FINAL

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
NEW TOWN PROJECT
AT NASA LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA

Lead Agency: National Aeronautics and Space Administration (NASA), Langley Research Center (LaRC), Hampton, Virginia

Proposed Action: Geothermal Ground Source Heat and Cooling System Installation for New Town Project at NASA LaRC

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Abstract: NASA LaRC is proposing to install and utilize geothermal ground source heat and cooling systems for the five buildings constructed as part of the New Town project. The environmental impacts of the New Town project were documented in the *Final Environmental Assessment of the New Town Project at NASA LaRC* (New Town EA) dated September 2008. At that time, the use of the geothermal heat and cooling systems was not anticipated, and the New Town EA does not address the impacts associated with the geothermal systems. This Supplemental Environmental Assessment (SEA) provides additional information where necessary to address the environmental impacts of the installation and use of geothermal heat and cooling systems. LaRC is anticipating that the geothermal systems would significantly reduce the energy usage, as well as associated energy costs, for the newly constructed buildings. This SEA evaluates the environmental impacts of the Proposed Action and the No-Action Alternative.

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HAMPTON, VIRGINIA

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1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

This Supplemental Environmental Assessment (SEA) analyzes the potential environmental impacts associated with NASA's proposal to install geothermal heating/cooling systems for new facilities constructed as part of the New Town redevelopment project at NASA Langley Research Center (LaRC), located in Hampton, Virginia. This SEA is an addendum to the September 2008 *Final Environmental Assessment of the New Town Project at NASA LaRC (New Town EA)*, which is included by reference.

This SEA 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) 8580.1, "Implementing the National Environmental Policy Act and Executive Order 12114." Information contained in this SEA will 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 implementing the Proposed Action is determined to potentially have significant environmental impacts, an Environmental Impact Statement would be prepared. 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 (FONSI).

Chapter 1 of this SEA includes background information and the purpose and need for the Proposed Action. Chapter 2 includes a description of the Proposed Action and the No-Action alternative. Chapter 3 describes how environmental resources would be affected by implementation of the Proposed Action and the No-Action alternative. Chapter 4 addresses the cumulative effects of other past, present, and reasonably foreseeable actions that may be implemented in the area of the Proposed Action. Appendix A contains an excerpt from *Narrative for the New Town Program, Administration Office Building One, Final Concept Design*, which describes the geothermal systems proposed for the first building to be constructed as part of the New Town project.

1.2 BACKGROUND

The environmental impacts of the New Town redevelopment project were documented in the *New Town EA* dated September 2008. At that time, the use of the geothermal heat and cooling systems was not anticipated, and the *New Town EA* does not address the impacts associated with geothermal systems. This SEA provides additional information where necessary to address the environmental impacts of the installation and use of geothermal ground source heat and cooling systems. This document should be considered in conjunction with the *New Town EA* and is not intended as a stand-alone document.

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the Propose Action is to implement cost-effective, energy-efficient, and sustainable heat and cooling systems for new facilities constructed at NASA LaRC. The use of efficient geothermal systems is estimated to produce a 40% energy savings over conventional heat pump systems. In addition, the use of geothermal energy for LaRC facilities allows the Center to comply with the Federal requirements for renewable energy sources, as well as contributing toward certification under the Leadership in Energy and Environmental Design (LEED) standards.

The need for the Proposed Action is to reduce operations and maintenance (O&M) costs so that critical funding can be directed towards modernizing LaRC's infrastructure to ensure the Center remains a viable, cutting-edge research center. In addition, the Proposed Action is needed as facilities constructed by Federal Agencies are subject to environmental and energy regulations, such as the Energy Policy Act (EPACT) of 2005 and Executive Order (E.O.) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." These regulations set goals for Federal Agencies in the areas of energy efficiency, acquisitions, renewable energy use, and sustainable building design.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

The Proposed Action consists of installing and utilizing geothermal ground source heat and cooling systems for new facilities constructed as part of the LaRC New Town project. The geothermal systems would provide heating/cooling capacity for five new buildings that range in size from 3,715 to 10,590 square meters (39,990 to 114,000 square feet). The number and depth of the geothermal wells would vary depending on the size of each building. Approximate locations and sizes of the proposed geothermal well fields are displayed in Figure 1.

Six locations have been proposed for geothermal well field installation, but not all the locations would need to be utilized. As the New Town project progresses over the next 15 years, the design and construction engineers would determine which geothermal well sites would be most suitable for each building. This SEA encompasses all proposed geothermal well sites and their expected impacts.

The proposed geothermal well fields are estimated to cover areas that would range in size from 4,000 to 13,600 square meters (1 to 3.4 acres). According to engineering estimates, an individual building could require 80 to 100 wells. These wells would be spaced approximately 6 meters (20 feet) apart and would reach a depth of 80 to 120 meters (250 to 400 feet) deep. New Town buildings would be expected to require 23 square meters (250 square feet) of land area for geothermal wells per ton of required air conditioning for the facility.

In two locations where buildings are currently located in the proposed area, the geothermal well fields would be constructed and installed only after the facilities have been completely deconstructed and removed as part of the scheduled New Town Project activities. Installation of geothermal well fields in two other locations would require the removal of existing parking lots prior to the start of drilling and installation. The other proposed sites involve previously-disturbed, grassy areas, and would not require prior removal of infrastructure.

The well installation process would cause significant soil disturbance, in part, because water would be injected into the soil to facilitate soil penetration. Soil, mud, and excess water would be generated at the work site during installation. A hole, or "sedimentation pond," that is 1.8 meters (6 feet) long, 61 centimeters (24 inches) wide, and 1.2 meters (4 feet) deep would be created and utilized to manage the excess soil produced during drilling. The soil would be deposited within the hole, mixed with water and compacted, then allowed to dry and settle. LaRC would acquire all necessary construction and other permits as required for the geothermal well installation, and would comply with best management practices to minimize wastewater and stormwater runoff. Upon completion of installation, the geothermal well fields would be regraded to match existing site contours. If necessary, parking lots could be reconstructed over the well fields, or the areas would be reseeded with grass to maintain manicured lawn areas.

