's GHG emissions was performed in 2009 to determine if the Center was subject to the Mandatory GHG Reporting Rule (40 CFR Part 98). Annual GHG emissions were calculated for years 2003 through 2008 using the EPA protocol. The evaluation determined that LaRC's annual emissions are well below the 25,000 metric ton of Carbon Dioxide equivalent (CO2e) per year reporting trigger. Similar evaluations were performed for years 2009 and 2010 with similar results. Table 3.3 provides a summary of the evaluations and copies of the calculations are included in Appendix D.

Table 3.3 - Annual Greenhouse Gas Emissions

CY	2003	2004	2005	2006	2007	2008	2009	2010
CO2e Metric tons	12,784	11,448	12,121	16,730	11,284	9,332	8,820	9,779

Under EO 13514, the Agency voluntarily established a goal of reducing NASA's GHG emissions 18% from the FY 2008 baseline by FY 2020. Ongoing efforts to reduce the GHG emissions of NASA's activities would rely on maintaining databases to collect Center-specific data on energy and related activities; promoting the use of energy-efficient infrastructure and renewable energy; and identifying new strategies to minimize GHG emissions across operations.

In response to EO 13514, NASA formed the Climate Adaptation Science Investigators (CASI) Workgroup in 2009 to provide tools (data, projections, models and other tools), processes and related expertise to help NASA and its field Centers to manage climate risks and enable them to develop local adaptation strategies. CASI has compiled historic climate and climate projections with associated uncertainties for each Center, assessed adaptation approaches and Center-level planning strategies and recommended future research initiatives that fill gaps. In 2011, members from the CASI workgroup assisted LaRC in hosting a Resilience and Adaptation to Climate Risks Workshop which was attended by over 100 personnel from the Center and various planning, operations and industry personnel from surrounding Hampton Roads localities. The 3-day workshop provided a forum for discussing the projected long-term climate change impacts on LaRC and surrounding communities to include sea level rise, increased temperature, air quality alerts, extreme rain and drought, increased summer energy demand, changing ecosystems and intense hurricanes.

LaRC has ensured that resilience and climate adaptation strategies are incorporated into LaRC's Master Plan and revitalization initiatives. As described in Section 1.6, LaRC is currently working with the Army Corps of Engineers to develop and implement storm hardening measures to protect the Center from potential storm surges and flooding associated with climate change. Additionally, the LaRC GIS Team is working with the City of Poquoson to develop flood prediction tools to prepare for future storm surges and hurricanes.

The following provides an analysis of impacts of the Proposed Action on GHG emissions, as well as the potential impacts of climate change on the environmental effects of the Proposed

Action. Climate change impacts are broadly described as there is inherent uncertainty in projecting specific future changes in a highly dynamic and ever changing system.

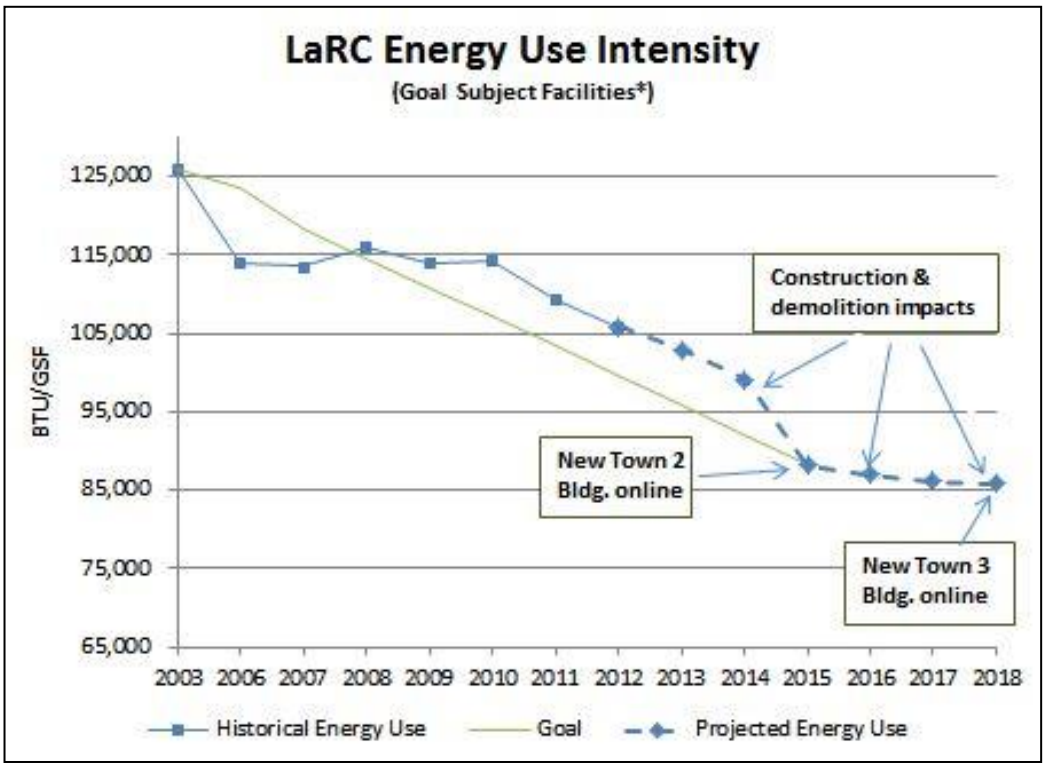
Construction Impacts

Construction activities would cause a slight increase in GHG emissions from vehicle and equipment exhaust at the Center; however the activities would be intermittent and staggered over a very long period of time. Compared to the Center's annual GHG emissions and the overall GHG emissions from the surrounding Hampton Roads region, construction activities would have minor short-term adverse impacts on GHG emissions at LaRC.

Operational Impacts

Following completion of the construction activities, it is anticipated that there would be a reduction in GHG emissions from Center operations. The reduced footprint and centralized core would promote walking rather than driving, and new and upgraded buildings and infrastructure would be more energy efficient, resulting in lower GHG emissions at LaRC. As shown in Figure 3.4, the Center's energy consumption would be reduced by 25% (from FY2012 levels) following completion of the initial phases of LaRC's Master Plan. Following completion of the later stages of the plan (past 2018), it is anticipated that the Center's energy use levels would eventually "flatten out" and remain fairly consistent, unless additional energy efficiency projects are implemented at the Center.

Figure 3.4 – Projected Energy Consumption at LaRC



*Energy consumption is projected for buildings that do not have significant variations in energy use due to research loads. These "Goal Subject" buildings comprise approximately 74% of building square footage on the Center.

Following completion of construction activities, it is anticipated that the potential for adverse impacts from climate change on Center operations would be reduced. The Center's footprint would be smaller so there would be less infrastructure located within the floodplain and the increase in pervious areas would provide for improved filtration and flow of floodwaters. Also, new buildings are being designed with higher finished floor elevations. Additionally, new and renovated buildings would better withstand fluctuations in temperature and the storm hardened infrastructure would protect LaRC from extreme weather events. As such, long-term adverse impacts on Center operations resulting from climate change would be reduced.

No Action Alternative

Implementation of the No-Action Alternative could result in a minor long-term increase in GHG emissions as the Center would continue to operate aging and inefficient infrastructure. It is anticipated that the increase in emissions would be negligible related to the overall GHG emission from the surrounding Hampton Roads region.

Implementation of the No-Action Alternative could result in minor long-term adverse impacts to LaRC as a result of climate change as it would leave existing, aging infrastructure vulnerable to increased temperatures and summer energy demand, extreme weather events, and sea level rise. Figure 3.5 shows the projected sea level rise by year 2050 combined with a 2.4 meter (8 foot) storm surge. LaRC's entire East Area would be flooded and approximately 90% of the West Area would be flooded.

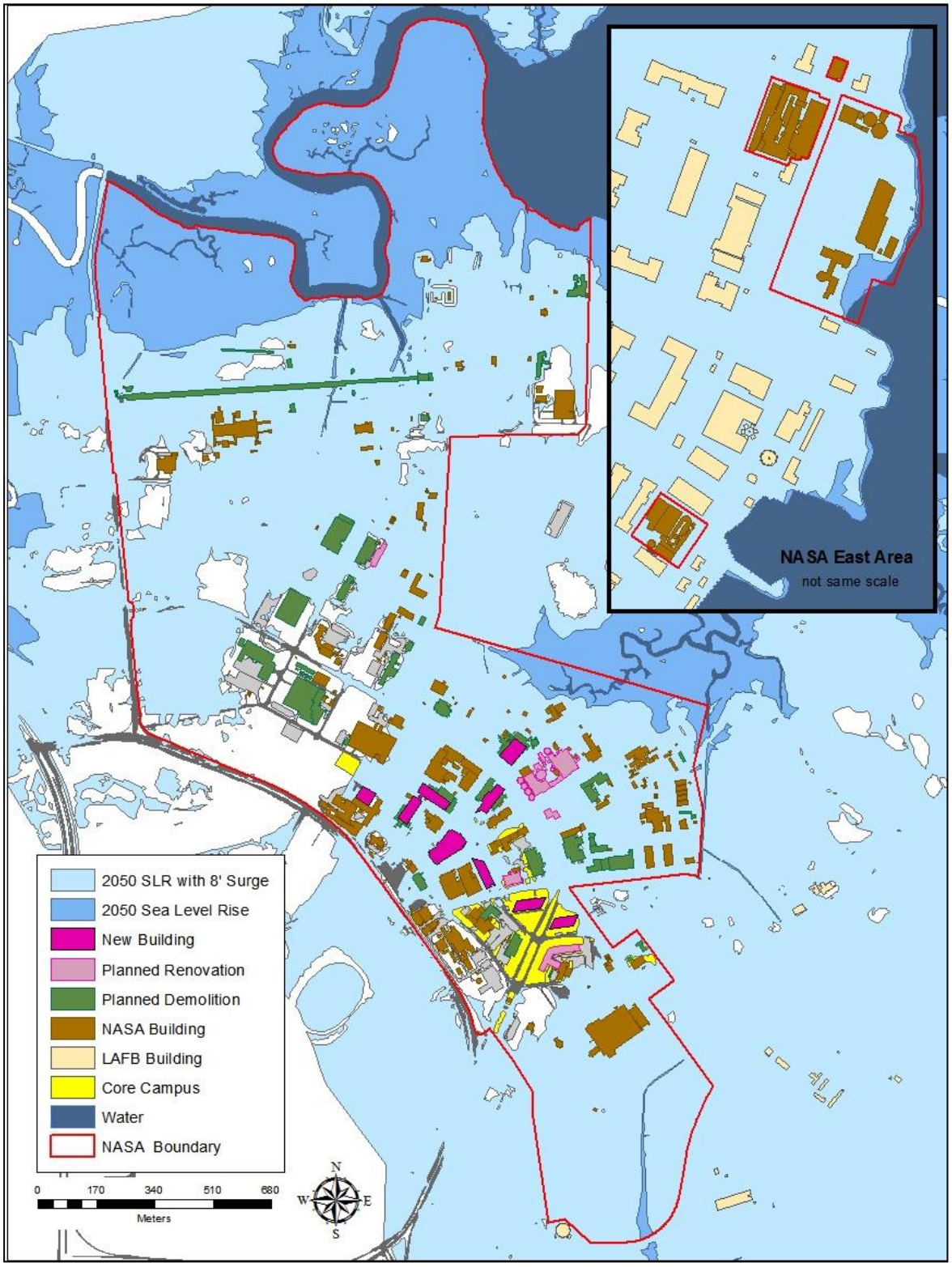


Figure 3.5 - Sea Level Rise by 2050 with Storm Surge

3.4.7 Hazardous Materials and Waste

Various hazardous materials are used at LaRC to support the Center's mission. Center personnel are required to track hazardous materials use and storage using the web-based Chemical Material Tracking System (CMTS). Additionally, the Center requires that all chemicals are stored in accordance with OSHA requirements.

LaRC has established waste management and disposal policies and procedures. LaRC is a large-quantity generator of hazardous waste under EPA Permit Number VA2800005033. The Center is not authorized to transport hazardous waste off site, store hazardous waste beyond a 90-day accumulation period, or dispose of hazardous waste on site. LaRC uses appropriately permitted contractors to transport wastes from the 90-day Hazardous Waste Pre-Transport Facility to off-site disposal facilities. Non-hazardous, non-regulated, solid materials that are not collected for recycling are consolidated and transported for energy recovery at Hampton's Refuse-Fired Steam Generating Facility or for disposal at a local landfill.

