DRAFT PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR SPACEX OPERATIONS AREA CAMPUS EXPANSION ON KENNEDY SPACE CENTER

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Executive Summary

Summary of Potential Effects to Resource Areas		
Resource Area	**Proposed Action**	**Gate Relocation Alternative**
Land Use / Visual Resources	Future development within the region of influence (ROI) would require changes to existing land use designations to accommodate phased construction of mission support, industrial, and operational facilities. These land use changes would support NASA's ongoing transition of KSC to a multiuser spaceport as described in the KSC Vision Plan and Master Plan that enables increased participation by commercial launch providers and other non-NASA partners. Portions of the study area currently managed by USFWS as part of the Merritt Island National Wildlife Refuge (MINWR) oversight would no longer be available for controlled burning operations. This change in land management would result in long-term, minor impacts to refuge management within the immediate footprint. Considering the consistency with other land uses in the Space Commerce District and the implementation of the Master Plan Amendment Process, the Proposed Action would not result in significant impacts to land use. Construction of the Proposed Action would result in short-term, moderate impacts to visual character resulting from use of construction equipment and lighting. The Proposed Action would result in a change in visual character from predominantly undeveloped land to an operational and industrial setting suitable for manufacturing, production, refurbishment and warehousing facilities. This change would constitute a long-term, minor to moderate impact to visual resources within the ROI due to the introduction of built infrastructure and associated operational features. However, because development would occur adjacent to and contiguous with existing SpaceX and NASA facilities, and would be consistent with established development patterns along the Roberts Road and A Avenue corridors, the Proposed Action would result in both short-term and long-term minor to moderate impacts to visual resources. Programmatic design controls, including KSC	The Gate Relocation Alternative would require similar land use changes from Operational Buffer/Conservation to Support Services as the Proposed Action to accommodate campus expansion. Visual effects under the Gate Relocation Alternative would be similar to the Proposed Action with respect to campus development; however, additional visual elements associated with relocated gates, fencing, and security infrastructure would be introduced along Kennedy Parkway, NASA Parkway, A Avenue, Ransom Road, and Schwartz Road. These features would incrementally increase the presence of built infrastructure within areas that currently exhibit a more open visual character. Visual effects would be minimized through application of KSC design standards, controlled lighting, and coordination with existing roadway and security features. The Gate Relocation Alternative would be subject to the same coastal zone management requirements and any associated effect regarding Coastal Zone Management would be similar to the Proposed Action.

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	exterior lighting standards, facility siting requirements, and vegetative buffering, would be applied to minimize visual contrasts with adjacent conservation lands. Therefore, the Proposed Action would not result in significant adverse impacts to visual resources. The Proposed Action would result in short-term and minor impacts, with negligible long-term impacts to coastal resources. The Proposed Action is consistent with the enforceable policies of the Florida Coastal Management Program and would not result in significant impacts on coastal uses and resources.	
Noise	Noise during construction would be limited primarily to the immediate vicinity of the area being developed. Noise levels would vary by type of construction but would be temporary in nature. Noise during facility operations would generally be consistent with the current noise environment at the SpaceX Operations Area. Considering the existing noise environment (frequent rocket launches), the relatively low number of maximum annual operations (20), the brief nature of the sound events (up to one minute per event and 20 minutes annually), and the fact that potential damage inducing noise levels would remain in the vicinity of the static fire stand on KSC there would be no significant impact due to noise.	The Gate Relocation Alternative would have similar noise effects as the Proposed Action. The Gate Relocation Alternative would not result in significant impacts due to noise.
Biological Resources	The Proposed Action would result in either “no effect” or “may affect, not likely to adversely affect” determinations for the majority of federally listed and proposed species, with limited exceptions where a “may affect, likely to adversely affect” determination was identified. No effects to designated or proposed critical habitat are anticipated. Overall, the Proposed Action is not expected to result in population-level impacts to listed species. Overall, the impacted area is small compared to the amount of suitable wildlife habitat available elsewhere on KSC. Accordingly, construction of the Proposed Action would result in short-term, moderate localized impacts to wildlife, and the	Under the Gate Relocation Alternative, biological resource effects from phased site development would be generally similar to the Proposed Action (permanent habitat loss, temporary or permanent habitat degradation, increased vehicular wildlife deaths and increased avoidance of the area; and increased disturbances to wildlife from noise and lighting for construction and operation activities), but the increased impacts from vehicular travel