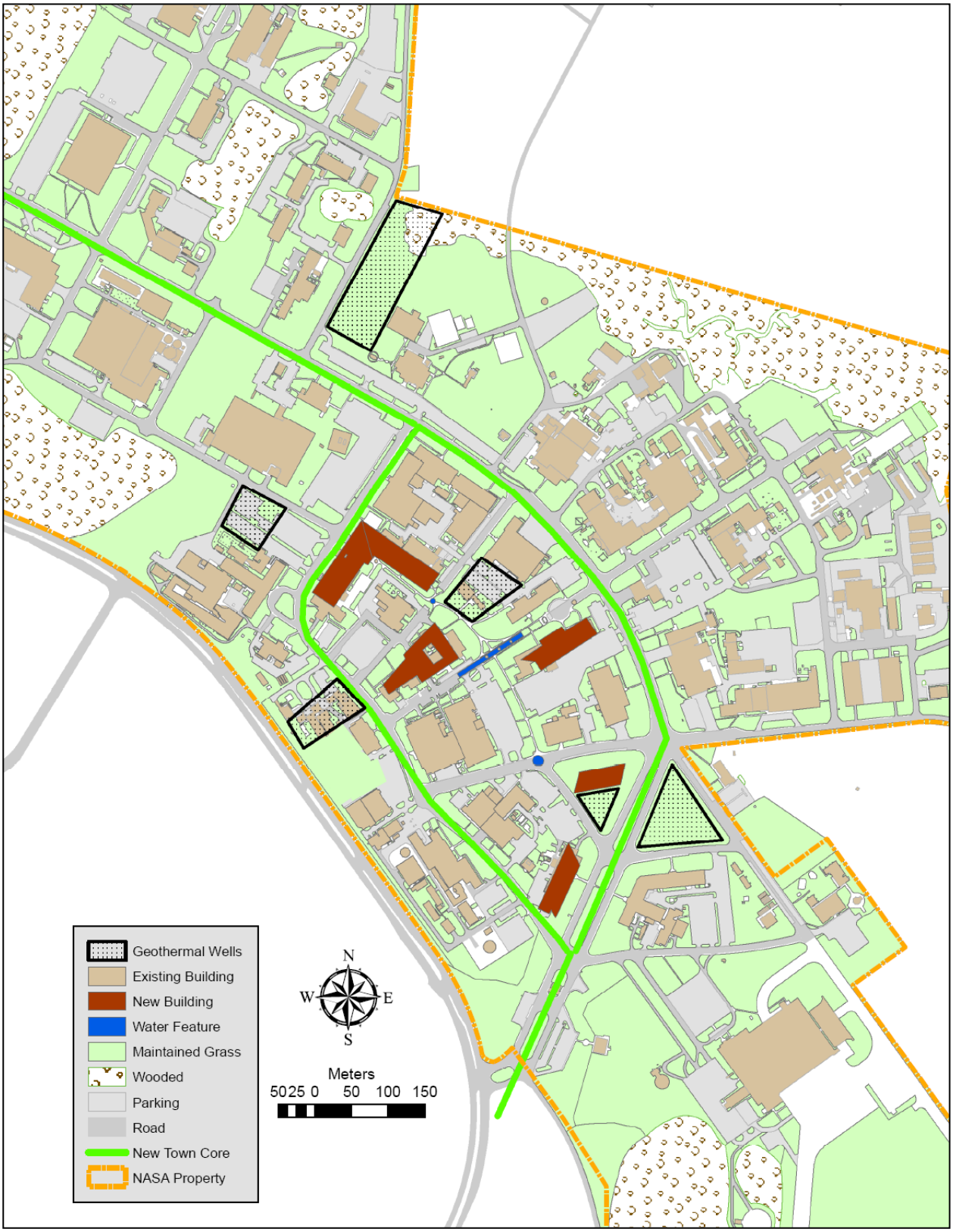

Figure 1 – Approximate Locations of Geothermal Well Fields

Each geothermal well field would consist of a series of vertical wells drilled into the earth into which "U tubes" of piping would be inserted for circulating water in a large closed loop, as displayed in Figure 2. The vertical wells would typically be 13 or 15 centimeters (5 or 6 inches) in diameter and from 80 to 120 meters (250 to 400 feet) deep depending on soil and groundwater conditions. The U tubes would consist of 2.5 centimeter (one inch) diameter plastic piping. The piping would be inserted into the wells and encased in a poured bentonite grout material to promote thermal conduction with the soil. In effect, the wells would act as a heat exchanger with the earth. The source water temperature would fluctuate around 18º Celsius (65º Fahrenheit). The geothermal well field would provide a cost effective heat sink and heat source.

Main supply and return water pipes would run underground between the well field and the building. The ground loop water would be circulated through modular reversible chillers (water to water heat pumps) located in the facilities. The modular reversible chillers would produce the chilled and heating water required to condition the buildings environment. Since the well fields would be sized for the peak cooling load of the buildings, no cooling towers would be required. Each modular reversible chiller would be equipped with a circulation pump on the source (ground loop) side. When the modular reversible chiller is energized the pump would circulate water through the modular reversible chiller and the well field. This would ensure the required flow for the chiller is developed while varying the flow through the well field based on building demand, thus providing substantial electrical energy savings.

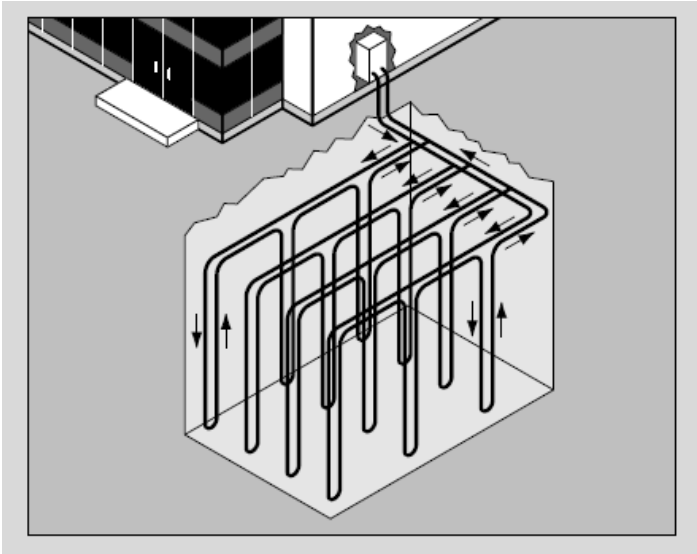

Figure 2 - Drawing of Basic Geothermal Heat and Cooling System

2.2 NO-ACTION ALTERNATIVE

Under the No-Action alternative, LaRC would not implement geothermal heating/cooling systems, and instead the New Town project would proceed as described in the *New Town EA*. The new buildings constructed as part of the New Town project would use conventional heat and cooling systems, such as electric or steam heat systems.

If LaRC were to implement the No-Action Alternative, LaRC would forego the opportunity to utilize heat and cooling systems that the EPA considers "the most energy efficient, environmentally clean and cost-effective space conditioning systems." LaRC would not take advantage of the energy savings, cost savings, and reduction in corresponding emissions that the geothermal system would provide over conventional systems. Additionally, LaRC would forego the opportunity to increase its useable energy from renewable sources, which would permit LaRC to better meet or exceed the requirements of the Energy Policy Act of 2005.

3.0 ENVIRONMENTAL IMPACTS

Existing environmental conditions that would be affected by the installation of geothermal systems are essentially unchanged from those that were discussed in Section 3 of the *New Town EA*, incorporated by reference. A review of that section showed that it adequately described the affected environment, and circumstances and conditions have not changed in a manner as to require additional detailed discussion of existing conditions. Therefore, the environmental consequences for those resources are described in this section, which is intended to supplement the information contained in the original *New Town EA*. Pertinent new information has been added if the resources were not described in detail in the *New Town EA*.