LaRC has a number of bulk storage tanks for storage of petroleum oils and fuels. The list of active Underground Storage Tanks (USTs) and Aboveground Storage Tanks (ASTs) is maintained by LaRC environmental staff. All USTs at LaRC are equipped with electronic leak-detection systems and product inventory records are maintained by operating personnel at each facility where USTs are located. In addition, documented AST inspections are performed in accordance with Virginia AST and EPA Spill Prevention Control and Countermeasure (SPCC) regulations. Records of AST inspections are maintained by LaRC environmental staff. The Center has an Integrated Spill Contingency Plan which integrates LaRC's SPCC Plan, the Oil Discharge Contingency Plan and the Hazardous Materials Spill Plan.

LaRC is co-listed with LAFB on the EPA's National Priorities List (NPL) with several remediation sites located throughout LaRC's West Area. Remediation has been completed at the majority of LaRC's sites and several require follow on monitoring. The LaRC Manager of Environmental Restoration is responsible for overseeing site remediation and monitoring activities and for coordinating with the LAFB remediation manager. Background and site status information on LaRC's NPL sites is available on the EPA Superfund Site Information website: http://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0303768.

Approximately 14.5 hectares (36 acres) of land along LaRC's east boundary was previously owned by the Department of Defense and as such, is eligible for the Formerly Used Defense Site (FUDS) Program. LaRC is currently investigating the area to determine if any Air Force activities may have contaminated the property. Preliminary information received from the Remediation Program Manager at LAFB indicates that no activities have occurred that would have contaminated the site, with the exception of pesticides, since the land is adjacent to the LAFB golf course.

Additional information on hazardous materials and waste, storage tanks and NPL sites is available in Chapters 7, 11 and 16 respectively of LaRC's ERD: http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts

It is anticipated that construction activities could have a negligible short-term adverse impact on the environment resulting from the hazardous material use and waste generation at the Center. Hazardous materials such as paints, thinners, sealants, adhesives, solvents, compressed gases and fuel may be used during construction activities. Construction contractors would be required to follow LaRC's hazardous materials use and storage requirements. All waste generated from the construction activities would be disposed of in accordance with LaRC's waste management procedures and applicable Federal, State, and local regulations. In the event that petroleum contaminated soils and groundwater were discovered during any construction activities, LaRC would properly characterize and dispose of such materials at an appropriately permitted waste management facility.

In accordance with established Center procedures, buildings planned for renovation, abandonment or demolition would be thoroughly inspected for hazardous and regulated materials prior to renovation, closure and/or demolition. Examples of hazardous and regulated materials that could be encountered include asbestos containing materials, lead based paint, mercury switches, light ballasts, fluorescent light bulbs, oils, and chemicals. For renovation and demolition projects, these materials would be removed and properly disposed of in accordance with LaRC's waste management procedures.

Other construction activities that involve the use or disposal of hazardous materials and/or waste would be reviewed by LaRC environmental staff through the Center's environmental project planning review process. Where possible, use of hazardous products would be minimized through substitution with non-hazardous or low-hazardous material containing products such as low VOC-emitting materials.

Any construction projects that involve the installation or removal of ASTs and USTs and other fuel/oil filled equipment would be reviewed by LaRC environmental staff through the Center's environmental project planning review process. LaRC would ensure that installation and removal of ASTs and USTs is performed in accordance with VA DEQ storage tank regulations (9 VAC 25-580 and 9 VAC 25-91-10).

Any soil that is suspected of contamination or any wastes that are generated during construction activities would be tested and disposed of in accordance with applicable federal, state and local laws and regulations. If evidence of a petroleum release is discovered during construction activities, LaRC would report the release to DEQ as authorized by Virginia Code #62.1-44.34.8 through 9 and 9VAC25-580-10 *et seq*. Additionally, any petroleum-contaminated soils and groundwater generated during construction activities would be characterized and properly disposed of.

No construction activities would occur at any of the Center's NPL sites. As part of LaRC's environmental project planning review process, these sites are restricted as "no build," and the LaRC Manager of Environmental Restoration monitors their status. As shown in Figure 3.6, demolition activities would occur on the edge of the FUDS property and other construction activitis would occur within close proximity. In the event that any contamination is encountered during construction and demolition activities, work would immediately stop and the LaRC Manager of Environmental Restoration would coordinate remediation with the Air Force.

A GIS database search of waste-related databases revealed other NPL, hazardous waste, solid waste, and Voluntary Remediation Sites located near LaRC; however, none of the sites are within a 0.8 kilometer (half mile) radius of any of the construction sites.

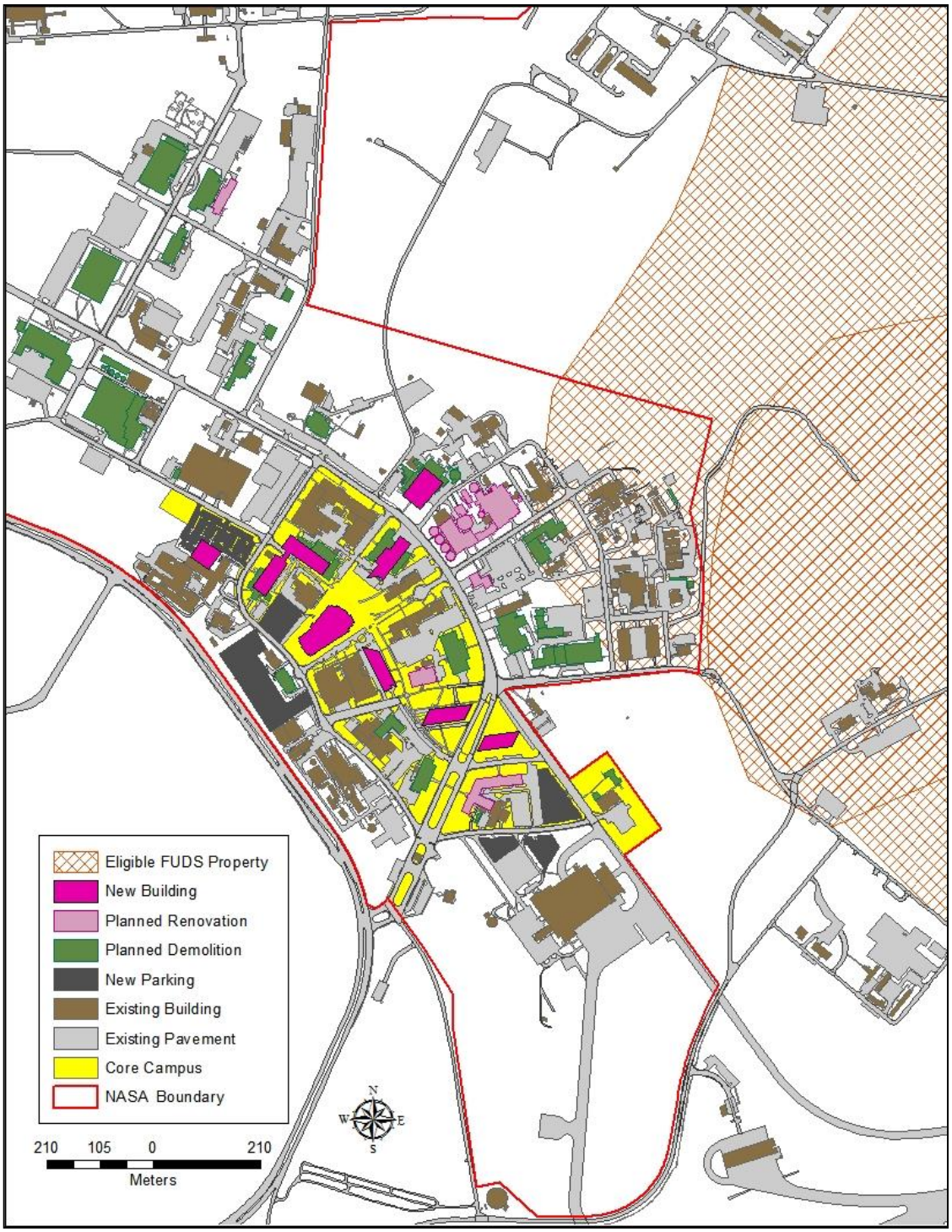


Figure 3.6 - Location of FUDS Property at LaRC

Operational Impacts
Following completion of the construction activities, Center operations would be carried out in accordance with LaRC's established hazardous materials use and waste disposal requirements. LaRC's ongoing policy of material substitution and waste minimization could result in reductions in hazardous materials used and disposed of at the Center. It is not expected that any new types of hazardous wastes would be generated as a result of Center operations; however any new waste streams would be properly characterized by LaRC environmental staff in accordance with established waste characterization procedures. Additionally, any projects or activities involving installation or removal of chemical/fuel/oil filled equipment would be reviewed by LaRC environmental staff to ensure compliance with applicable regulations.

No-Action
Under the No-Action alternative, there would be no change to the current levels of hazardous materials used or waste generated at the Center.

3.4.8 Pollution Prevention and Recycling

LaRC has established a pollution prevention (P2) policy with the goal of minimizing the volume and toxicity of wastes generated at the Center to the extent technically and economically feasible. Over the last few years LaRC's P2 Program has been integrated into the broader Environmental Management System (EMS) program (see Section 1.4 for more detail).

As part of its daily operations, LaRC recycles white and mixed paper, cardboard, toner cartridges, plastic bottles, aluminum cans, scrap metal, used oil, batteries, fluorescent light bulbs, and used tires. Additionally, construction contractors are required to recycle construction and demolition (C&D) debris to the maximum extent possible. In FY 2012, LaRC achieved an overall landfill diversion rate of 93 percent; which included recycled C&D debris; recyclable items such as paper, aluminum cans, and plastic bottles; and solid waste sent to the RECOUP facility for on-site steam generation. During FY 2012, LaRC recycled over 403,244 Kg (889,000 lbs.) of recyclables (excluding C&D debris) and burned over 699,439 Kg (1,542,000 lbs.) of non-hazardous waste to generate steam for use by the Center's facilities. Less than 132,499 Kg (292,000 lbs.) were sent to landfills. Of 1,291,377 Kg (2,847,000 lbs.) of C&D debris generated, 97 percent was recycled or reused.

Additional information on pollution prevention and recycling at LaRC is available in Chapter 7 of LaRC's ERD: http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts
Construction activities could result in minor short-term adverse impacts relating to the potential generation of pollution at LaRC. In order to minimize the impacts, construction activities would be carried out following Center's principles of P2, to include source reduction, recycling/reuse, treatment and proper disposal of wastes. Materials generated from construction activities such as concrete, steel structural elements and other metals would be recycled to the maximum extent possible. Furthermore, contractors would be required to follow applicable Best Management Practices to further reduce pollution.

New construction and building renovations would conform to at least the silver standard established by the LEED Green Building Rating System. Additionally, sustainability initiatives that could be implemented include energy-efficient lighting; "green" roofs; xeriscaping; and the use of wind, solar, or geothermal energy. While there would be a temporary increase in solid waste generated during construction activities, this would be offset by upgrading or replacing outdated, inefficient facilities with energy-efficient, sustainably designed structures.

Operational Impacts

Following completion of construction activities, Center operations would be consistent with LaRC's current P2 and recycling policies which focus on source reduction, recycling, recovery and reuse. The reduction in the Center's footprint and operation of more energy efficient facilities and systems would result in moderate long-term beneficial impacts on the P2 and EMS program goals of the Center and the Agency.

No-Action Alternative

Under the No-Action alternative, LaRC would continue to operate aging and inefficient infrastructure. Lack of upgrades to buildings and systems and no new construction could result in releases of pollutants to the environment (e.g., failure to upgrade/replace portions of the sanitary sewer system could result in a sewage release; failure to replace an aging transformer could result in release of transformer oil). As such, implementation of the No-Action alternative could have minor long-term adverse impacts on the Center's ability to prevent the release of pollutants to the environment.

3.5 Biological Environment

The most current biological surveys of LaRC include a 2009 facility-wide habitat classification and wildlife survey and a 1995 facility-wide fish, wildlife, and plant survey.

Fish and Wildlife

LaRC supports several wildlife species with its unimproved lands providing habitat for fur-bearing (game) mammals, small mammals, migratory and non-migratory birds, reptiles, amphibians, and fish. Tall fencing surrounding the property limits movement of many larger animals on and off the property from adjacent unimproved lands. Some species that would be expected in this area include common rodents, such as house mouse or white-footed mouse; birds such as American robin, blue jay, fish crow, and common grackle; and reptiles such as eastern box turtle. LaRC also attracts some raccoons, foxes, and Virginia opossum that forage from the adjacent woods and wetland areas. The northern boundary of LaRC (predominantly wetlands), Brick Kiln Creek and the Back River are designated as an Essential Fish Habitat area. Additionally, the Northwest and Southwest Branches of the Back River are condemned shellfish–growing waters and are identified on the State's list of impaired waters due to high levels of Fecal Coliform.