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	Proposed Action would not result in significant impacts to Biological Resources.	would be anticipated to be less than impacts from the Proposed Action.
Cultural Resources	Construction of the Proposed Action would not result in impacts to cultural resources protected under the NRHP as no known resources are present within the APE.	The Gate Relocation Alternative would result in similar impacts to cultural resources as the Proposed Action.
Hazardous Materials / Hazardous Waste	Considering the limited extent of potential effects, implementation of standard operating procedures and best management practices (BMPs), and adherence to regulatory requirements, the Proposed Action would result in short-term and long-term minor impacts, and would not result in significant impacts related to hazardous materials or hazardous waste.	Hazardous materials and waste effects under the Gate Relocation Alternative would be similar to those of the Proposed Action. Additional minor, localized construction related wastes and spill risks could result from gate relocation, fencing installation, and associated utility tie-ins. With application of the same management practices and controls as the Proposed Action, construction related effects would be short term and minor, and operational effects would remain long term and minor.
Water Resources	Under the Proposed Action, site development would directly impact approximately 156 acres of wetlands and/or surface waters. In addition to direct impacts, the Proposed Action has the potential to result in secondary impacts to wetlands and surface waters caused by the direct alteration of the habitats from development. Stormwater runoff associated with site development represents the primary pathway by which the Proposed Action could affect surface water resources. These effects would represent long-term, minor impacts to surface water resources. Stormwater management systems would be required to be designed for full buildout conditions, maintain pre-development hydrology to the extent practicable, and comply with applicable permitting requirements and tiered NEPA review. With the implementation of BMPs, mitigations, and controls described in the PEA, it is anticipated that the Proposed Action would not result in significant impacts on water resources.	Under the Gate Relocation Alternative, water quality effects would be generally similar to the Proposed Action, but roadway corridor stormwater and wetland effects associated with constructing the connector road would be avoided. Floodplain effects would be similar to the Proposed Action; however, connector-road corridor drainage effects would be avoided, while localized floodplain conveyance and drainage changes could occur near relocated gate facilities and along affected corridors where grading, pavement, and drainage structures are introduced. Groundwater effects would be generally similar to those of the

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	Under the Proposed Action, phased grading and construction could temporarily alter localized drainage patterns and shallow flow pathways during construction. With stormwater management systems in place, the Proposed Action is not expected to measurably increase base flood elevations or adversely affect floodplain function. Therefore, impacts to floodplains would remain short-term and minor during construction and long-term and negligible during operation, and would not result in significant impacts. Under the Proposed Action, phased site development could require localized excavation below the water table and temporary dewatering. The likelihood of measurable groundwater impacts would be minimized through use of secondary containment, routine inspection and maintenance, and spill response procedures consistent with KSC and SpaceX requirements. With these measures, operational groundwater effects would be long-term and minor, and would not result in significant impacts.	Proposed Action. In addition, localized excavation and utility work near gate relocation areas could encounter shallow groundwater and require temporary dewatering, and construction activities could introduce typical spill pathways associated with access features.
Geology and Soils	Under the Proposed Action, short-term, localized soils disturbances could occur. Potential effects include temporary erosion and sedimentation, compaction and rutting of wet soils, minor alterations to surface drainage patterns, and localized dewatering during excavation. Geologic conditions would not be altered because activities would not affect regional geologic formations. With implementation of standard erosion and sediment control measures, stormwater pollution prevention practices, construction phasing, and stabilization of disturbed areas, soils impacts would be short-term, localized, and minor to moderate. No additional impacts to geology or soils would occur during operation of the Proposed Action. Therefore, the Proposed Action would not have a significant impact on geology and soils.	Under the Gate Relocation Alternative, soils and geology effects would be similar to the Proposed Action. Because the roadway footprint would be avoided, overall disturbance may be reduced relative to the Proposed Action; however, localized erosion, compaction, and dewatering could still occur near gate locations.
Transportation	During construction, roadway and infrastructure development activities would result in short-term, minor impacts to the transportation network due	The Gate Relocation Alternative would provide similar transportation efficiency benefits