Resources Eliminated From Detailed Consideration

Several resources were not evaluated in this SEA because it was determined unlikely that implementation of either the Proposed Action or the No-Action alternative would have any impact on these areas. A brief explanation of the reasons why each resource has been eliminated from further consideration in this SEA is provided below.

Virginia Coastal Zone Programs. The following Virginia Department of Environmental Quality (DEQ) enforceable programs and policies are not applicable, because neither the Proposed Action nor the No-Action alternative would have any effect on the resources. The programs and policies include:

> Fisheries Management – concerning the conservation and enhancement of finfish and shellfish resources or the promotion of commercial and recreational fisheries.
>
> Subaqueous Lands Management – regarding encroachment into, on or over state-owned subaqueous lands.
>
> Dunes Management – relating to sand covered beaches or sand dunes.
>
> Shoreline Sanitation – concerning the placement of septic tanks near streams, rivers, and other waters of the Commonwealth.

Other Virginia Coastal Zone Program areas that are applicable to the Proposed Action are addressed later in this chapter.

Socioeconomic. The Proposed Action would occur over the course of the 15-year New Town project. There would be no change in the number of NASA employees as a result of the Proposed Action. The installation work would be performed by contractors from the regional work force or from elsewhere in Virginia. There is a sufficient pool of local workers to accomplish these tasks in the anticipated timeframe. Because these are temporary jobs that would be filled by the existing regional work force, there would be no effect on area population or increase in the demand for housing or public services in the region. Therefore, this resource was eliminated from further analysis.

Climate. Implementation of either the Proposed Action or the No-Action alternative would have no measurable effect on the local climate and as such, this resource was eliminated from further analysis.

Environmental Justice. Implementation of either the Proposed Action or the No-Action alternative would not have disproportionate human health or environmental effects on low-income populations or minority populations; and this resource was eliminated from further analysis.

Transportation. Implementation of the Proposed Action would not change the use of transportation resources in the region. Local highways currently accommodate the traffic generated by LaRC employees and other individuals traveling the roads on a daily basis. Transportation of the construction and installation materials would be along an established haul route leading off the Center. Implementation of the No-Action alternative would not affect transportation resources. Therefore, this resource was eliminated from further analysis.

3.1 LAND USE

3.1.1 Proposed Action

Coastal Zone Management
Since LaRC is located within the coastal zone as defined under Virginia DEQ's Coastal Zone Management Program, proposed LaRC activities must be consistent with its enforceable policies regarding coastal resources. As noted in Section 3.0, several enforceable policies are not applicable to the location of the Proposed Action. The Coastal Lands Management policy is addressed in this section and the remaining Coastal Zone Management Program policies relating to air and water pollution are addressed in Section 3.8 and Section 3.10 respectively. As described in these sections, the Proposed Action would be consistent with the Coastal Zone Management Program's enforceable policies.

The Coastal Lands Management program regulates activities in the Chesapeake Bay Resource Management Areas (RMAs) and Resource Protection Areas (RPAs). The Proposed Action would not impact these areas because no geothermal well field installation activities would take place within RPAs or RMAs.

Functional Zones
LaRC has a current Center Master Plan (CMP) that supports the Center's strategic approach to programmatic facility planning. The *New Town EA* describes the functional zones identified in the CMP in more detail. The geothermal wells would be installed in the following functional zones: Wind Tunnels/Labs, New Town Core, and Multi-Use. The implementation of the Proposed Action would not have an effect on the LaRC functional zones as they would be established based on the proposed New Town design.

3.1.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no land use impacts.

3.2 NOISE

3.2.1 Proposed Action

With the implementation of the Proposed Action, heavy equipment and machinery would cause temporary increases in noise at the project areas and along traffic corridors. The project areas are located in highly developed areas, and high noise levels generated from aircraft and wind tunnel operations are common. Compared to noise generated by aircraft, noise produced by installation activities would generally be relatively lower in magnitude and spread out during the day. Table 1 shows examples of sound levels produced by construction equipment at a distance of 15 meters (50 feet). Use of heavy machinery and equipment could result in a temporary minor adverse impact on tenants of the buildings and offices near the project sites.

Table 1. Examples of Noise Levels Generated by Construction Equipment

Equipment	Typical Noise Level (dBA) at 15 meters
Auger Drill Rig	85
Backhoe	80
Concrete Mixer	85
Dozer	85
Drill Rig Truck	84
Grader	85
Jack Hammer	88
Loader	85
Shovel	82
Truck	88

Source: http://www.fhwa.dot.gov/environment/noise/handbook/09.htm

3.2.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no impact to LaRC's noise environment.

3.3 CULTURAL RESOURCES

3.3.1 Architectural Resources

3.3.1.1 Proposed Action

Impacts to architectural resources are not expected under the proposed action. None of LaRC's five National Historic Landmarks would be impacted by the Proposed Action as they are not located near the proposed geothermal well fields. In addition, the Proposed Action would not adversely affect the integrity of the proposed LaRC Historic District as the geothermal well fields would be installed underground and their operation would not change the character and function of research and testing facilities located throughout the district. Therefore, implementation of the Proposed Action would not adversely impact LaRC's architectural resources.

3.3.1.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on LaRC's architectural resources.

3.3.2 Archaeological Resources

3.3.2.1 Proposed Action

A portion of one proposed geothermal well field location partially overlaps a LaRC archeological site, Site 44HT76. NASA LaRC conducted a Phase II archeological survey of this site in 2005. It was determined the site did not meet the criteria for inclusion in the National Register of Historic Places and that no further investigations were required. The other proposed sites for the geothermal well fields are in highly industrialized, previously disturbed areas, or the sites have undergone Phase I survey work with no resources identified. In the event that resources were uncovered during well installation, all earthmoving activity would immediately stop in the vicinity of the discovery and LaRC would notify the State Historic Preservation Officer. In addition, LaRC would implement the procedures included in the Cultural Resources Management Plan for unanticipated discovery of cultural materials. As such, implementation of the Proposed Action would not affect archaeological resources.

3.3.2.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on archaeological resources.

3.4 HAZARDOUS MATERIALS AND HAZARDOUS/SOLID WASTE

3.4.1 Proposed Action

Bentonite grout would be used as a backfill material in the well boreholes for the geothermal wells. The grout would act as a sealing material holding the piping in place and would promote thermal conductivity between the pipes and earth. Bentonite is a naturally occurring colloidal clay material composed largely of the mineral montmorillonite which expands upon wetting. Bentonite grout is formed when bentonite material is mixed in a prescribed percentage with potable water. Bentonite is biologically inert and has no known environmental side effects. However, it can contain low level of silica (quartz) which can be hazardous to lungs with chronic exposure. The bentonite would be used and stored in accordance with applicable OSHA and environmental regulations and NASA LaRC policy. Personnel handling and working with the bentonite would be properly trained and would wear the appropriate personal protective equipment.

Hazardous materials and solid wastes generated from the installation of the geothermal ground source heat and cooling systems 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 or groundwater were discovered during the excavation or installation activities, LaRC would properly characterize and dispose of such materials at an appropriately permitted waste management facility.