Vegetation

Significant portions of LaRC contain undeveloped wooded vegetation as well as large areas of maintained grass and landscaping. Fourteen habitat types have been identified at LaRC, with the dominant habitat types consisting of Developed and Maintained areas. The flora at LaRC is

dominated by maintained areas consisting of mowed grass, shrubs, and ornamentals. The majority of non-developed, non-maintained habitat consists of Coastal Plain Forest dominated by hardwood, with evergreens being predominant in the southern forested area. The 2009 survey identified 66 plant species, none of which are federally listed as threatened or endangered.

Threatened and Endangered Species

While no threatened and endangered animal species were identified in the most recent biological survey of LaRC conducted in 2009, the potential exists for species to occur at the Center as transient visitors from surrounding areas. Table 3.4 lists the animal species that have been identified in the Cities of Hampton and Poquoson within the past 25 years.

Table 3.4 - Threatened, Endangered and Special Concern Species

Common Name	Status	Last Year Observed
Sedge Wren	SSC	1992
Gull-billed Tern	ST	2010
Bald eagle	FSOC,ST	2012
Piping Plover	FT, ST	1989
Great egret	SSC	2012
Least Tern	SSC	1999
Northern harrier	SSC	1992
Royal Tern	SSC	2010
Black Skimmer	SSC	1989
Sandwich Tern	SSC	2010
Atlantic Sturgeon	SE	2007
Canebrake Rattlesnake	SE	2010
Notes: FT = Federal Threatened; SE = State Endangered; ST = State Threatened; FSOC = Federal Species of Concern SSC = State Special Concern		

Source: VA Department of Conservation and Recreation, Division of Natural Heritage website, 2013

Additional information on LaRC's biological resources is available in Chapters 5 and 6 of LaRC's ERD: http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts

It is expected that any adverse impacts to wildlife caused by construction activities would be minor and short-term. Disturbance resulting from construction activities would be limited to the local project sites. The activity and noise generated from construction activities could temporarily displace most wildlife from the immediate vicinity of the project areas. In the event that construction activities encountered any bird nesting activity, work would be stopped and LaRC Environmental staff would contact the local U.S. Fish and Wildlife Office.

Minimal vegetation exists in LaRC's East Area as the buildings and structures are mainly surrounded by parking lots and LAFB buildings. Figure 3.7 shows the location and general types of vegetation in LaRC's West Area in relation to the construction activities. The majority of vegetation that would be impacted by construction activities would be manicured grass and landscaping plants in the construction areas, but these landscapes would be replanted following

completion of construction. Any cleared areas would be re-seeded or allowed to revert to native vegetation. Additionally, activities with the potential to impact trees would be reviewed by LaRC environmental staff to ensure appropriate protection measures are employed. LaRC environmental staff would also review design plans for any new landscaping projects to ensure the appropriate native species of plants and trees are selected. It is expected that any adverse impacts to vegetation caused by construction activities would be minor and short-term.

Since no endangered or threatened species are known to occur at LaRC, no impacts are expected from construction activities. In the event that one of the species identified in Table 3.4 is encountered during construction activities, work would be stopped and LaRC environmental staff would contact the Virginia Department of Game and Inland Fisheries.

Operational Impacts

Following completion of construction activities, it is anticipated that minor long-term beneficial impacts to biological resources would occur as the result of increased green space on LaRC property. Additionally, Center operations would be carried out in a more centralized area which would result in fewer disturbances to wildlife living in the outlying areas of the Center.

No-Action Alternative

Under the No-Action alternative, there would be no change to the biological resources at LaRC.

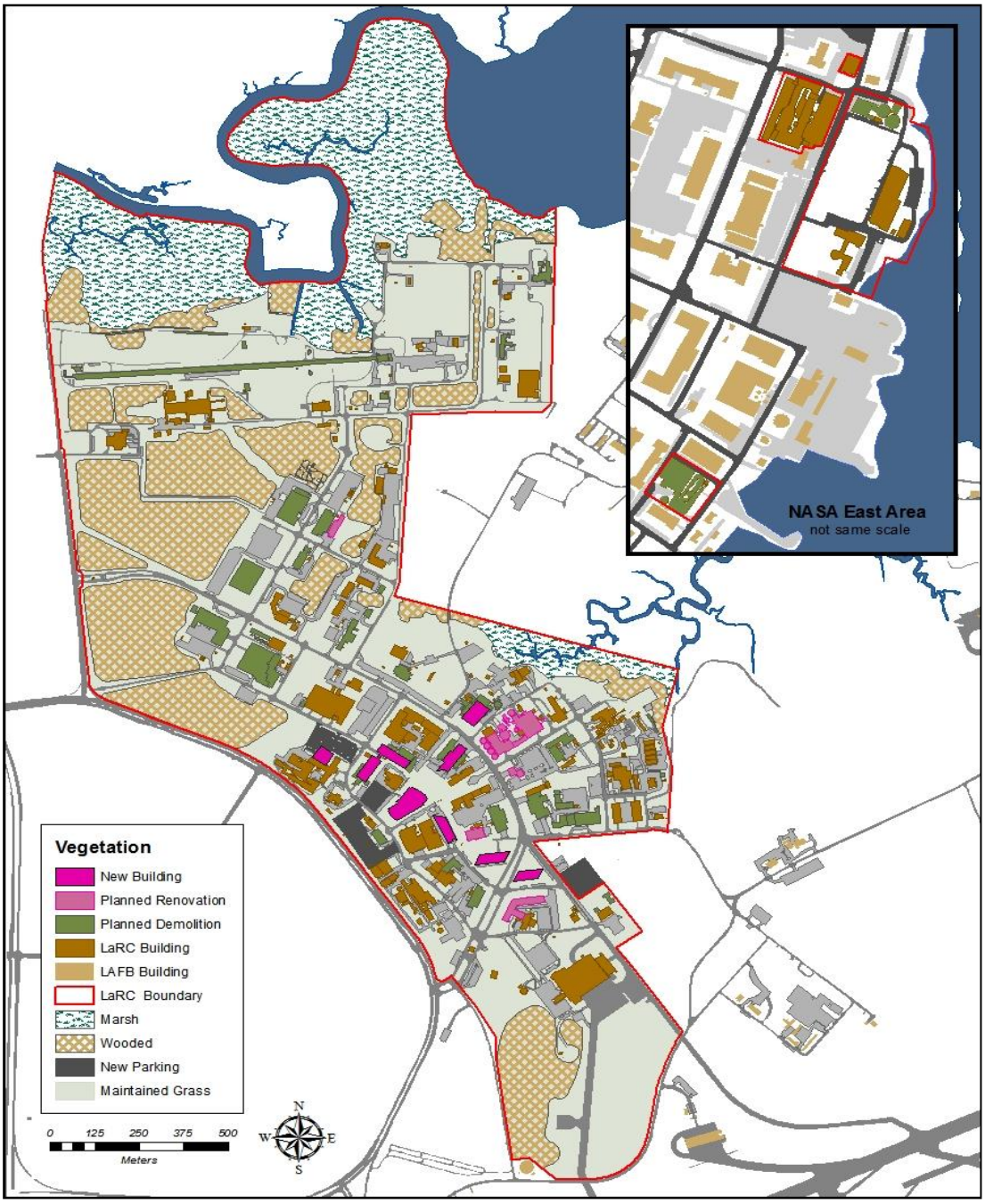


Figure 3.7 - Vegetation at LaRC

3.6 Social and Economic Environment

3.6.1 Land Use

Many areas within LaRC's West Area are developed to a certain degree, although several large contiguous tracts of undeveloped land exist within the area. The largest undeveloped sections of the West Area consist of a wooded tract in the southern portion adjacent to LAFB, an extensive wooded area along State Route 172, and individual open tracts scattered throughout the northern

portion of the Center. The East Area, which is located on LAFB property, is almost fully developed. LaRC's land use planning process involves developing functional zones throughout the Center's West Area. The functional zones are defined by the types of activities performed and infrastructure located within each area. The functional zones are incorporated into the Center's Master Plan and assist LaRC planning personnel in developing cohesive and streamlined strategies for future land use and development at the Center.

Additional information on land use at LaRC is available in Chapter 4 of LaRC's ERD: http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts
Construction activities would be consistent with the Center's Master Plan functional zones and new construction would mainly occur within the compact "New Town" core. Figure 3.8 shows LaRC's functional zones in relation to the construction activities. Land use immediately adjacent to construction activities would be impacted by modified parking/pedestrian spines, and increased background noise. It is anticipated that any adverse impacts to land use associated with construction activities would be minor and short-term.

Operational Impacts
Following completion of construction activities, land use at LaRC would be modified as LaRC's operations would be more centralized and previously developed areas would be open green space. For LaRC's East Area, following demolition of LaRC's buildings, the land would be returned to LAFB, and it is anticipated that the subsequent land use would be consistent with LAFB master planning requirements. Long-term improved land use at LaRC would occur as the Center's overall footprint would be reduced resulting in maximized open green space and a pedestrian-friendly centralized campus that would obviate the need for vehicular transportation between facilities. Additionally, Center operations would be consistent with the established functional zones at LaRC.

No-Action Alternative
Implementation of the No-Action alternative would not impact current land use and the Center's infrastructure would remain poorly distributed. The opportunity to streamline operations and maximize green space would be obviated and the land use would be inconsistent with the Center's established functional zones.

3.6.2 Economy and Employment

LaRC is located within the Norfolk-Virginia Beach-Newport News, VA-NC Metropolitan Statistical Area (MSA) known as Hampton Roads. The area is the 36th largest MSA in the U.S. and the second largest between Washington, D.C. and Atlanta, Georgia. Total employment for the Hampton Roads MSA in 2012 was 790,065. On an annual basis, LaRC contributes significantly to the local economy, and to the state and national economies. In addition to employing 3,630 full-time civil service and contractors on site, LaRC's operations support jobs for research professionals, scientists, engineers and administrative services throughout Virginia and the U.S. Table 3.5 provides LaRC's economic impact and jobs information for the past three fiscal years.

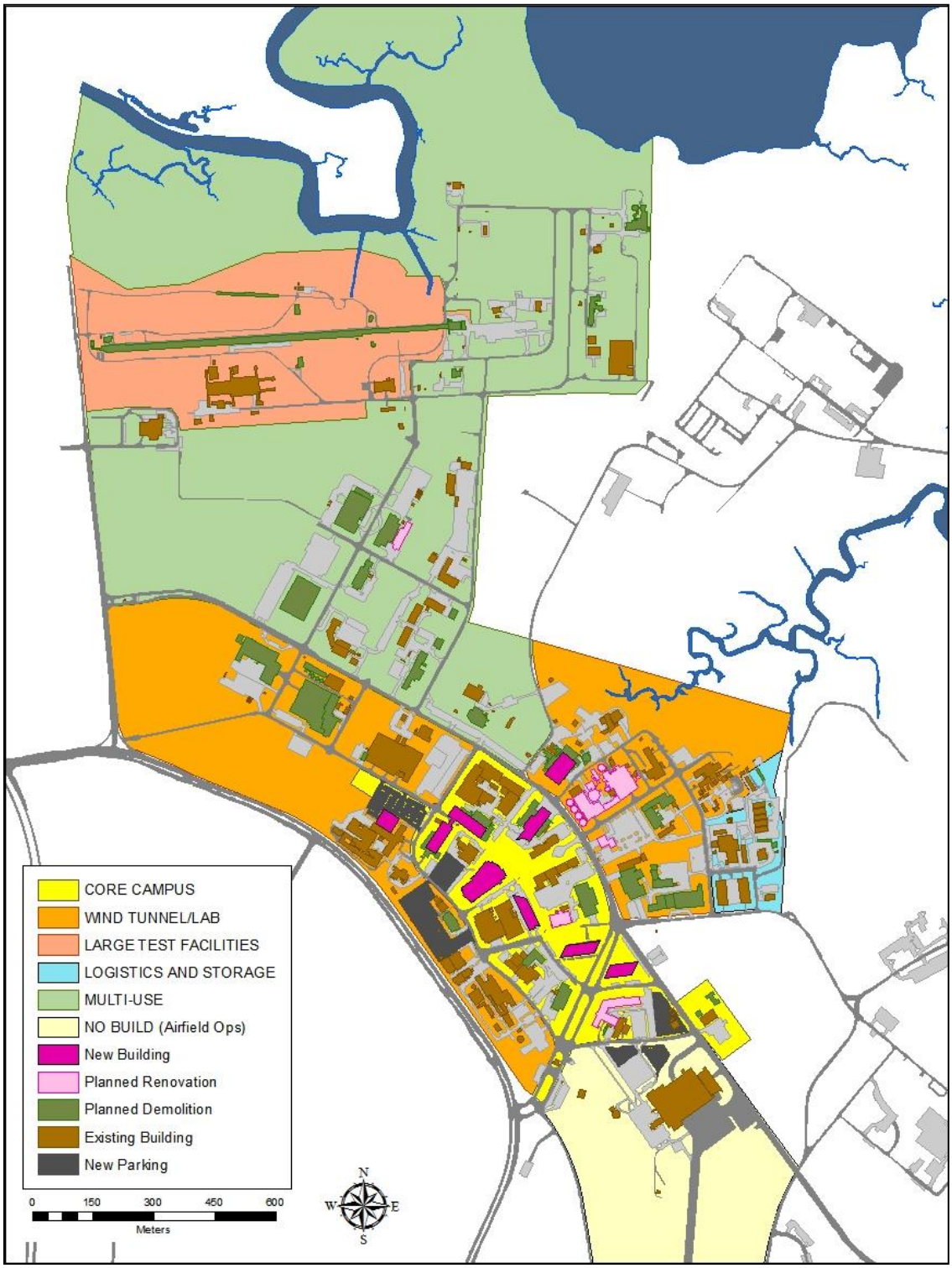


Figure 3.8 - Functional Zones at LaRC

Table 3.5 - LaRC's Economic and Jobs Impact

FY	U.S.		Virginia		Hampton Roads	
	Impact	Supporting Jobs	Impact	Supporting Jobs	Impact	Supporting Jobs
2010	$2.1 B	16,865	$946.8 M	8,624	$886.7 M	7,962
2011	$2.1 B	17,062	$1 B	9,058	$937.3 M	8,839
2012	$2.3 B	18,743	$989.8 M	8,888	$886.3 M	7,594

B = billion; M = million; NASA Langley Annual Reports for FY2010, 2011 and 2012.