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	to temporary increases in construction traffic, localized congestion, and minor disruptions to traffic flow. Although increased traffic volumes would occur on the adjacent roadways, the Proposed Action would also include necessary improvements to traffic signal timing, resulting in an overall neutral effect on the transportation network, and no significant impacts.	compared to the Proposed Action. The Gate Relocation Alternative would also result in short-term, minor impacts during construction and neutral impacts during operation on the existing transportation network.
Air Quality	The Proposed Action would result in temporary increases of criteria pollutants during the construction phases and potentially substantive increases in emissions of criteria pollutants during operations at full buildout. Due to the phased approach to construction anticipated in this PEA, it is unlikely emissions during construction would exceed applicable thresholds (250 tons per year (tpy) of each pollutant), and violations of applicable air quality standards or contribution to a change in attainment status is not anticipated. However, if construction phases overlap each other, it is possible that annual emissions could exceed 250 tpy. Therefore, future project-level reviews would assess construction emissions in greater detail based on project-specific plans and data. Greenhouse gas emissions under the Proposed Action would be generated by long-term operations (e.g., facility energy use and mobile sources). At the programmatic level, these emissions are expected to represent a small incremental contribution relative to regional and global inventories and would not be expected to measurably influence climate trends. Overall, expected construction and operation of the Proposed Action would not have significant air quality impacts.	Air quality effects under the Gate Relocation Alternative would be similar to those of the Proposed Action. Construction-related emissions associated with campus development and gate relocation would be minor, temporary, and localized, and operational emissions would remain below applicable significance thresholds.
Utilities	During construction, installation of utilities and associated infrastructure could result in short-term, minor impacts due to localized disturbance, temporary service disruptions, and construction-related activities. These effects would be limited in extent and duration and would be managed through standard construction controls and BMPs.	Under the Gate Relocation Alternative, utility demands for the campus expansion would be similar to the Proposed Action and would continue to rely primarily on existing KSC and regional utility systems. The absence of the connector

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	During operations, the Proposed Action is not expected to exceed the capacity of existing utility systems. Any required utility extensions or upgrades would be evaluated through tiered NEPA review and applicable permitting as specific phases are proposed. As a result, operational effects would be long-term and minor, associated with incremental increases in demand on existing systems. The Proposed Action would not result in significant impacts to utilities.	roadway would generally reduce the need for roadway-corridor utility placement associated with that feature, though localized utility tie-ins may be required to support relocated gate infrastructure (e.g., lighting, communications, access controls).
Socioeconomics	The increase in employment, coupled with higher-than-average wages associated with the aerospace industry, would result in long-term, moderate, beneficial impacts to employment, income, and overall economic conditions within the region. The Proposed Action would not have a significant impact on socioeconomic conditions.	Under the Gate Relocation Alternative, short-term and long-term employment and other economic benefits are anticipated to be the same as with the Proposed Action Alternative.
Health and Safety	Potential adverse impacts on human health and safety may arise throughout the construction phase and industrial activities as a result of the Proposed Action. During construction and operation, compliance with Occupational Safety and Health Administration regulations, as well as other recognized standards would be implemented. With these measures in place, the Proposed Action would have a short-term and long-term minor impact on health and safety, and would not result in a significant impact on health and safety.	Under the Gate Relocation Alternative, short-term and long-term heath and safety requirements would be the same as with the Proposed Action Alternative.