Initially, the Proposed Action would generate solid waste because existing concrete and asphalt at two geothermal well field locations would require removal to facilitate drilling and installation of the geothermal wells. The concrete and asphalt would be recycled to the maximum extent possible in order to reduce the amount of waste disposed in landfills. If non-hazardous, non-regulated, solid materials require disposal and the materials cannot be recycled, they would be consolidated and transported for disposal to a local landfill or for energy recovery at Hampton's Refuse-Fired Steam Generating Facility. As such, implementation of the Proposed Action would have a negligible impact on the environment resulting from the generation of hazardous, regulated and solid waste.

3.4.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no associated hazardous, regulated and solid waste.

3.5 POLLUTION PREVENTION

3.5.1 Proposed Action

The Proposed Action would be carried out following LaRC's principles of pollution prevention (P2), to include source reduction, recycling/reuse, treatment and proper disposal of wastes. Materials generated from excavation of concrete and asphalt prior to well installation activities in certain locations would be recycled to the maximum extent possible. Furthermore, contractors would be required to follow applicable Best Management Practices to further reduce pollution. While there would be a temporary increase in solid waste generated from installation activities, this would be offset by using energy-saving, sustainable heat and cooling systems.

The EPA considers geothermal ground source heat and cooling systems to be the most energy efficient, environmentally clean and cost-effective space conditioning system. It has been estimated that LaRC would reduce energy consumption, and corresponding emissions, by up to 40% compared to the use of conventional boiler systems. The geothermal well fields would help newly constructed New Town buildings better conform to the "silver" or possibly the "gold" standard established by the LEED Green Building Rating System. This system promotes sustainable green designs using specific performance criteria in five key areas: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. LEED provides a third party certification for the design, construction and operation of high performance green buildings. LaRC's LEED certification would confirm LaRC's contribution to NASA's agency goals for high performance and sustainable buildings outlined in Executive Order 13423, Section 2(f).

Additionally, geothermal ground source heat and cooling systems would allow NASA LaRC to increase its use of energy from renewable sources, permitting LaRC to better meet or exceed the requirements of the Energy Policy Act of 2005. Therefore, the implementation of the Proposed Action would be a net long-term benefit to the pollution prevention and related goals of the Center and the Agency.

3.5.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no associated benefit to LaRC's pollution prevention program or goals. Installation and operation of traditional HVAC systems could cause a minor negative impact due to pollutant emissions and/or cooling tower blow down.

3.6 HEALTH AND SAFETY

3.6.1 Proposed Action

The geothermal ground source heat and cooling system installation activities would be carried out by qualified and properly licensed and permitted contractors. Contractors performing work at LaRC are required to comply with all applicable safety and health regulations, including OSHA and NASA regulations. LaRC's underground tunnels and utilities in the work site areas would be properly surveyed and marked prior to project initiation, to ensure that the contractors would not risk injury upon impact with LaRC's subsurface features. Contractors involved in the project would be required to prepare and follow a site-specific Health and Safety Plan to ensure the safety of human health and the environment during geothermal heating/cooling system installations. 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. Therefore, the Proposed Action would not result in significant health or safety impacts.

3.6.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no impacts to personnel health and safety.

3.7 VISUAL RESOURCES

3.7.1 Proposed Action

The Proposed Action would degrade visual resources in the immediate project areas during the active well installation process due to the large amount of drilling, trenching, and soil disturbance required to install the geothermal wells. Injection of water during the well-drilling process would produce muddy substrates which require time to dry and settle. However, the visual degradation would be temporary since the geothermal well fields would be covered and the project areas replanted upon completion. There would be no long-term impact to LaRC's visual resources as a result of the Proposed Action.

3.7.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on visual resources.

3.8 AIR QUALITY

3.8.1 Proposed Action

Geothermal well field installation activities would result in a slight increase in emissions from vehicle/equipment exhaust and from fugitive dust. These effects would be minor and staggered

over the length of the project. In relation to the large number of personal and Government vehicles operating on the Center, the additional emissions resulting from vehicles and from equipment would be negligible. In addition, fugitive dust 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.

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). Since the Hampton Roads AQCR is an ozone maintenance area, the emissions of ozone precursor pollutants (VOCs and NO_x) were calculated for the geothermal heating/cooling system installations. LaRC's calculations of the estimated emissions for installation compared to de minimis and regional emissions inventories are displayed in Table 2.

Table 2. Air Conformity Applicability

Pollutant	Maximum Emissions from Proposed Action	De Minimis Threshold	10% of Regional Emissions Inventory
NO_x	1.05 tons per year	100 tons per year	715.2 tons per year
VOCs	0.19 tons per year	100 tons per year	879 tons per year

Source: US Air Force Conformity Applicability Model (ACAM) 4.3.3

The Proposed Action would not involve open burning.

No new stationary air emission sources are associated with the geothermal well field installation, so there would be no revisions to LaRC's Stationary Source Permit to Operate from the Virginia DEQ. LaRC would ensure that all activities associated with the Proposed Action 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). Therefore the Proposed Action would be consistent with the enforceable air management policies of the Coastal Zone Management Act. As such, implementation of the Proposed Action would result in minimal impact on air quality at LaRC.

3.8.2 No-Action

Under the No-Action Alternative, no impacts to air quality associated with activities supporting the installation of geothermal well fields would occur.

3.9 SOILS AND GEOLOGY

This resource area was not described in detail in the *New Town EA*. A description of the affected environment is included below.

NASA LaRC is located on the Virginia Coastal Plain, characterized by flat land that dips gently eastward and is cut by rivers, creaks, and streams. The Coastal Plain is underlain by a thick wedge of sediment, two-thirds of which is late Jurassic and Cretaceous clay, sand, and gravel. A thin layer of fossilized marine sands overlies the older sediment. The youngest deposits of the

Coastal Plan are sand, silt, and mud. LaRC is located in an area designated as Seismic Risk Zone 1, which is an area with minor damage expected.

The soils at LaRC range in texture from clay and silt to fine gravel, with most of the soils being fine to medium sandy loam. The surface is a deposited loam from 0.6 meters (2 feet) to 1.8 meters (6 feet) in depth. These types of soil are considered to be poorly-drained to moderately well-drained.

LaRC conducted a formation thermal conductivity study and data analysis of the subsurface soils by drilling a vertical bore "test well" in one of the proposed geothermal well field locations. The vertical bore was similar in size to that of the proposed geothermal wells and drilled to the expected maximum depth. The test well was 13 centimeters (5.1 inches) wide and 125 meters (410 feet) deep. The bore indicated that soils consisted of the following types:

Brown, sandy clay: 0 to 1.83 meters (0 to 6 feet)
Cobbles: 1.83 to 2.44 meters (6 to 8 feet)
Blue clay: 2.44 to 12.19 meters (8 to 40 feet)
Sand and shells: 12.19 to 21.34 meters (40 to 70 feet)
Blue clay: 21.34 to 70.10 meters (70 to 230 feet)
Silt: 70.10 to 124.97 meters (230 to 410 feet)

A 121.92 meter (400 feet) long u-bend pipe was placed in the bore and it was filled with Baroid Bensesal bentonite grout, simulating the composition of a proposed well. Other geothermal well field locations would be expected to have similar soil compositions.