Additional information on economy and employment is available in Chapter 13 of LaRC's ERD: http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts

Construction activities would involve support from contractors located within the local region as well as outside of Virginia. Since the majority of on-site construction work would be performed by contractors from the regional work force, the increase in employment opportunities would benefit local businesses and stores. Activities associated with construction engineering and design, as well as building material manufacture and supply could be performed by businesses located outside of Virginia which would stimulate economic growth in other parts of the U.S. As such, it is anticipated that construction activities would have moderate short-term beneficial impacts on the local economy and minor short-term beneficial impacts on the regional and U.S. economies.

Operational Impacts

Upon completion of construction activities, it is anticipated that staffing levels at the Center would be consistent with current levels and LaRC's operations would continue to contribute to the local, state and national economies. LaRC's new and upgraded facilities and infrastructure and enhanced capabilities would enable the Center to continue to perform leading-edge research in space exploration, aeronautics and science. In addition to attracting and retaining expert research professionals, scientists and engineers, LaRC's enhanced capabilities would increase the opportunity for partnerships with research and technology businesses located locally as well as throughout the U.S. As such, it is anticipated that Center operations would have moderate long-term beneficial impacts on the local economy and minor long-term beneficial impacts on the regional and U.S. economies.

No-Action Alternative

Under the No-Action alternative, LaRC would continue to operate aging infrastructure and over time, the Center's ability to perform leading-edge research would become compromised, potentially resulting in a loss of programs, projects, and associated workforce. Also, attracting and retaining highly qualified employees would become a challenge. Additionally, the No-Action alternative could place the Center at risk of closure if LaRC is no longer able to support NASA's mission. As such, implementation of the No-Action alternative could result in moderate to major adverse impacts to the Center and minor adverse impacts to the local, regional and U.S. economies.

3.6.3 Transportation and Parking

LaRC is served by a transportation system that connects it to local, regional and national points. Interstate Highway 64 is located within 6.4 km (4.0 mi) and connects LaRC regionally and nationally. The principal arterial road providing access to the main entrance of LaRC is State Route 172/Commander Shepard Boulevard which feeds from State Route 134/Magruder Boulevard and Armistead Avenue. The primary arterial road leading to the back entrance of LaRC is Wythe Creek Boulevard. The arterial roads in the vicinity of LaRC are currently maintained by Virginia Department of Transportation. Reconfiguration and improvements to LaRC's main gate entrance, and road widening of Commander Shepard Boulevard and Armistead Avenue were completed in 2005. Currently, the network of existing roads and highways are adequate to support LaRC operations and the road network within LaRC's boundaries provides convenient circulation to most points within the Center.

The parking capacity at LaRC is adequate for the number of employees and visitors, although several areas experience poor distribution of parking in relation to employee destinations. Several of the parking lots are in poor condition, with some areas doubling as truck or heavy equipment routes or staging areas. Most parking lots are asphalt cement surface course laid directly on sub-soil. As part of the New Town project, several temporary parking lots have been installed to compensate for the loss of parking areas within and adjacent to on-going construction areas.

Additional information on transportation is available in Chapter 13 of LaRC's ERD:
http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

Construction Impacts
Construction activities would result in minor short-term adverse impacts to transportation and parking at LaRC. There would be an increase in traffic volume caused by construction contractor personnel entering and exiting LaRC. This includes light duty vehicles as well as large trucks and equipment used to deliver materials and remove debris from construction sites. The volume of truck and equipment traffic could be high at times; however this volume would be episodic and dispersed over time. The potential exists for congestion annoyance and traffic backups during peak travel times at LaRC's main gate. This would cause a short-term delay for employees, contractors and visitors entering the Center.

Construction activities would involve constructing and removing parking areas, as well as restricting access to existing parking located within or adjacent to construction sites. It is anticipated that up to 18,580 square meters (200,000 square feet) of new or modified parking and up to 4,645 square meters (50,000 square feet) of temporary parking may be installed in previously disturbed areas at LaRC. During the different phases of construction, existing parking lots may be fenced off for use as construction contractor staging areas. The potential exists that inadequate and poorly distributed parking could result is a short-term inconvenience for employees, contractors and visitors.

Operational Impacts
Following completion of the construction activities, it is anticipated that Center operations would result in a long-term beneficial impact to transportation and parking. The location of parking would be well-distributed and the pedestrian-friendly centralized campus combined with the

ability to "work from anywhere" (e.g., telecommuting) would result in less vehicular traffic on the Center as well as on local public roadways. Additionally, with the new and upgraded infrastructure, it is anticipated that there would be less vehicular traffic associated with performing maintenance and repairs.

No-Action

The No-Action Alternative would result in minor long-term adverse impacts to parking as the current issue of poorly distributed parking areas around the Center would not be addressed. Determining impacts to transportation under the No Action Alternative is difficult. As noted in Section 3.6.2, LaRC would continue to operate aging infrastructure and over time, the Center's ability to perform leading-edge research would become compromised, potentially resulting in a loss of programs, projects, and associated workforce at the Center. While this would result in less vehicular traffic, the increased need for maintenance and repair of the Center's aging infrastructure could result in an increase in vehicular traffic on the Center and surrounding public roads.

3.6.4 Cultural Resources

LaRC has a Cultural Resource Management Plan (CRMP) to assist personnel in managing the Center's cultural resources and historic properties. The CRMP is integrated with LaRC's Master Plan and GIS database in order to facilitate project planning and ensure historic preservation issues are addressed in project planning at the Center. Additionally, LaRC follows the *Programmatic Agreement (PA) with the Virginia SHPO and the ACHP for the Management of Facilities, Infrastructure and Sites at NASA LaRC.* The PA provides for streamlined consultation and standard mitigation for LaRC projects that may impact historic properties. NASA also has a nationwide PA for management of the Agency's National Historic Landmarks (NHLs). Copies of the PA's are available at:
http://environmental.larc.nasa.gov/cultural-resources/

LaRC has three NHLs: the Gantry, the Variable Density Tunnel and the Rendezvous Docking Simulator. Additionally, LaRC is a National Register of Historic Places (NRHP) listed Historic District with 151 contributing properties. The boundaries of the district include the entire West Area and three small areas in the East Area, which is the original site of the National Advisory Committee for Aeronautics (NACA), the pre-cursor organization to NASA. Several of the original NACA properties located in the East Area historic district are now owned by LAFB and are being used as administrative office space. Figure 3.7 shows the location of historic properties and the historic district boundaries.

LaRC also has 11 NR eligible archaeological sites and one site that is listed in the NRHP. Maps showing the locations of LaRC's archeological sites are maintained by the Center's Historic Preservation Officer (HPO).

Additional information on LaRC's cultural resources is available in Chapter 12 of LaRC's ERD:
http://environmental.larc.nasa.gov/files/2013/02/NASA-LaRC-ERD-2012.pdf

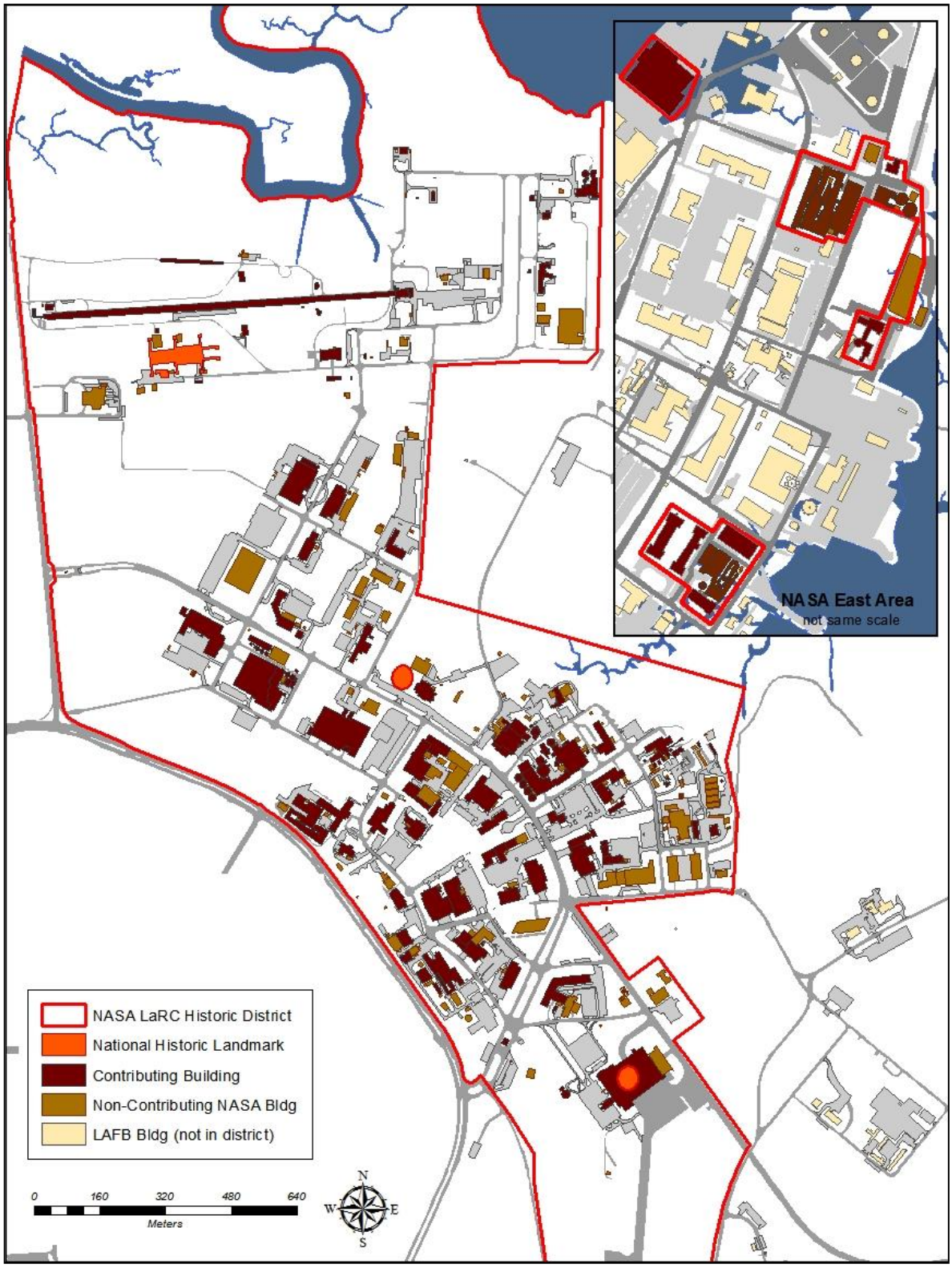


Figure 3.9 - Historic Properties and Historic District at LaRC

Construction Impacts

For architectural resources, construction activities would have moderate long-term adverse impacts on the Center's historic properties and the integrity of the Historic District. Figure 3.10 shows the location of LaRC's historic properties and the boundaries of the historic district post-construction.