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Acronyms and Abbreviations

BMPs – Best Management Practices
BO – Biological Opinion
CCSFS – Cape Canaveral Space Force Station
CFR – Code of Federal Regulations
CWA – Clean Water Act
EA – Environmental Assessment
EPA – U.S. Environmental Protection Agency
ESA – Endangered Species Act
EUL – Enhanced Use Lease
FAC – Florida Administrative Code
FDEP – Florida Department of Environmental Protection
FPL – Florida Power and Light
GHG – Greenhouse Gas
IPaC – Information for Planning and Consultation
KSC – Kennedy Space Center
MBTA – Migratory Bird Treaty Act
MINWR – Merritt Island National Wildlife Refuge
NAAQS – National Ambient Air Quality Standards
NASA – National Aeronautics and Space Administration
NEPA – National Environmental Policy Act
NOAA – National Oceanic and Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
NRCS – Natural Resources Conservation Service
PEA – Programmatic Environmental Assessment
ROI – Region of Influence
SEA – Supplemental Environmental Assessment
SPCC – Spill Prevention, Control, and Countermeasure
SWPPP – Stormwater Pollution Prevention Plan
USACE – U.S. Army Corps of Engineers
USFWS – United States Fish and Wildlife Service

1.0 PURPOSE AND NEED

The National Aeronautics and Space Administration (NASA) is evaluating Space Exploration Technologies Corp.'s (SpaceX's) proposal to expand its facilities at the Roberts Road Operations Area at Kennedy Space Center (KSC). SpaceX currently leases 167 acres from NASA on Roberts Road where it operates facilitates and conducts rocket processing and refurbishment. SpaceX now seeks to lease additional land from NASA. SpaceX must enter into and execute a real property agreement with NASA for this expansion. NASA's execution of a real property agreement and subsequent property development is considered a major federal action under the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States Code [U.S.C.] 4321, et seq.) and requires an environmental review. NASA is the lead federal agency for this environmental review, and it was prepared pursuant to NASA regulations for implementing NEPA (12 CFR 1216 et. seq. and the NASA Procedural Requirement (NPR) for Implementing NEPA.

This Programmatic Environmental Assessment (PEA) has been prepared under the supervision of NASA. This PEA assesses the potential direct and indirect reasonably foreseeable effects of the action and alternatives. A programmatic document is a type of general, broad NEPA review from which subsequent NEPA documents can be tiered, focusing on the issues specific to the subsequent actions. Programmatic NEPA documents may be prepared for broad federal actions, such as a proposed program, policy, plan, or suite of projects, which addresses actions occurring over large areas or systems and may include groupings of similar actions or repeating actions over longer periods of time than other NEPA reviews (42 U.S.C. § 4336e(11).[1] The use of a programmatic Environmental Assessment, and subsequent preparation of project specific NEPA documents, is referred to as "tiering" the environmental review. NASA has recognized that a programmatic review and tiering may be appropriate to sequence the environmental documents from the early stage of a proposed action to a subsequent stage to help focus on issues that are ripe for decision and exclude from consideration issues not yet ripe or already decided.

1.1 Background

NASA was created in 1958 to lead the nation's civilian space exploration and aeronautical technology development activities and began acquiring property to be used as a base for launch operations in support of the Manned Lunar Landing Program in 1962. KSC, located in Florida within Brevard and Volusia counties, is comprised of approximately 139,436 acres and is situated along the Atlantic east coast approximately 150 miles south of Jacksonville, 200 miles north of Miami, and 40 miles east of Orlando (Figure 1-1). KSC is the nation's primary federal spaceport for government and commercial access to space. From 1981 to 2011, KSC was responsible for ground processing, launch, and landing activities for the Space Shuttle Program. Since 2011, KSC has developed partnerships with governmental entities and commercial operators and made its unique assets, capabilities, and expertise available for use. KSC has transitioned from a government-only space launch complex to a public-private space gateway that facilitates the largest concentration of space launch operators in the world.

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[1] *The Council on Environmental Quality's December 2014 guidance, Effective Use of Programmatic NEPA Reviews, states "[in the absence of certainty regarding the environmental consequences of future proposed actions, agencies may be able to make broad program decisions and establish parameters for subsequent analyses based on a programmatic review that adequately examines the reasonably foreseeable consequences of a proposed program, policy, plan, or suite of projects."*