3.9.1 Proposed Action

Installation of geothermal well fields would involve ground disturbance associated with drilling numerous well boreholes spaced 6.1 meters (20 feet) apart. Boreholes would extend through the surface soil layers of brown, clayey sand and cobbles. The wells would extend into the layer of silt-like sand with shell fragments which reaches a depth of 21.34 meters (70 feet) and blue clay which reaches a depth of 70.10 meters (230 feet). There would also be the possibility of boreholes extending into the silt layer which reaches a depth of 124.97 meters (410 feet). Water would be injected into the soils during borehole drilling activities in order to facilitate deep soil penetration. A hole, or "sedimentation pond," that is 1.2 meters (4 feet) deep, 61 centimeters (24 inches) wide, and 1.8 meters (6 feet) long would be created and utilized to manage the excess soil produced during drilling. The soil would be deposited within the hole, mixed with water and compacted, then allowed to dry and settle. The well boreholes would be backfilled with bentonite grout. In the event that petroleum contaminated soils or groundwater were discovered during the excavation or installation activities, LaRC would properly characterize and dispose of such materials at an appropriately permitted waste management facility. Upon completion of installation of the wells, the property would be regraded to match existing site contours. As such, implementation of the Proposed Action would have a limited impact on the local geology and soils.

3.9.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on soils and geology.

3.10 WATER RESOURCES

3.10.1 Surface Waters

3.10.1.1 Proposed Action

In accordance with Virginia's Department of Conservation and Recreation (DCR), construction activities at LaRC that disturb equal to or greater than 0.4 hectares (one acre) require coverage under the General Permit for Discharges of Stormwater From Construction Activities. Additionally, since LaRC is within a Chesapeake Bay Preservation locality, construction activities larger than 232 square meters (2,500 square feet) also require coverage. Since even the smallest of the proposed geothermal well fields would have a footprint of approximately 4,000 square meters (1 acre), a permit would be required prior to beginning work at any of the proposed sites. Silt fences, storm drain inlet and outlet protection, and other appropriate standard construction practices would be implemented in accordance with the erosion and sediment control requirements of Virginia's DCR. Additionally, LaRC would ensure that the contractors obtain the appropriate permits and prepare the required plans in accordance with DCR's construction site stormwater permit requirements. Following completion of the Proposed Action, there would be no long-term impact to the quality or quantity of stormwater drainage to LaRC's outfalls.

The Proposed Action would result in limited impact to the surface water resources of LaRC and the surrounding environment. Soil disturbance during drilling and installation activities would produce a minor and temporary increase in suspended solids in the stormwater reaching the outfalls that drain the affected areas (primarily Outfalls 3, 8, 9, and 12). Figure 3 shows the locations of LaRC's permitted outfalls in relation to geothermal well field installation areas. Concrete and asphalt removed prior to drilling activities in affected locations would be promptly transported off-Center in order to minimize the potential for contaminated runoff from stockpiled debris.

The Virginia Coastal Zone Management Program maintains enforceable policies related to point source and non-point source water pollution. The Proposed Action does not involve point source water pollution, but does have the potential to generate a non-point water pollution source. The Coastal Zone Management Program requires that soil-disturbing projects be designed to reduce soil erosion and to decrease inputs of chemical nutrients and sediments to the State's waters. The contractors would adhere to the standards of LaRC's current VPDES permit (General Permit for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems) that requires LaRC to implement Best Management Practices (BMPs) mitigating stormwater pollution from Center activities. These BMPs include employee training, preventive maintenance, visual inspections, spill prevention and response, sediment and erosion control, good housekeeping, and record keeping and reporting. Since LaRC would implement appropriate BMPs to reduce erosion and pollution, the Proposed Action would be consistent with the Coastal Zone Management Program.

Water injection would be used during the drilling process to promote penetration of soils to required depths. There would be an increase in the amount of moisture in the soils surrounding each borehole; however, this increase would be temporary and the volume would not be enough to affect the flow of surface waters at LaRC.