Construction, renovation and demolition activities would adversely impact individual properties as well as the integrity of the historic district. LaRC would minimize the adverse impact by completing mitigation measures prescribed in the PA. Examples of mitigation include:

- Recordation – preparing documentation in accordance with the Secretary of the Interior and the Virginia Department of Historic Resources guidelines.
- Artifact Salvage and Curation – preserving architectural elements of the buildings or artifacts within the buildings for curation or display purposes.
- Public Interpretation – maintaining LaRC's Cultural Resources website to allow for public interpretation of the Center's history and cultural resources. The website includes photographs and written records associated with LaRC's properties, videotaped interviews of researchers, virtual tours of unique historic properties, and a link to "From Biplanes to Apollo: The NASA Langley Historic District" written by Joseph Chambers. The website is available at: http://crgis.ndc.nasa.gov/historic/larc.

The LaRC HPO would submit conceptual design plans for new construction and major renovation activities to the SHPO for review and comment. Additional mitigation may be performed as agreed upon by LaRC and the SHPO.

It should be noted that construction activities would not directly impact LaRC's three NHL properties. The Rendezvous Docking Simulator (RDS) is currently attached to the ceiling of Building 1244, the Hangar, and no construction activities are planned within the facility that would impact the RDS. The Variable Density Tunnel (VDT) is on display in an area next to Building 1222, the Reid Conference Center, which is planned for demolition in 2014. Prior to beginning demolition activities, the area around the VDT would be surrounded by fencing, barricades and signage to ensure that the structure is protected from heavy machinery and falling debris. Building 1297, the Gantry, is located in the northern portion of the Center which is largely undeveloped. Future demolitions in the area include the Aircraft Landing Dynamics Facility (ALDF) and several small abandoned support facilities, all of which are located at least 125 meters (136 yards) from the Gantry and as such, no impacts would occur as a result of demolition activities.

For archaeological resources, the majority of construction activities would be located in highly industrialized areas that have experienced previous ground disturbance and the discovery of undisturbed archaeological resources would not be anticipated. LaRC has several processes in place to minimize any adverse impacts to archaeological resources as a result of construction activities. The LaRC HPO reviews the design plans associated with construction activities to assess potential impacts to archaeological resources. In the event that resources were uncovered during construction, all earthmoving activity would immediately stop in the vicinity of the discovery and LaRC would notify the SHPO. In addition, LaRC would implement the procedures included in the CRMP for unanticipated discovery of cultural materials. For

construction activities located in undisturbed areas where no archaeological survey work has occurred, the HPO would consult with the SHPO in accordance with the provisions of the PA, and surveys would be conducted as required.

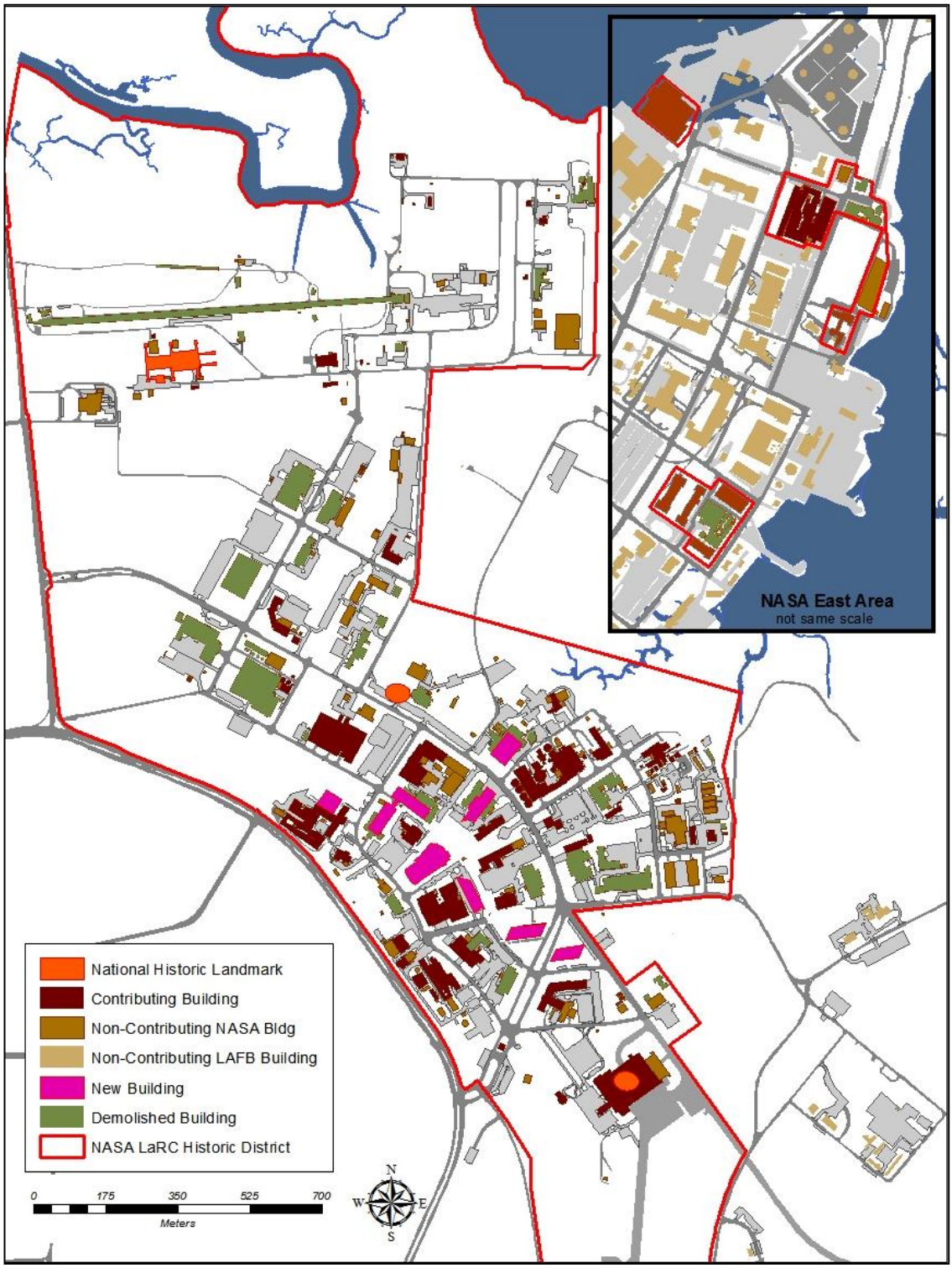


Figure 3.10 - Historic Properties at LaRC, Post-Construction

Operational Impact
Following completion of construction activities, Center operations would be carried out in accordance with the CRMP as well as the PA. The HPO would be included in the Center's environmental project planning review process to ensure that LaRC's cultural resources are managed in compliance with the National Historic Preservation Act. As such, it is anticipated that Center operations would not impact LaRC's cultural resources.

No-Action
Under the No-Action alternative, facilities proposed for demolition would remain closed and/or unused by LaRC. The lack of funding for maintenance and upkeep would result in deterioration of the facilities and present a management challenge for LaRC, as allowing a historic property to deteriorate through neglect would result in an adverse impact. As such, implementation of the No-Action alternative could have moderate long-term adverse impacts on cultural resources at LaRC.

3.6.5 Health and Safety

LaRC adheres to Occupational Safety and Health Administration (OSHA) and applicable Federal, State and local safety and health regulations. In addition to Federal regulations LaRC also implements its own health and safety regulations many of which are referenced in Langley Policy Directive 1700.1, "Safety Program." Each building at the Center is assigned a Facility Safety Head (FSH) and Facility Coordinator (FC) to ensure operations are carried out in accordance with LaRC's safety requirements.

LaRC has been recognized by OSHA as a leader in health and safety by awarding the Center the Star designation level of achievement in the Voluntary Protection Program (VPP). In addition to its VPP and Safety Programs, LaRC has its own fire program and maintains a fire department on site which is centrally located at Building 1248. In the event of an emergency such as fire, explosion, chemical spill or other accident; fire department personnel serve as first responders to initiate actions as necessary to minimize hazards to all personnel and limit damage to property and the environment.

As part of its Safety Program, contractors performing work at LaRC must comply with all applicable safety and health regulations, including OSHA, Agency and Center regulations.

Construction Impacts
Construction activities would be carried out by qualified and properly licensed and permitted contractors. Construction contractors would be required to prepare and follow a site-specific Health and Safety Plan that complies with the regulations to ensure the safety of human health and the environment. Signage, fencing and other safety measures (e.g., email to alert LaRC personnel of new traffic pattern or potential safety hazards associated with a job site) would be employed to ensure Center employees are protected from hazards associated with construction activities. Adherence to applicable health and safety procedures would minimize the risk of injury to either the contractors working in the active project areas or the surrounding LaRC personnel. As such, it is anticipated that there would be no impacts to human health and safety resulting from construction activities.

Operational Impacts
Following completion of construction activities, it is anticipated that Center operations would be carried out in accordance with the Center's Safety Program requirements. A FSH and FC would be appointed to any new facilities and new projects and activities would be reviewed by the LaRC Safety office, in addition to LaRC environmental staff, to ensure compliance with the Center's safety and environmental program requirements. The increase in operational reliability and reduction in equipment failure associated with the upgrades to infrastructure (including mechanical equipment and operating systems) could result in a minor long-term beneficial impact to human health and safety at LaRC.

No-Action
Under the No-Action alternative, minor adverse impacts to human health and safety could occur. LaRC personnel would continue to work in old facilities which may have asbestos containing materials, lead paint, and old HVAC systems; and the potential would exist for worker exposure to hazardous materials and poor indoor air quality. Additionally, lack of upgrades to the Center's infrastructure could result in equipment failure and possible injury to workers.

3.7 Cumulative Impacts

The CEQ regulations require that all Federal agencies include cumulative impacts in their environmental analyses. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions". This includes those that may be "individually minor but collectively significant actions taking place over time."

There are two approaches to analyzing cumulative impacts. The first is the list approach, which requires identification of specific past, present, and reasonably anticipated future projects producing related or cumulative impacts. The second is the summary approach wherein the relevant projections contained in adopted general plans or related planning documents designed to evaluate regional or area-wide conditions are summarized. This EA uses the projection approach and summarizes cumulative impacts based on past, present and future regional development and growth projections. Since the Proposed Action is a long-term, multi-decade project, other plans, projects and programs could be implemented; but their timing is unknown and their effects cannot be precisely determined or quantified at this time.

Since the majority of impacts associated with the Proposed Action are related to construction and development activities, other past, present and reasonably-foreseeable future construction and development projects in the area surrounding LaRC have been summarized. The information was obtained from the most current comprehensive and community planning documents for LAFB and the surrounding cities of Hampton, Newport News and Poquoson.

Past Activities
The following provides some general examples of activities that have occurred over the past ten years by area:

LaRC – Center-wide demolition initiative to remove abandoned and unneeded infrastructure; renovation of buildings and construction of new facilities and parking lots; and upgrades to utility systems.

LAFB- Expansion and renovation of the LAFB Hospital, construction of a new fitness center, renovation of housing, renovation of Bayview Towers, various building demolitions, shoreline restoration and hardening, construction of new dormitories, repairs to King Street and Tabbs Creek Bridges, construction of various F/A-22 support facilities, and construction of commercial truck inspection station.

Newport News - development of City Center at Oyster Point and Port Warwick; expansions of Christopher Newport University, Mariners Museum, Virginia Living Museum and Riverside Regional Medical Center; redevelopment of Madison Heights and Orcutt Homes in the Southeast community; revitalization of the Patrick Henry retail area; upgrades and improvements to various transportation systems.

Hampton – development of the National Institute for Aerospace (NIA), re-configuration of Magruder and Commander Shepard Boulevards, development of the Hampton Roads Convention Center, development of Coliseum Central to include the Peninsula Town Center, Boo Wouldiams Sports Complex, the Power Plant, Sentara Medical Complex and streetscaping; development of Buckroe Beach area to include construction of the Parade of Homes and a new fishing pier, streetscaping and beach re-nourishment; development of Downtown to include construction of new apartments, condominiums and parking lots, and streetscaping; development of the Kecoughtan area to include construction of a new housing area and new school; development of the King Street area to include construction of mixed-use apartment and retail space and improvements to roads; development of the Phoebus area to include expansion of the American Theatre and construction of retail spaces; and closure of Fort Monroe.

Poquoson – installation and upgrades of utilities, road improvements/widening, construction of several housing communities, and renovation of the Whitehouse Cove Marina.

Present and Future Activities

Due to the low inventory of developable land in the region, it is expected that the majority of current and future activities would focus on redevelopment and revitalization of existing infrastructure and developed areas. The following provides some general examples of activities by area:

LaRC – activities associated with the Proposed Action.

LAFB – Upgrading and/or replacing utility systems; demolishing unneeded and outdated infrastructure (including Building 720); renovating existing buildings; constructing and re-configuring parking areas and sidewalks; reusing property of former NASA facilities as infill sites for administrative facilities; developing an outdoor recreation area and walkways near the marina; redeveloping portions of the flightline to maximize use and improve aircraft and vehicle circulation and parking; constructing new facilities such as a security forces compound, indoor small arms range, kennel, consolidated communications compound, gas

station, veterinary clinic and fire station; relocating the fuel pier; and constructing a new North Base gate.