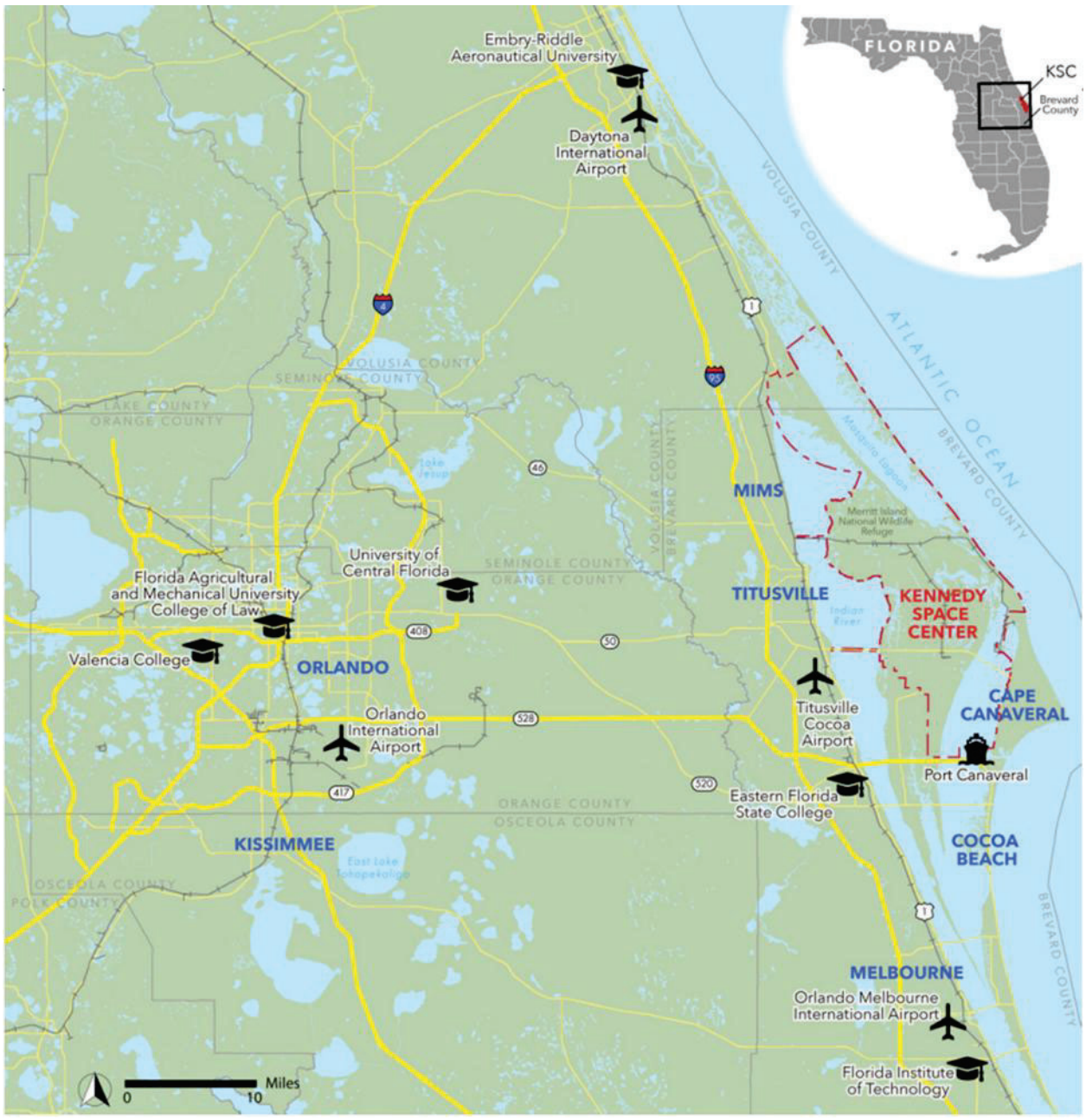
NASA encourages the use of KSC property by other governmental agencies, commercial space and related industries, and universities through real property agreements. NASA is leasing multiple KSC facilities and land for a variety of space programs that support the agency and advance the commercial space industry, secondary support industries, and universities.

In 2018, SpaceX and NASA prepared the *Final Environmental Assessment for Space Exploration Technologies Operations Area on Kennedy Space Center* (NASA, 2018a), referred to as 2018 EA for the purpose of this document, to evaluate the potential environmental impacts of construction and operation of the SpaceX Roberts Road Operations Area. NASA issued a Finding of No Significant Impact (FONSI) in December 2018. The 2018 EA included development and corresponding expansion of necessary utilities adjacent to the intersection of Roberts Road and A Avenue.