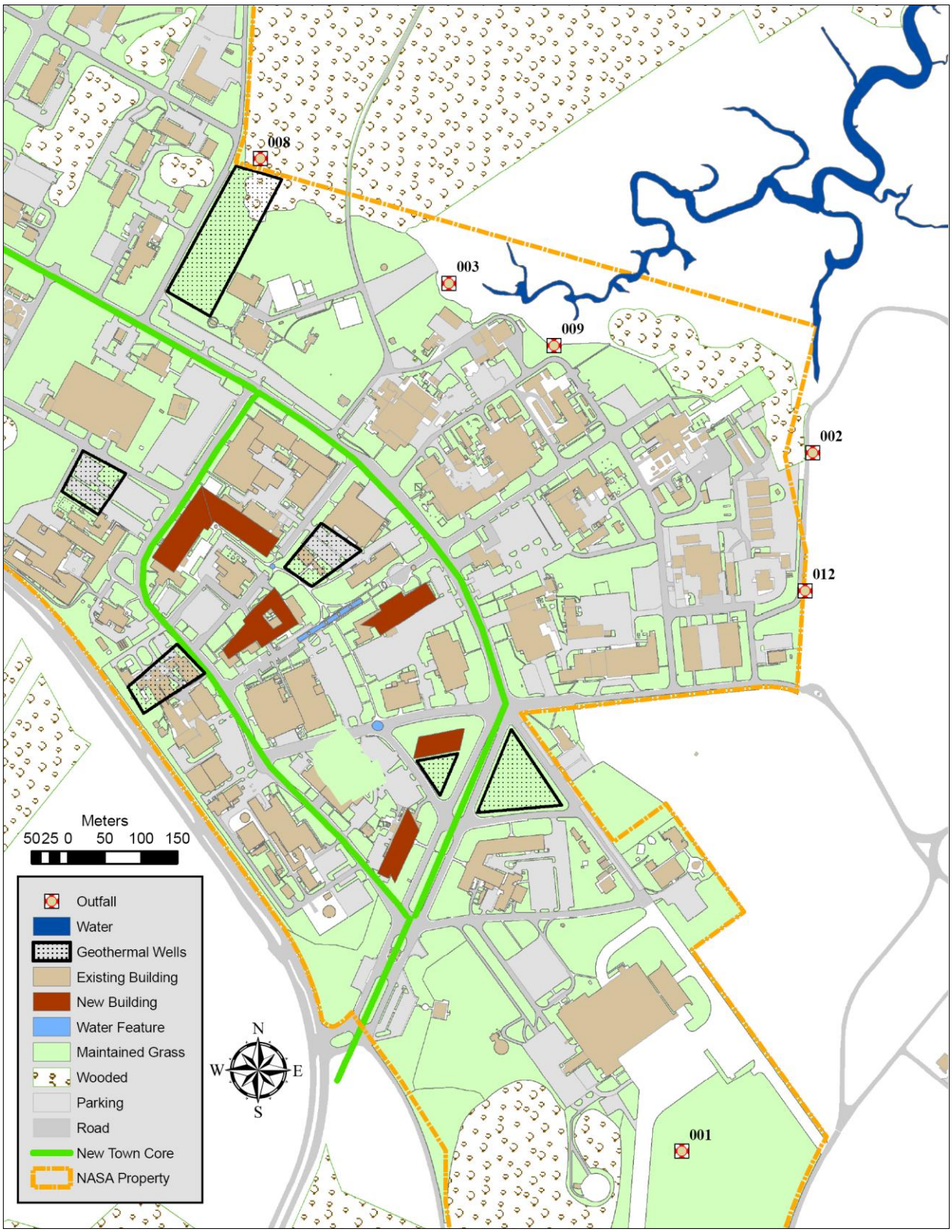

Figure 3 – LaRC Outfalls

As such, implementation of the Proposed Action would result in limited impacts to surface water resources at LaRC.

3.10.1.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on surface waters.

3.10.2 Groundwater

LaRC's existing groundwater conditions were not described in the *New Town EA*, and a description of the affected groundwater environment is included below.

Groundwater in the Coastal Plain is present primarily in pores in the sediments. Thick sequences of porous and permeable strata form regional aquifers, and less permeable strata form confining units between the aquifers. Groundwater in the Virginia Coastal Plain is recharged principally by infiltration of precipitation and percolation to the water table. Most of the unconfined ground water flows relatively short distances and discharges to nearby streams, but a small amount flows downward to recharge the deeper, confined aquifers.

Groundwater at NASA LaRC is often brackish because of the Chesapeake Bay's close proximity and marine deposits found in the soil. Groundwater movement at NASA LaRC is tidally influenced at locations near Brick Kiln Creek and Tabbs Creek. A total of 32 shallow wells (depth up to 6 meters (20 feet)), seven intermediate wells (22.9 meters (75 feet)), and five deep wells (depths over 29 meters (95 feet) have been installed over the years to identify and monitor potential contamination of groundwater at NASA LaRC. The wells are sampled periodically and the LaRC Environmental Management Office (EMO) maintains all records regarding monitoring well sampling events. No samples taken from monitoring wells in the vicinity of the proposed geothermal wells have indicated contamination of the groundwater.

The Safe Drinking Water Act (SDWA) authorizes the EPA to set national health-based standards for drinking water and its sources such as rivers, lakes, reservoirs, springs, and groundwater wells. The Virginia State Department of Health has primary responsibility for administration and enforcement of drinking water regulations applicable to public water systems in Virginia. NASA LaRC does not draw water from groundwater resources, nor does it have any collection or treatment facilities. Since LaRC obtains all of its water from independent sources and the public water system, and it does not sell the water or operate as an interstate commerce carrier, LaRC is exempt from the SDWA and Virginia Waterworks Regulations as set by the Virginia Department of Health.

3.10.2.1 Proposed Action

The geothermal systems would be a closed-loop design, in which water runs through polyethylene pipes that are grouted into place. The water would not contain any additives or chemicals, and it would be re-circulated through the pipes for the entire life of the system. The water would not be extracted from the ground or any source outside the system. Additionally, the durable polyethylene pipes that enclose and circulate the water would also ensure there is no contamination or cross flow with water in the surrounding soils or groundwater table. The bentonite grout used as a backfill material for the geothermal wells would prevent subsurface

migration or communication of fluids. Leakage from the pipes would not be expected and there would be no contamination of groundwater or local drinking water supplies. In the unlikely event of a leak from the pipe, the impact on groundwater would be negligible since the circulating media consists solely of water.

There would be an increase in the amount of moisture in soils in the project areas due to water injection during drilling; however, this increase would be temporary and the volume would not be enough to affect LaRC's groundwater table.

Therefore, implementation of the Proposed Action would result in no impact to groundwater resources at LaRC.

3.10.2.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on groundwater.

3.10.3 Wetlands

3.10.3.1 Proposed Action

The Proposed Action would have no impact on LaRC's wetlands. No geothermal well field installation activities would take place in identified wetlands, as displayed in Figure 4. One of the proposed geothermal well fields (the large field in the northern part of the Center) would be located 35 meters from a forested wetlands area.

3.10.3.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on wetlands.

3.10.4 Floodplains

3.10.4.1 Proposed Action

No proposed geothermal well field locations would be located within the 100-year or 500-year floodplain. Therefore Executive Order 11988, Floodplain Management, is not applicable and the Proposed Action would have no impact on LaRC's floodplains.

3.10.4.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on floodplains.

3.11 ECOLOGICAL RESOURCES

3.11.1 Threatened and Endangered Species

3.11.1.1 Proposed Action

Since no Federal or State-listed threatened or endangered species were documented at LaRC during the most recent biological survey of the Center, it is anticipated that no species would be adversely affected by the Proposed Action. Although it is possible that some of the threatened

and endangered species identified in the adjacent City of Hampton could also inhabit LaRC, these species would not be anticipated in the proposed geothermal well installation areas. Most of Hampton's identified threatened and endangered species are aquatic or beach-dwelling species: several sea turtles, the Northeastern beach tiger beetle, the upland sandpiper and the piping plover. The other threatened and endangered species found in Hampton would not be anticipated to inhabit the Proposed Action areas because these areas have experienced heavy development and high levels of human activity. Although the Division of Natural Heritage documents the presence of natural heritage resources in the Hampton area, it is not anticipated that the Proposed Action would adversely impact these resources because of the scope of the activity and the distance to the resources.

3.11.1.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on threatened and endangered species.

3.11.2 Wildlife

3.11.2.1 Proposed Action

The proposed geothermal well field areas would be located in highly developed areas that offer limited value to native wildlife. Disturbance resulting from the Proposed Action would be limited to the local project sites. The activity and noise generated from installation activities would temporarily displace most wildlife from the immediate vicinity of the project areas. It is expected that the impacts to wildlife caused by the geothermal heat and cooling system installation activities would be very minor and short-term.

3.11.2.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on wildlife.

3.11.3 Vegetation

3.11.3.1 Proposed Action

Geothermal well field installations would take place in highly developed areas and the only vegetation that would be impacted by the Proposed Action would be landscaping plants and manicured grass. However, these locations would be replanted following completion of geothermal heating/cooling system installations. Therefore, there would be no long-term change to LaRC's vegetation resource as a result of the Proposed Action.

3.11.3.2 No-Action

Under the No-Action alternative, LaRC would not install geothermal ground source heat and cooling systems for New Town facilities, and there would be no effect on vegetation.