Newport News – redeveloping and revitalizing Downtown, the Southeast Community and the Upper Warwick Boulevard Commercial Corridor in Denbigh; revitalizing the Parkview/Newmarket area along Jefferson Avenue, the Ivy Farms/Beaconsdale area and the Greater Hilton Area; continuing development of Oyster Point/Jefferson Ave. area, and streetscaping, upgrading and improving roads and transportation systems.

Hampton – continuing redevelopment of Buckroe Beach area; extending Commander Shepard Blvd. from North Campus Parkway to Big Bethel Road; constructing new public elementary schools; maintaining and modernizing parks and recreation facilities; developing portions of Fort Monroe; and streetscaping, upgrading and improving roads and transportation systems.

Poquoson – developing the Big Woods area for commercial and professional use, improving the sidewalk and bike path system, widening roads (Victory Blvd. from Wythe Creek Road to Magruder Boulevard, and Wythe Creek Road from Huntlandia Avenue to LaRC's back gate), streetscaping, and improving parks and recreation facilities.

Below is a description of potential cumulative impacts for those resource areas of principal concern that are likely to be affected by implementation of the Proposed Action when combined with impacts from past, present and future actions as described above. The term "Combined Projects" is used as a general descriptor for the Proposed Action combined with the other past, present and future actions occurring within the defined geographic scope. It should be noted that since limited quantitative data is available for the actions described above, the cumulative impacts are assessed qualitatively.

Air Quality – The geographic scope for cumulative air quality impacts is the Hampton Roads Intrastate Air Quality Control Region (AQCR) which consists of the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach and Wouldiamsburg, and the counties of Isle of Wight, James City, Southampton and York. For purposes of impact analysis, it is assumed that the types of construction activities that have occurred and would be occurring throughout the AQCR are similar to those described above. Construction activities associated with the Combined Projects occurring in the AQCR would generate intermittent, short-term emissions of criteria pollutants and toxic air contaminants, including suspended and inhalable particulate matter and equipment exhaust emissions. It is anticipated that construction sites would implement mitigation measures and BMPs to control fugitive dust and vehicle and equipment emissions. As such, the adverse cumulative impacts to air quality are expected to be minor and short-term.

Water Quality – The geographic scope for cumulative impacts to water quality includes Brick Kiln Creek, Tabbs Creek, the Back River and the Chesapeake Bay. Construction activities associated with the Combined Projects occurring within this area could result in minor short-term cumulative adverse impacts to the surface water resources as soil disturbance during construction may produce a minor and temporary increase in suspended solids in the stormwater

runoff. In order to mitigate the impacts, it is anticipated that construction sites would obtain the appropriate permits, prepare a SWPPP and ESC Plan, and implement BMPs.

Hazardous and Solid Waste – The geographic scope for cumulative hazardous and solid waste impacts includes LaRC, LAFB, and the surrounding cities of Hampton, Newport News and Poquoson. It is expected that the volumes of hazardous materials used and hazardous wastes generated from the Combined Projects would not be substantial and that construction sites would follow applicable regulations and employ BMPs in the transportation, storage, handling and disposal of hazardous materials and waste. As such, any adverse cumulative impacts to the environment resulting from hazardous materials use and waste disposal would be minor and short-term.

The volume of solid waste generated from the Combined Projects could be considerable; however, generation would be occurring over a 20-year period. It is anticipated that construction sites would recycle solid waste such as demolition debris and construction materials to the maximum extent practicable to minimize impacts to local waste disposal sites. As such, the adverse cumulative impacts from solid waste generation are expected to be minor and short-term.

GHG emissions and Climate Change – The geographic scope for GHG emission impacts is the AQCR. For purposes of impact analysis, it is assumed that the types of construction activities that have occurred and would be occurring throughout the AQCR are similar to those described above. Construction activities associated with the Combined Projects would cause an increase in GHG emissions from vehicle and equipment exhaust; however the activities would be intermittent and staggered over a 20-year period. It is anticipated that the adverse cumulative impacts on GHG emissions associated with the Combined Projects would be minor and short-term.

Following completion of the Combined Projects, the potential long-term cumulative impacts resulting from climate change are difficult to determine. While new, upgraded and storm hardened infrastructure would better withstand fluctuations in temperature and provide protection against extreme weather events, sea-level rise and increased storm intensity and/or frequency in the Hampton Roads area could result in long-term adverse impacts.

Economy and Employment – The geographic scope for cumulative impacts on the economy and employment includes the Hampton Roads area, and other parts of Virginia and the U.S. Construction activities associated with the Combined Projects would involve support from contractors located within the local region as well as outside of Virginia. Since the majority of on-site construction work would be performed by contractors from the regional work force, the increase in employment opportunities would benefit local businesses and stores. Activities associated with construction engineering and design, as well as building material manufacture and supply could be performed by businesses located outside of Virginia which would stimulate economic growth in other parts of the U.S. As such, it is expected that cumulative impacts associated with the Combined Projects would have a short-term moderate beneficial impact on the local economy and minor short-term beneficial impact on the regional and U.S. economies.

Transportation – The geographic scope for cumulative impacts on transportation includes LaRC, LAFB and the surrounding arterial roads. The cumulative impacts from the Combined Projects could result in moderate short-term adverse impacts to the transportation system. The impacts would be caused by an increase in construction vehicle traffic, road closures and detours. The potential widening of Wythe Creek Road would be the most significant project as the road serves as the main route from LaRC and LAFB to Poquoson. Road closures associated with the project could impact employee access to LaRC's back gate and cause increased traffic volume at the main gate. Since the Wythe Creek Road widening would occur concurrently with the Proposed Action, the increase in construction traffic, when combined with detoured traffic, could result in moderate traffic congestion and backups on the arterial roads surrounding LaRC during peak travel times. The potential construction of a new North Base gate for LAFB would result in similar impacts, as the proposed location for the new gate is near LaRC's main gate.

Cultural Resources – The geographic scope for cumulative impacts to cultural resources includes LaRC and LAFB since the two installations have historic architectural resources associated with the development of Langley Field and its two Federal occupants, the air arm of the U.S. Army (pre-cursor to LAFB), and NACA (pre-cursor to NASA). The two installations also have archaeological resources associated with plantation sites dating back to the seventeenth century. Several of the sites extended across both LaRC and LAFB and have related histories associated with land transfers and intermarriage of property owners.

Architectural Resources
LAFB is proposing to demolish Building 720 which is a contributing resource to the LaRC Historic District. Constructed in 1931, Building 720 is the office portion of the NACA Tow Tank No. 1 facility which was originally used to test the hydrodynamics of takeoff and landing for seaplanes. The facility was transferred to LAFB in 2006 and the tow tank portion was demolished. LAFB is proposing to demolish the office portion in 2014.

Building 720 is located adjacent to Building 644 (LaRC's Low Speed Tunnel), and Building 645 (LaRC's Vertical Spin Tunnel), both of which may be abandoned and demolished as part of the Proposed Action. Building 648 (LaRC's Transonic Dynamics Tunnel) is also located in the same area and the long-term need for this facility past the year 2023 is uncertain. Past and on-going demolitions of other LaRC properties within the area include Building 640 (the 8-Foot Transonic Tunnel), Building 641 (the 8-Foot High Speed Tunnel – tunnel portion only), Building 643 (the Full Scale Tunnel) and Buildings 582, 582A, 583, and 585 (the Low Turbulence Pressure Tunnel Complex). LaRC is in the process of transferring ownership of the remaining office portion of Building 641 to LAFB for use as administrative office space. LAFB is proposing demolition of Building 999, which is a small chapel located within the Lighter than Air portion of the Langley Field Historic District. The building is a contributing resource to the district. Other proposed LAFB projects include interior renovations of five National Register eligible buildings, and exterior modifications to two National Register eligible buildings.

The cumulative effects of the Combined Projects would result in moderate long-term adverse impacts to historic properties. For LaRC's past demolitions, mitigation was performed in accordance with the provisions of the PA's described in Section 3.6.4. LaRC mitigated adverse impacts by preparing Historic American Engineering Record (HAER) documentation on the

tunnels and other extensive documentation continues to be posted to LaRC's publicly available cultural resource website: http://crgis.ndc.nasa.gov/historic/larc. Additionally, architectural items have been salvaged from the tunnels for display and reuse. The winged NACA sign from the 8-Foot Transonic Tunnel and a hub/fan blade assembly from the Full Scale Tunnel were sent to the Smithsonian for long-term display. A complete list of other items that have been salvaged from LaRC's demolitions is available at: http://crgis.ndc.nasa.gov/historic/Salvaged_Artifacts. For LaRC's current and future demolitions, LaRC plans to carry out similar mitigation, as shown in Table A.3.

For LAFB demolitions and other projects, it is expected that LAFB would consult with LaRC and the SHPO to mitigate any adverse impacts to LAFB-owned properties located within LaRC's Historic District and that LAFB would consult with the SHPO to mitigate any adverse impacts to their historic properties located within the Langley Field Historic District.

Archaeological Resources

It is anticipated that the cumulative effects of the Combined Projects would result in no impacts to archaeological resources. Both LaRC and LAFB have rather extensive archaeological survey data for each installation, as well as established procedures as specified in their Cultural Resource Management Plans to ensure impacts to archaeological resources are minimized or avoided.

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APPENDIX A

PROJECTS ASSOCIATED WITH THE PROPOSED ACTION

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Appendix A
Projects Associated with the Proposed Action

Implementation of the various features of LaRC's Master Plan is dependent on the plan being reasonable and coinciding with anticipated funding levels. Master planning is an ongoing process and the overall planning schedule for the proposed projects is not absolute. Modification could be made to priorities and specific implementation dates of future facility requirements. Funding availability would be the primary driver of the schedule. Additionally, since the Proposed Action is a long-range project that would last at least twenty years, specific facility requirements could change especially during the last fifteen years of implementation. Even with these potential changes, the overall concept of development should remain intact. Table A.1 describes the various projects associated with the Proposed Action, and Table A.2 provides a list of current and possible future demolitions and the planned mitigation.

Table A.1 – Projects Associated with the Proposed Action

FY Start	Project Description	Justification and Associated Activities
FY14	Facility Rehab – Rehabilitate Building 1230 laboratory for Safety Critical Avionics Laboratory	Convert previously gutted office space in the east wing of Building 1230 (2 floors) into a Safety Critical Avionics Lab to enhance avionics research and accelerate the demolition of Building 1220; continue consolidation of assets to the New Town core campus.
FY14	Facility Upgrade - Building 1299F: Upgrade the Experimental Test Range (ETR)	Increase the Center's radio frequency and microwave test capability and replace two existing anechoic facilities located in Building 1299. Precursor to demolish Building 1299.
FY14-16	Infrastructure Rehab - Building 1247E: Compressor Station Rehab: Electrical Distribution Upgrades – Centerwide (5 phases)	Address aging infrastructure/ compressor reliability issues
FY14-16	New Construction – Computational/Office Data Center; Corps of Engineers design/build	Building 1194 (Library) was determined to be a poor candidate for rehab into a new data center; core campus: consolidation of IT resources; energy efficient. Demolish Building 1209 and repurpose Building 1268.
FY15	New Construction – New Town 3 (NT3) Measurement Sciences Laser/Lidar and Electromagnetics lab.; move Building 1220 into NT3; Move Electromagnetic Interference and Compatibility Chamber to Building 1250	Develop core campus; relevant to all Mission Directorates. Precursor to demolish Building Buildings 1200/A, 1202, and 1299. Addressed in New Town EA.

Table A.1 – Projects Associated with the Proposed Action (cont.)