In 2024, SpaceX and NASA prepared the *Final Supplemental Environmental Assessment for the Roberts Road SpaceX Operations Area Expansion & Supporting Infrastructure on Kennedy Space Center*, referred to as the 2024 SEA for the purpose of this document, to evaluate the potential environmental impacts of construction and operation of an expanded area of the SpaceX Roberts Road Operations Area. NASA issued a Finding of No Significant Impact (FONSI) in April 2024. The 2024 SEA included scope allowing the SpaceX Roberts Road Operations Area to be expanded by 100 acres immediately north of the existing site and an expansion of the Saturn Causeway.

In 2020, NASA published the KSC Vision Plan and Programmatic EA. The Vision Plan was the first stage of a Master Plan update, aimed to serve as a framework for stewarding KSC's physical assets over the next 20 years. This foundational step, developed through collaboration with stakeholders within NASA and federal, state, and local governments, and commercial entities, guides the development of the Master Plan update, prioritizing mission and institutional alignment, affordability, sustainability, and launch throughput, in accordance with relevant policy and guidance. The KSC Vision Plan aims to meet NASA's missions while maximizing opportunities for non-NASA stakeholders to develop and grow additional resources and capabilities at KSC. The KSC Vision Plan divides KSC into seven planning districts to focus follow-on planning efforts. The existing SpaceX Roberts Road Operations Area and the expanded area north of Roberts Road that is under construction are within the Space Commerce District defined in the KSC Vision Plan, the goal of which is to provide support to commercial space operations, capabilities, and supporting infrastructure at KSC. The Proposed Action area is not within the Space Commerce District boundary and would require an amendment to the KSC Master Plan.

Figure 1-1. Vicinity Map



Source: (NASA, 2020a)

1.2 Federal Agency Roles

1.2.1 National Aeronautics and Space Administration

As the lead federal agency, NASA is responsible for analyzing the potential environmental effects of the Proposed Action. As the landowner, NASA is responsible for managing areas on KSC for space-related development and operations and provides oversight of non-NASA space and technology development on KSC property. KSC is responsible for establishing and coordinating appropriate use agreements and operating procedures for those activities outlined in the Proposed Action.

1.2.2 United States Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) Merritt Island National Wildlife Refuge (MINWR) is a cooperating agency due to its special expertise and management responsibilities for land potentially affected by the activities evaluated in this PEA. Through official agreement with NASA (KCA-1649 Rev. C), USFWS manages KSC lands not specifically used for space program-related operations as MINWR.

1.3 Purpose and Need

The purpose of NASA's Federal action is to fulfill its Congressional mandate to encourage the "fullest commercial use of space" and to advance its mission to foster a commercial space launch and services industry (51 U.S.C. § 20112 and 51 U.S.C. § 50904). This action will also improve the return on taxpayer investment in KSC spaceport facilities through expanded and improved utilization. NASA's execution of real property agreements for use of KSC by other governmental agencies, commercial space and related industries, and universities fulfills this mandate and furthers the goals of KSC long-term planning initiatives and NASA programmatic objectives, and ultimately increases American competitiveness in commercial space. Commercial use of KSC real property supports NASA's mandate to encourage the fullest commercial use of space, supports the goals of the National Aeronautics and Space Act, and advances the National Space Policy that federal agencies shall ensure that U.S. Government space technology and infrastructure is made available for commercial use on a reimbursable, noninterference, and equitable basis. The proposed action is in direct support of national directives outlined in the Commercial Space Launch Act, the National Space Policy, and the National Space Launch Policy.

The purpose of SpaceX's proposed action is to increase the capabilities, efficiency, and cost effectiveness of SpaceX's production and launch support operations in Brevard County, Florida. Locating production, manufacturing, and other facilities near launch sites reduces the impact on nearby transportation networks as oversized or otherwise sensitive components would not need to be transported over public roads or waterways and therefore expedites NASA's mandate of supporting the commercial space industry with fewer impacts to the public.