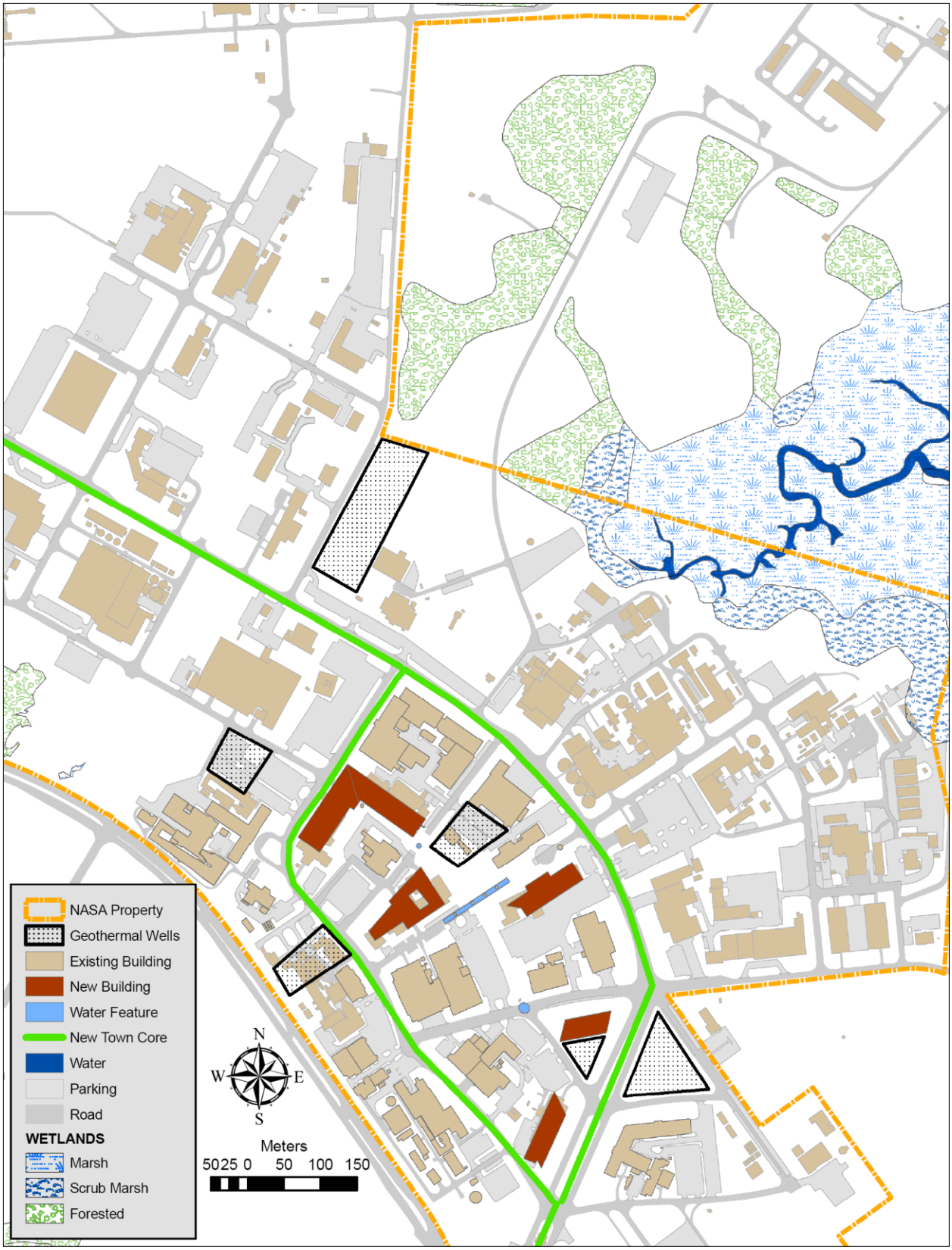

Figure 4 – LaRC Wetlands

4.0 CUMULATIVE EFFECTS

The CEQ regulations require that all Federal agencies include cumulative impacts in their environmental analyses (40 CFR 1508.25(c)). 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" (40 CFR 1508.7). This includes those that may be "individually minor but collectively significant actions taking place over time" (40 CFR 1508.7).

4.1 PAST, PRESENT AND REASONABLY FORESEEABLE ACTIONS

The most significant action being planned for NASA LaRC is the New Town Project, which is addressed in the *New Town EA*. There are several other past, present, and reasonably foreseeable actions that may also occur in the area of the Proposed Action. The actions were described in detail in Section 5.1 of the *New Town EA*.

In addition to the past, present, and future actions described in the *New Town EA*, NASA LaRC is proposing the construction of a Hydro-Impact Basin at the Landing and Impact Research Facility (LandIR), Building 1297. Construction of the basin is planned for spring 2009 and would allow for full-scale water-impact testing for simulated Orion Crew Exploration Vehicle (CEV) ocean splashdown research in support of NASA's Constellation Program. The Proposed Action consists of construction of a rectangular basin of steel mesh and spray-on concrete; use of the water-filled basin for CEV testing for approximately five years; and draining and refilling of the basin following completion of the testing program. The Hydro-Impact Basin would measure 35 meters (115 feet) by 27 meters (90 feet) with a maximum depth of 7.6 meters (25 feet), and would be filled with 4.5 million liters (1.2 million gallons) of potable water. LaRC issued an EA for the project in January 2008. No significant impacts were identified and a FONSI was issued in February 2009.

Over the next several years, LaRC is also proposing to deconstruct an additional 20 unneeded and abandoned administration and support buildings in the ongoing effort to streamline the Center's infrastructure and minimize operation and maintenance costs. Prior to the deconstruction of additional facilities LaRC would prepare the appropriate documentation as required by NEPA and the National Historic Preservation Act.

4.2 ANALYSIS OF CUMULATIVE EFFECTS

LaRC has examined the impacts on the environment that could result from the incremental impact of the Proposed Action when added to the actions described above and those included in the *New Town EA*. The analysis examined whether such a relationship would result in potentially significant impacts not identified when the Proposed Action is considered alone.

LaRC has determined that the projected cumulative effect of the Proposed Action, coupled with the other past, present, and future actions occurring at LaRC would result in minimal cumulative impacts to the resources analyzed in this EA.

5.0 REFERENCES

Formation Thermal Conductivity Test and Data Analysis at NASA Langley Research Center, November 2008. Prepared by Toano Well and Pump Service Inc., Toano, VA and Geothermal Resource Technologies, Inc., Bowie, TX.

Geothermal Heat Pump Consortium. Geoexchange Systems: Renewable and Ready. July, 2008. http://www.geoexchange.org/geothermal/publications/cat_view/62-fact-sheets.html

NASA, 2001. NASA Procedural Requirement (NPR) 8580.1, Implementing the National Environmental Policy Act and Executive Order 12114. http://nodis3.gsfc.nasa.gov/npg_img/N_PR_8580_0001_/N_PR_8580_0001_.pdf

NASA Langley Research Center, 2007. Environmental Assessment, Demolition of Building 1212B, the 7- by-10-Foot High Speed Tunnel at NASA Langley Research Center. Prepared by SAIC, Hampton, VA.