FY Start	Project Description	Justification and Associated Activities
FY15-17	Facility Upgrade - Building 1247: Consolidate and re-purpose multiple research wind tunnels to complement/enhance Supersonic and Hypersonic research capability.	Consolidate existing facilities into a single, more efficient space in New Town core campus while preserving essential research capability; proactive approach eliminates substantial deferred maintenance Precursor to demolish Buildings 1221, 1251 and 1275.
FY18	New Construction – New Town 4 (NT4) Materials/Nano Research and separate Flight Dynamics Research Facility (Vertical Spin Tunnel); and possible Computational Data Center	Continue campus consolidation. Relevant to all Mission Directorates; Demolish Buildings 1209, 1238(all), 1251(all), 1267, 1267A, 1293C, 644, 645, 645A, and 646. Precursor to demolish Building 1194 and re-purpose Building 1268. Addressed in New Town EA.
FY23	New Construction – New Town 5 (NT5) Flow Physics Research Facility Baseline includes new Trisonic Research Wind Tunnel	Continue campus consolidation. Relevant to Mission Directorates; Demolish Buildings 1191 and 1214. Precursor to vacating the East Area. Addressed in New Town EA.
FY28	New Construction – New Town 6 (NT6) Integrated Systems Development Integrated Systems Development	Continue campus consolidation. Relevant to all Mission Directorates; Demolish Buildings 1225, 1232A, 1237A, 1237B, 1237C, 1250, and 1250A. Addressed in New Town EA.
Varies	New Construction – new or extended parking areas; Building 1146 (extend 99,321 sq. ft)], Building 1212 [extend 3,492 sq. meters (37,591 sq. ft.), NT2 [extend 614 sq. meters (6,611 sq. ft.)], Data Center [extend up to 8,491 sq. meters (91,401 sq. ft)],other misc. parking; total new or modified parking to equal approximately 18,580 sq. meters (200,000 sq. ft.)	Accommodate new construction and shift of LaRC workforce to centralized core campus.

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Table A.1 – Projects Associated with the Proposed Action (cont.)

FY Start	Project/Action	Description
TBD	Storm Water Analysis and Upgrades	Perform storm water run-off analysis for the Building 1268 parking lot and corresponding upgrades
TBD	Buildings 647 & 648 Perimeter Flood Barrier	Build flood control wall around Buildings 647 & 648, encapsulating the Transonic Dynamics Tunnel (TDT) courtyard
TBD	Utility Tunnel Upgrades	Install cameras, raise tunnel hatches and fresh air intakes; install stand pipes for pumping
TBD	Building Hardening	Install storm shutters at windows, grade and install French drains at Buildings 1308 and 1216; install aluminum louvered panels at Buildings 1268 and 1247E; repair exterior of various buildings to eliminate entry of wind-driven rain; install perimeter flood barrier at Building 1186 (sewage pump/lift station)
TBD	Removal of Unneeded Parking Lots/Pavement	In outlying areas, following demolitions, to increase open green space.
TBD	Electrical Substation Protection	Remove trees near substations; construct temporary wall at Building 1247E.
TBD	HVAC System Hardening/Upgrades	Raise chillers and components at Buildings 1212, 1216, 1222, and 1297; raise condensing units at Building 1248.
TBD	Tunnel Upgrade or Repurpose	Implement tunnel upgrades or repurpose the following*:* *4 subsonic tunnels:* Vertical Spin Tunnel (VST),12' Low Speed Tunnel (LST), 14x22 Subsonic Tunnel, and the Basic Aerodynamics Research Tunnel (BART) *3 transonic tunnels:* National Transonic Facility (NTF), TDT, and the 0.3Meter Transonic Cryogenic Tunnel *2 supersonic tunnels:* 6”x10” Supersonic Low Disturbance Tunnel, 20” Supersonic Wind Tunnel *5 hypersonic tunnels:* 8’ High Temperature Tunnel (HTT), 20” Mach 6, the Arc-Heated Scramjet Test Facility, the Mach 8 Variable Density Tunnel (VDT) repurposed to replace 31” Mach 10, and the Nozzle Test Chamber repurposed to a quiet flow tunnel.

Table A.1 – Projects Associated with the Proposed Action (cont.)

FY Start	Project/Action	Description
TBD	New Tunnels	Trisonic tunnel (with subsonic, transonic, and supersonic 4'x5' test section). Flight dynamics research facility to include new improved capability to replace the VST and 12' LST; proposed location is next to 14' x 22' tunnel.
TBD	New Tunnels (contingent on program funding)	Multi-gas, Hypersonic Aerodynamic planetary atmosphere tunnel for entry, descent and landing (EDL), plan is to repurpose CF4 tunnel to state-of-the-art aeroacoustic wind tunnel; move or replace the Low Speed Aeroacoustic Wind Tunnel (LSAWT) or add anechoic chamber to the new trisonic tunnel.
TBD	Tunnel Closures	CF4 Tunnel; 12' LST; Unitary Plan Wind Tunnel (UPWT), 31"Mach 10, and the 15"Mach 6 in B1251; the LSAWT, Direct Connect Supersonic Combustion Test Facilities, and the Combustion Heated Scramjet Test Facility in B1221.
TBD	Potential tunnel closures/demolitions	8' HTT - future is less clear; would depend on the Air Force committing to test their hypersonic vehicle development engines at a funding level that would cover most of the yearly operational costs. Otherwise, the NASA mission alone may not be sufficient to sustain the tunnel. UPWT - (vacated by NASA; under one-year lease by Jacobs Technology) would likely be demolished at some future date. The 31' Mach 10 and 15" Mach 6 tunnels in B1251 would be closed and new tunnels built at B1247 using repurposed assets on center to realize significant cost containment. TDT – near-term need continues, but the long-term need for the tunnel is uncertain. Aeroelasticity research and evaluating nontraditional airframe configurations such as the hybrid wing body and truss braced wing may continue however, future use by industry to test future derivative aircraft for flutter clearance is not expected. The revitalization plan calls for the TDT to close "no earlier than 2023", pending availability of the new trisonic tunnel to shift research over to the new tunnel. Replacement of the VST and 12" LST by the new flight dynamics facility could result in closure of the two tunnels and possible demolition.

Table A.2 - Current and Possible Future Demolitions and Planned Mitigation

Building #	Building Name	Demo Yr.	Planned Mitigation*
Various	Addressed in the New Town EA	2013-2025	recordation / salvage
582,582A,583,583A, 585	Low Turbulence Pressure Tunnel Complex (LTPT)	2013	recordation/salvage (complete)
1257, 1257N+S, 1258, 1258A,1259, 1260, 1261, 1261A+B	Aircraft Landing Dynamics Facility Complex	2013	recordation/salvage (complete)
1145	Visual Imaging Studio	2014	recordation
1231, 1231B	Child Development Center	2014	recordation
1298	Office Facility	2014	recordation
1275	CF4 Tunnel Complex	2015	recordation / salvage
1283	Fabrication Facility	2015	recordation / salvage
1289	Maintenance Coatings Shop	2015	recordation
1292A	Construction Storage	2015	recordation
1292B	Building Trades Shop	2015	recordation
1220	Management Information Systems Simulation	2017	recordation / salvage
1221, 1221A-E	High-Intensity Noise Research Facility	2017	recordation / salvage
1299	Flight Electronics Electromagnetics Laboratories	2017	recordation / salvage
644	12-Foot Low-Speed Tunnel (LST)	2018	large format photo doc. / salvage
645	20-Foot Vertical Spin Tunnel (VST)	2018	large format photo doc. / salvage
645A	Spin Tunnel Support Building	2018	recordation
646	Engineer Technology Laboratory	2018	large format photo doc. / salvage
1251	Unitary Plan Wind Tunnel (UPWT)	2018	recordation / salvage
1251A-E	Continuous Flow Hypersonic Tunnel + Support Buildings	2018	recordation / salvage
1267	Thermal Protection Research Lab	2018	recordation / salvage
1267A	Materials Development Shop	2018	recordation / salvage

Table A.2 – Current and Possible Future Demolitions and Planned Mitigation (cont.)

Building #	Building Name	Demo Yr	Planned Mitigation
1293C	1293 Research Complex	2018	recordation
1191	Support Offices	2023	recordation
1214	BART (tunnel)	2023	recordation / salvage
648	Transonic Dynamics Tunnel (TDT)	TBD	recordation / salvage
1194	Library	TBD	recordation / salvage
1225	Experimental Machine Shop	TBD	recordation / salvage
1232A	Structural Fabrication Offices	TBD	recordation
1237A	Foundry	TBD	recordation / salvage
1250, 1250A	Environmental + Space Sciences	TBD	recordation / salvage

*The level of recordation would depend on the type of facility. At a minimum, interior and exterior photos of the buildings would be taken prior to demolition and a page would be created on LaRC's public CRM website; any research files and documents would be removed from the facilities prior to demolition and additional documentation would be prepared in accordance with the PA's. Salvage would depend on the type of facility and items/artifacts available at each facility. (e.g., building components, models, instrumentation)

APPENDIX B

CONSULTATION LETTERS AND EA DISTRIBUTION LIST

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National Aeronautics and Space Administration
Langley Research Center
MS 133
Hampton, VA 23681

October 25, 2012

M. Amanda Lee
Historic Preservationist
Office of Review and Compliance
Virginia Department of Historic Resources
2801 Kensington Avenue
Richmond, Virginia 23221

RE: Update of Master Plan, NASA Langley Research Center, Hampton, Virginia

Dear Ms. Lee:

NASA Langley Research Center (LaRC) is in the process of updating our Master Plan. In addition to providing the baseline for Center operations, the plan includes a comprehensive revitalization strategy for managing and operating the Center's various facilities and laboratories. The plan will be implemented over the next 20 years and expands on the New Town concept. Revitalization is crucial for NASA LaRC in order to strategically align our resources with the Agency's new mission and defined core competencies.

In the coming months you will receive an Environmental Assessment (EA) document for the proposed implementation of LaRC's Master Plan. The EA will outline the scope and goals of the plan, as well as its environmental implications, including potential impacts to historic properties. As will be stated in the EA, it is our intention to satisfy the requirements of Section 106 for all individual actions arising from the activities associated with implementing the Master Plan through compliance with the terms of LaRC's Center-wide Programmatic Agreement dated January 2010.

As you review the EA, if you have any questions about LaRC's Master Plan, its implementation schedule, or its potential impacts to historic property, we would be happy to meet with you and discuss in further detail. Please feel free to contact me at 757-864-7762 or via email at mary.gainer@nasa.gov.

Sincerely,

Mary Gainer
Historic Preservation Officer

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NASA Langley Research Center
Master Plan EA Distribution List

State Agencies:

Ms. Ellie Irons, Program Manager
Virginia Department of Environmental Quality
Office of Environmental Impact Review
P.O. Box 1105
Richmond, VA 23218

Local Governments:

Ms. Judy Wiggins, City Clerk
Poquoson City Hall
500 City Hall Avenue
Poquoson, VA 23662

Mr. Neil Morgan, City Manager
10th Floor, City Hall
2400 Washington Avenue
Newport News, VA 23607

Mr. James McReynolds, York County Administrator
224 Ballard St., P.O. Box 532
Yorktown, VA 23690

Langley Air Force Base

Ms. Christine Garrett
Chief, Asset Management Flight
633d Civil Engineer Squadron (CES/CEA)
37 Sweeney Blvd.
Joint Base Langley-Eustis, Virginia 23665

Ms. Johnna Scepansky
EIAP/BCAMP/Cultural Resources Manager
633d Civil Engineer Squadron (CES/CEAO)
37 Sweeney Blvd.
Joint Base Langley-Eustis, Virginia 23665

Public
Poquoson Public Library
Hampton Main Library
NASA LaRC's NEPA Library: http://environmental.larc.nasa.gov/nepa/

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APPENDIX C

AIR CONFORMITY ANALYSIS

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Documentation of Conformity Analysis Performed 2/27/2013

Basis:
U.S. Air Force Conformity Applicability Model (ACAM) 4.5.0
Inputs provided by Thomas Gleave for the NASA LaRC Master Plan

Construction Assumptions:

- 640,000 sq. ft. of new office space constructed
- Phase 1 (Grading phase) duration = 1 year
- Gross area to be graded = 18 acres (Comment: 640,000 sq. ft. = 14.7 acres. Conservatively increased (22%) that estimate to 18 acres. In actuality, gross area to be graded would be less than 18 acres)
- Total acres paved with asphalt = 5 acres (Comment: worst case scenario as some of the paving would utilize pervious pavers)
- Start date of construction is 3rd Qtr. 2013
- Phase 2 (Construction phase) duration = 10 years (Comment: ACAM model only allows for 10 year maximum for Phase 1 (Grading) plus Phase 2 (Construction) so assumed 1 year for Phase 1 and 10 years for Phase 2).
- Assumed no dust controls in place for soil piles and for exposed surface/grading (worst case)
- Assumed truck hauling roads are paved

Demolition Assumptions:

- Duration of demolition assumed to be 2 years. This is the maximum allowed by the ACAM model.
- Total of 1.21M square feet of buildings proposed for demolished. For purposes of ACAM model, assumed one large building of dimensions 1000 ft. long x 2000 ft. wide x 20 ft. high. Therefore, demolition of a 2,000,000 sq. ft. building was modeled.
- Start date of demolition would be 3rd Qtr. 2013

The Proposed Action is not subject to the General Conformity Rule of the Clean Air Act because emissions of applicable pollutants would not exceed annual de minimis thresholds, nor are they regionally significant (i.e. 10% of regional emissions inventory).