NASA Langley Research Center, 2007. Environmental Resources Document.

NASA Langley Research Center, 2008. Environmental Assessment, Hydro-Impact Basin at the Landing and Impact Research Facility at NASA Langley Research Center. Prepared by SAIC, Hampton, VA.

NASA Langley Research Center, 2007. LPR 8800.1, LaRC Environmental Program Manual. http://lms.larc.nasa.gov/admin/documents/LPR8800-1.pdf

NASA Langley Research Center, 2008. Pollution Prevention / Environmental Management and Sustainability Plan. Prepared by SAIC, Hampton, VA.

NASA Langley Research Center, 2008. Environmental Assessment, Demolition of Various Buildings and Infrastructure at NASA Langley Research Center, Hampton, Virginia (NHL EA), March 2008.

NASA Langley Research Center, 2008. LaRC Center Master Plan. http://gis-www.larc.nasa.gov/masterplan/

NASA Langley Research Center, 2008. New Town Program Administration Office Building One Final Concept Design Narrative. Prepared by DMJM Design, Arlington, VA.

NASA Langley Research Center, 2005. Phase I and Phase II Evaluations of Site 44HT45 and 44HT76 City of Hampton, Virginia. Prepared by James River Institute for Archaeology, Inc., Williamsburg, VA.

US Air Force, 2008. US Air Force Conformity Applicability Model (ACAM) Version 4.3.3. http://www.afcee.brooks.af.mil/products/air/acam/acam.asp

US Department of Transportation, Federal Highway Administration, 2006. Highway Construction Noise Handbook. http://www.fhwa.dot.gov/environment/noise/handbook/09.htm

US Department of Energy, Energy Efficiency and Renewable Energy, 2008. Geothermal Technologies Program. http://www1.eere.energy.gov/geothermal/

US Department of Energy, National Renewable Energy Laboratory. Geothermal Heat Pumps. September 1998. http://www.alliantenergygeothermal.com/stellent2/groups/public/documents/pub/geo_001416.pdf

6.0 LARC PREPARERS AND CONTRIBUTORS

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Appendix A

Excerpt from *Narrative for the New Town Program, Administration Office Building One, Final Concept Design*

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Narrative

20 January 2009

NASA Langley Research Center – New Town Program
Administration Office Building One
Final Concept Design

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D30. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

D3010. ENERGY SUPPLY

A. Narrative

The heating, ventilating, and air-conditioning (HVAC) systems serving AOB1 shall be designed to maximize energy efficiency, occupant comfort, and operational flexibility, while minimizing operating and maintenance requirements. This will be accomplished through a combination of state-of-the-art equipment, systems and controls.

B. Required System Components

The Design-Build contractor shall not be permitted to deviate from these specific system components. The HVAC system shall utilize a geo-exchange field as its heat source and heat sink. High efficiency modular reversible chillers or water to water heat pumps shall use the source water from the geo-exchange field to generate chilled and heating water to serve the building's loads. Air handling units shall be equipped with airside economizers to minimize mechanical cooling. An energy recovery unit shall operate during peak cooling periods to minimize the required mechanical cooling of outside ventilation air. The Building Automation System (BAS) shall be provided by one of NASA's Langley campus accepted manufacturers; Trane, Johnson, of Invensys. The design build contract is responsible for coordinating with NASA Langley to determine the extent of the system and the point of connection with the campus system.

C. Geothermal Transfer Field

To maximize energy efficiency, a ground source heat pump system is required with a geothermal transfer field. The geothermal transfer field shall consist of drilling a series of vertical wells into which "U tubes" of piping are inserted for circulating water in a large closed loop. The vertical wells are typically five (5) or six (6) inches in diameter and are from 200 to 400 feet deep; depending on soil and groundwater conditions. The U tubes consist of one-inch diameter plastic piping. The piping is inserted into the wells and encased in a poured grout material to promote thermal conduction with the soil. In effect, the wells act as a heat

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exchanger with the earth. The source water temperature will fluctuate around 65 °F. The geothermal transfer field will provide a cost effective heat sink and heat source.

Based on preliminary test results, it is estimated the building will require about 80 to 100 vertical wells and about one acre of land, depending on the well depth selected. Refer to the geotechnical report for additional information. Main supply and return water pipes shall run underground between the well field and the building. The ground loop water will be circulated through modular reversible chillers (water to water heat pumps) located in the penthouse. The modular reversible chillers shall produce the chilled and heating water required to condition the building's environment and to precondition domestic hot water. The well field shall be sized for the peak cooling load of the building; no cooling tower will be required.

Each modular reversible chiller shall be equipped with a circulation pump on the source (ground loop) side. When the modular reversible chiller is energized the pump shall circulate water through the modular reversible chiller and the well field. This will insure the required flow for the chiller is developed while varying the flow through the well field based on building demand, thus providing savings on pump energy.

D. Electric

The energy supply for the Heating, Ventilation, and Air Conditioning system is electricity. Electricity shall power the modular reversible chillers that shall generate the heating and chilled water distributed to the building. This system allows refrigerant cycles to generate heat, which is more cost effective then electric resistance heating. The building's only energy source shall be electricity.

D3020. HEAT AND COOLING GENERATION SYSTEM

A. Narrative

The ground loop serves as a heat source and heat sink for the modular reversible chillers, also referred to as water to water heat pumps. The Florida Heat Pump WW series, Water Furnace EW, and McQuay GRW series are three examples of modular reversible chillers. The piping shall be configured so each modular reversible chiller can provide either chilled water for space cooling or hot water for space heating. The building load for each system shall determine the number of chillers producing chilled water and the number of chillers producing heating water. Due to relatively constant source water temperature, the reversible chillers shall operate very efficiently in either the cooling or heating mode.

Each modular reversible chiller shall be equipped with a circulating pump on the load side. This pump shall start when the modular chiller is energized, circulating the required water flow through the chiller. Two three-way valves shall be installed on the load side of each chiller. The valves shall operate in unison, to direct water to and return water from either the chilled water or the heating water buffer tank. Based on building demand for the two systems, modular reversible chillers are staged on and off. The staging shall circulate water through the buffer tanks in volume steps, minimizing the energy required to operate chillers.

The control system shall have an adjustable transition period. This is the time the chiller shall be shut down before it is available to produce load water for the other system to avoid shocking the chiller. The transition period shall be based on manufacturer's recommendations. The control system shall have an adjustable delay before a chiller is alternated from chilled water to heating water and back.

A primary pump and a standby pump shall be provided for both the chilled water loop and heating water piping loops. The pumps shall circulate water through the associated buffer tank and out to the building. The chilled water pumps shall serve the eight Variable Air Volume (VAV) air handling units, Energy Recover Unit (ERU), and fan coil units. The hot water pumps shall serve the VAV Terminals, unit heaters, and fan coils. All chilled and heating water coils shall be equipped with two-way control valves, so only the water required to meet the demand shall be circulated. All four pumps shall be equipped with Variable Frequency Drives (VFD) to modulate the water flow based on building's demand.