Table C.1 - Air Conformity Applicability

Pollutant	Maximum Emissions from Proposed Action	De Minimis Threshold	10% of Regional Emissions Inventory
NO_x	5 tons per year	100 tons per year	1,351 tons per year
VOCs	1 ton per year	100 tons per year	357 tons per year

Source: US Air Force Conformity Applicability Model (ACAM) 4.5.0

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APPENDIX D

GHG EMISSIONS EVALUATIONS

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Greenhouse Gas Emissions from LaRC

Reporting Threshold = 25,000 Metric Tons

Fuel HHV and Emission Factors	Natural Gas		No. 2 Fuel Oil		Propane	
High Heat Value	1.028E-03	mmBtu/scf	0.138	mmBtu/gal	0.091	mmBtu/gal
CO2 Emission Factor	53.02	kg CO2/mmBtu	73.96	kg CO2/mmBtu	61.46	kg CO2/mmBtu
CH4 Emission Factor	1.0E-03	kg CH4/mmBtu	3.0E-03	kg CH4/mmBtu	3.0E-03	kg CH4/mmBtu
N2O Emission Factor	1.0E-04	kg N2O/mmBtu	6.0E-04	kg N2O/mmBtu	6.0E-04	kg N2O/mmBtu

Global Warming Potentials (from Table A-1 to Subpart A of Part 98)		
	CO2	1
	CH4	21
	N2O	310

Natural Gas Combustion Source	CY2008 (MMcf)	CY2007 (MMcf)	CY2006 (MMcf)	CY2005 (MMcf)	CY2004 (MMcf)	CY2003 (MMcf)
No 1 B&W Boiler	38.4	105.8	106.4	34.8	29.8	22.2
No. 2 B&W Boiler	38.0	45.6	83.6	92.2	16.2	43.3
No. 3 English Boiler	33.7	15.4	8.6	15.8	30.5	2.24
No. 5 B&W Boiler	31.1	11.7	84.6	42.6	96	74.4
Bldg. 647 Cleaver Brooks Boilers	18.0	18.0	17	16.6	17	11.7
1237A Wax Furnace	0.05	0.16	0.16	0.13	0.1	0.33
Bldg. 1236 Burners	0.10	0.18	1.00	0.97	1.13	0.95
Heaters - Natural Gas	6.83	2.22	1.39	1.56	1.13	1.4
High Temp Tunnel - Nat Gas	2.68	5.39	2.39	1.55	1.57	2.24
CF4 Tunnel Heater	0.36	0.14	0	0	0	0
Total (MMcf)	169.2	204.6	305.1	206.2	193.4	158.8
Total (scf)	**169,220,000**	**204,590,000**	**305,140,000**	**206,210,000**	**193,430,000**	**158,760,000**
Calculated CO2 Emissions (metric tons) =	9,223	11,151	16,632	11,239	10,543	8,653
Calculated CO2e Emissions (metric tons) =	9,223	11,151	16,632	11,239	10,543	8,653
Calculated CH4 Emissions (metric tons) =	0.174	0.210	0.314	0.212	0.199	0.163
Calculated CO2e Emissions (metric tons) =	3.65	4.42	6.59	4.45	4.18	3.43
Calculated N2O Emissions (metric tons) =	0.017	0.021	0.031	0.021	0.020	0.016
Calculated CO2e Emissions (metric tons) =	5.39	6.52	9.72	6.57	6.16	5.06
Natural Gas Total CO2e Emissions (metric tons) =	**9,232**	**11,162**	**16,648**	**11,250**	**10,553**	**8,662**

#2 Fuel Oil Combustion Source	CY2008 Kgal	CY2007 Kgal	CY2006 Kgal	CY2005 Kgal	CY2004 Kgal	CY2003 Kgal
No 1 B&W Boiler	0.75	0	0	17.2	2.09	5.58
No. 2 B&W Boiler	0	0	0	42.2	20.8	25.3
No. 5 B&W Boiler	0	0	0	14.8	43.2	333
Bldg. 647 Cleaver Brooks Boilers	0	0	0	2.79	6.55	24.5
Heaters #2 Fuel Oil	8.0	8.9	7.3	8.0	10.2	8.8
Total (Kgal)	8.8	8.9	7.3	85.0	82.8	397.2
Total (gal)	**8,750**	**8,900**	**7,300**	**84,990**	**82,840**	**397,180**
Calculated CO2 Emissions (metric tons) =	89	91	75	867	846	4,054
Calculated CO2e Emissions (metric tons) =	89	91	75	867	846	4,054
Calculated CH4 Emissions (metric tons) =	0.00362	0.00368	0.00302	0.03519	0.03430	0.16443
Calculated CO2e Emissions (metric tons) =	0.076	0.077	0.063	0.739	0.720	3.453
Calculated N2O Emissions (metric tons) =	0.00072	0.00074	0.00060	0.00704	0.00686	0.03289
Calculated CO2e Emissions (metric tons) =	0.225	0.228	0.187	2.18	2.13	10.2
#2 Fuel Oil Total CO2e Emissions (metric tons) =	**90**	**91**	**75**	**870**	**848**	**4,067**

Propane Source	CY2008 Kgal	CY2007 Kgal	CY2006 Kgal	CY2005 Kgal	CY2004 Kgal	CY2003 Kgal
SUE Burner Propane	1.75	5.5	1.4	0	8.36	9.79
Total (gal)	**1,750**	**5,500**	**1,400**	**0**	**8,360**	**9,790**
Calculated CO2 Emissions (metric tons) =	9.79	30.76	7.83	0	46.76	54.75
Calculated CO2e Emissions (metric tons) =	9.79	30.76	7.83	0	46.76	54.75
Calculated CH4 Emissions (metric tons) =	0.000478	0.001502	0.000382	0	0.002282	0.002673
Calculated CO2e Emissions (metric tons) =	0.0100	0.0315	0.0080	0	0.0479	0.0561
Calculated N2O Emissions (metric tons) =	0.000096	0.000300	0.000076	0	0.000456	0.000535
Calculated CO2e Emissions (metric tons) =	0.0296	0.0931	0.0237	0	0.1415	0.1657
Propane Total CO2e Emissions (metric tons) =	**9.83**	**30.9**	**7.9**	**0**	**46.9**	**55.0**
GRAND TOTAL CO2e (metric tons) =	**9,332**	**11,284**	**16,730**	**12,121**	**11,448**	**12,784**

Greenhouse Gas Emissions from LaRC (2009 - 2010)

Reporting Threshold = 25,000 Metric Tons

Fuel HHV and Emission Factors	Natural Gas		No. 2 Fuel Oil		Propane	
High Heat Value	1.028E-03	mmBtu/scf	0.138	mmBtu/gal	0.091	mmBtu/gal
CO2 Emission Factor	53.02	kg CO2/mmBtu	73.96	kg CO2/mmBtu	61.46	kg CO2/mmBtu
CH4 Emission Factor	1.0E-03	kg CH4/mmBtu	3.0E-03	kg CH4/mmBtu	3.0E-03	kg CH4/mmBtu
N2O Emission Factor	1.0E-04	kg N2O/mmBtu	6.0E-04	kg N2O/mmBtu	6.0E-04	kg N2O/mmBtu

Global Warming Potentials (from Table A-1 to Subpart A of Part 98)		
	CO2	1
	CH4	21
	N2O	310

Natural Gas Combustion Source	CY2009 (MMcf)	CY2010 (MMcf)
No 1 B&W Boiler	11.5	19.3
No. 2 B&W Boiler	87.4	92.4
No. 3 English Boiler	10.5	15.4
No. 5 B&W Boiler	19.1	20.8
Bldg. 647 Cleaver Brooks Boilers	21.4	19.8
1237A Wax Furnace	0.05	0.042
Bldg. 1236 Burners	0.41	0.75
Heaters - Natural Gas	5.82	5.66
High Temp Tunnel - Nat Gas	1.88	2.07
CF4 Tunnel Heater	0.22	1.56
Total (MMcf)	158.3	177.8
Total (scf)	**158,280,000**	**177,782,000**
Calculated CO2 Emissions (metric tons) =	8,627	9,690
Calculated CO2e Emissions (metric tons) =	8,627	9,690
Calculated CH4 Emissions (metric tons) =	0.163	0.183
Calculated CO2e Emissions (metric tons) =	3.42	3.84
Calculated N2O Emissions (metric tons) =	0.016	0.018
Calculated CO2e Emissions (metric tons) =	5.04	5.67
Natural Gas Total CO2e Emissions (metric tons) =	**8,635**	**9,699**

#2 Fuel Oil Combustion Source	CY2009 Kgal	CY2010 Kgal
No 1 B&W Boiler	0	0.107
No. 2 B&W Boiler	6	0
No. 5 B&W Boiler	0	0
Bldg. 647 Cleaver Brooks Boilers	0	0
Heaters #2 Fuel Oil	9.8	7.7
Total (Kgal)	15.8	7.8
Total (gal)	**15,800**	**7,807**
Calculated CO2 Emissions (metric tons) =	161	80
Calculated CO2e Emissions (metric tons) =	161	80
Calculated CH4 Emissions (metric tons) =	0.00654	0.00323
Calculated CO2e Emissions (metric tons) =	0.137	0.068
Calculated N2O Emissions (metric tons) =	0.00131	0.00065
Calculated CO2e Emissions (metric tons) =	0.406	0.200
#2 Fuel Oil Total CO2e Emissions (metric tons) =	**162**	**80**

Propane Source	CY2009 Kgal	CY2010 Kgal
SUE Burner Propane	4.00	0
Total (gal)	**4,000**	**0**
Calculated CO2 Emissions (metric tons) =	22.37	0.00
Calculated CO2e Emissions (metric tons) =	22.37	0.00
Calculated CH4 Emissions (metric tons) =	0.001092	0.000000
Calculated CO2e Emissions (metric tons) =	0.0229	0.0000
Calculated N2O Emissions (metric tons) =	0.000218	0.000000
Calculated CO2e Emissions (metric tons) =	0.0677	0.0000
Propane Total CO2e Emissions (metric tons) =	**22.46**	**0.0**
GRAND TOTAL CO2e (metric tons) =	**8,820**	**9,779**

APPENDIX E

LIST OF ABBREVIATIONS AND ACRONYMS

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ACAM	Air Conformity Applicability Model
ACHP	Advisory Council on Historic Preservation
AQCR	Air Quality Control Region
AST	Aboveground Storage Tank
BMP	Best Management Practice
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CRMP	Cultural Resource Management Plan
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
dBA	Decibels, A-weighted Scale
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environmental Protection Agency
ESC	Erosion and Sediment Control
FC	Facility Coordinator
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FSH	Facility Safety Head
FUDS	Formerly Used Defense Site
HPO	Historic Preservation Officer
HRSD	Hampton Roads Sanitation District
JBLE	Joint Base Langley-Eustis
LAFB	Langley Air Force Base
LaRC	Langley Research Center
LEED	Leadership in Energy and Environmental Design
MSL	Mean Sea Level
NACA	National Advisory Committee for Aeronautics
NRHP	National Register of Historic Places
NCSHPO	National Conference of State Historic Preservation Officers
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NOx	Nitrogen Oxides
NPL	National Priorities List
NPR	NASA Procedural Requiremen
OSHA	Occupational Safety and Health Administration
O_3	Ozone
P2	Pollution Prevention
PCB	Polychlorinated Biphenyls
RMA	Resource Management Area
ROD	Record of Decision
RPA	Resource Protection Area
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
$S0_2$	Sulfur Dioxide
SWPPP	Stormwater Pollution Prevention Plan
UST	Underground Storage Tank
VCP	Virginia Coastal Program
VOC	Volatile Organic Compound
VPDES	Virginia Pollutant Discharge Elimination System
VPP	Voluntary Protection Program
VSMP	Virginia Stormwater Management Program

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APPENDIX F

METRIC/BRITISH CONVERSION TABLES

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METRIC/BRITISH CONVERSION UNITS

NASA requires that numeric calculations and figures be presented in metric units with the British equivalent provided in parenthesis.

Common Length Conversions			
Metric to	**British**	**British to**	**Metric**
Centimeter	0.39 inches	Inch	25.4 millimeters
Meter	3.28 feet	Foot	0.305 meters
Meter	1.09 yards	Yard	0.914 meters
Kilometer	0.621 miles	Mile	1.61 kilometers
Common Area Conversions			
Metric to	**British**	**British to**	**Metric**
Square meter	10.764 square feet	Square foot	0.093 square meters
Square meter	1.195 square yards	Square yard	0.836 square meters
Hectare	2.47 acres	Acre	0.405 hectares
Square kilometers	0.386 square miles	Square mile	2.59 square kilometers
Common Volume Conversions			
Metric to	**British**	**British to**	**Metric**
Liter	2.1 pints	Pint	0.47 liters
Liter	0.26 gallons	Gallon	3.8 liters

End.