The need for SpaceX's action stems from the escalating requirements of its commercial and government-contracted missions, which demand integrated facilities to handle increased production volumes and minimize logistical risks like road closures or waterway disruptions in Brevard County. This expansion addresses specific challenges, such as current transportation impacts on State Road 405 and the Indian River Lagoon, by shortening transport distances from miles to on-site movements, aligning with FAA spaceport licensing standards (e.g., 14 CFR Part 420) for efficient operations.

1.4 Licenses, Permits and Approvals

To proceed with construction and operations of the Proposed Action identified in Chapter 2, SpaceX would require several environmental and regulatory permits in addition to the execute the necessary real property agreements such as an Enhanced Use Lease (EUL) and/or easement with NASA. NASA has identified the following environmental permits and approvals for the Proposed Action, but others may be required as well.

- **Bald and Golden Eagle Protection Act –** The Bald and Golden Eagle Protection Act prohibits the take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, and export or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. Coordination with the USFWS under the Bald and Golden Eagle Protection Act is conducted as part of the NEPA process through the PEA review.

- **Endangered Species Act** – Section 7 of the Endangered Species Act requires all Federal agencies to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any listed species or result in destruction or adverse modification of designated critical habitat. In accordance with Section 7, NASA is conducting consultation with the USFWS.
- **Migratory Bird Treaty Act** – Birds, both migratory and most native-resident bird species, are protected under the Migratory Bird Treaty Act. Under the Migratory Bird Treaty Act, it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill; attempt to take, capture, or kill; or possess migratory birds or their nests or eggs at any time, unless permitted by regulation. Effects to migratory birds and compliance with the Migratory Bird Treaty Act are addressed as part of the NEPA process; NASA will consider measures to reduce effects as required by Executive Order 13186, which directs federal agencies to act to further implement the Migratory Bird Treaty Act.
- **National Historic Preservation Act** – Section 106 of the National Historic Preservation Act requires Federal agencies to consider the effect of Federal undertakings on historic properties, including historic, archaeological, and cultural resources. As part of the National Historic Preservation Act Section 106 process, NASA is consulting with the Florida State Historic Preservation Office and federally recognized tribes to help determine the potential effects of the Proposed Action.
- **Clean Water Act** – The Clean Water Act regulates discharges of pollutants into waters of the United States and sets water quality standards for surface waters. Dredging, filling, stormwater management, and other alterations to wetlands or jurisdictional waters during construction and operations would require permits under Sections 401 (Water Quality Certification), 402 (National Pollutant Discharge Elimination System), and 404 (Dredge and Fill) from the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and/or delegated state authorities (e.g., Florida Department of Environmental Protection).
- **Florida Environmental Resource Permit Program** – The State of Florida operates the Environmental Resources Permitting Program, which regulates activities involving the alteration of surface water flows. This includes new activities in uplands that generate stormwater runoff from construction, as well as dredging and filling in wetlands and other surface waters.

1.5 Scope of Environmental Analysis

This PEA addresses the reasonably foreseeable environmental effects from the Proposed Action and No Action Alternative. The environmental effects of the Proposed Action and Alternatives are discussed in the appropriate resource area sections. The structure of the PEA is as follows: Chapter 2, Proposed Action and Alternatives, describes the Proposed Action and Alternatives. Chapter 3, Affected Environment and Environmental Consequences, describes the existing conditions for each resource area and analyzes the potential reasonably foreseeable environmental effects of the Proposed Action and alternatives. Chapter 4, List of Preparers, includes a list of preparers and independent evaluators.

1.6 Documents Incorporated by Reference

To cut down on bulk without impeding review of the Proposed Action, the following documents are incorporated by reference and their relevance is discussed throughout this PEA where these documents are referenced. These documents were reviewed to identify any changes in existing conditions or anticipated that have occurred since their publications. Any relevant changes identified are incorporated into the PEA.

- Final Supplemental Environmental Assessment for the Roberts Road SpaceX Operations Area Expansion & Supporting Infrastructure on Kennedy Space Center (NASA, 2024)
- Final Kennedy Space Center Vision Plan and Programmatic Environmental Assessment (NASA, 2020)
- Final Environmental Assessment for Space Exploration Technologies Operations Area on Kennedy Space Center (NASA, 2018)

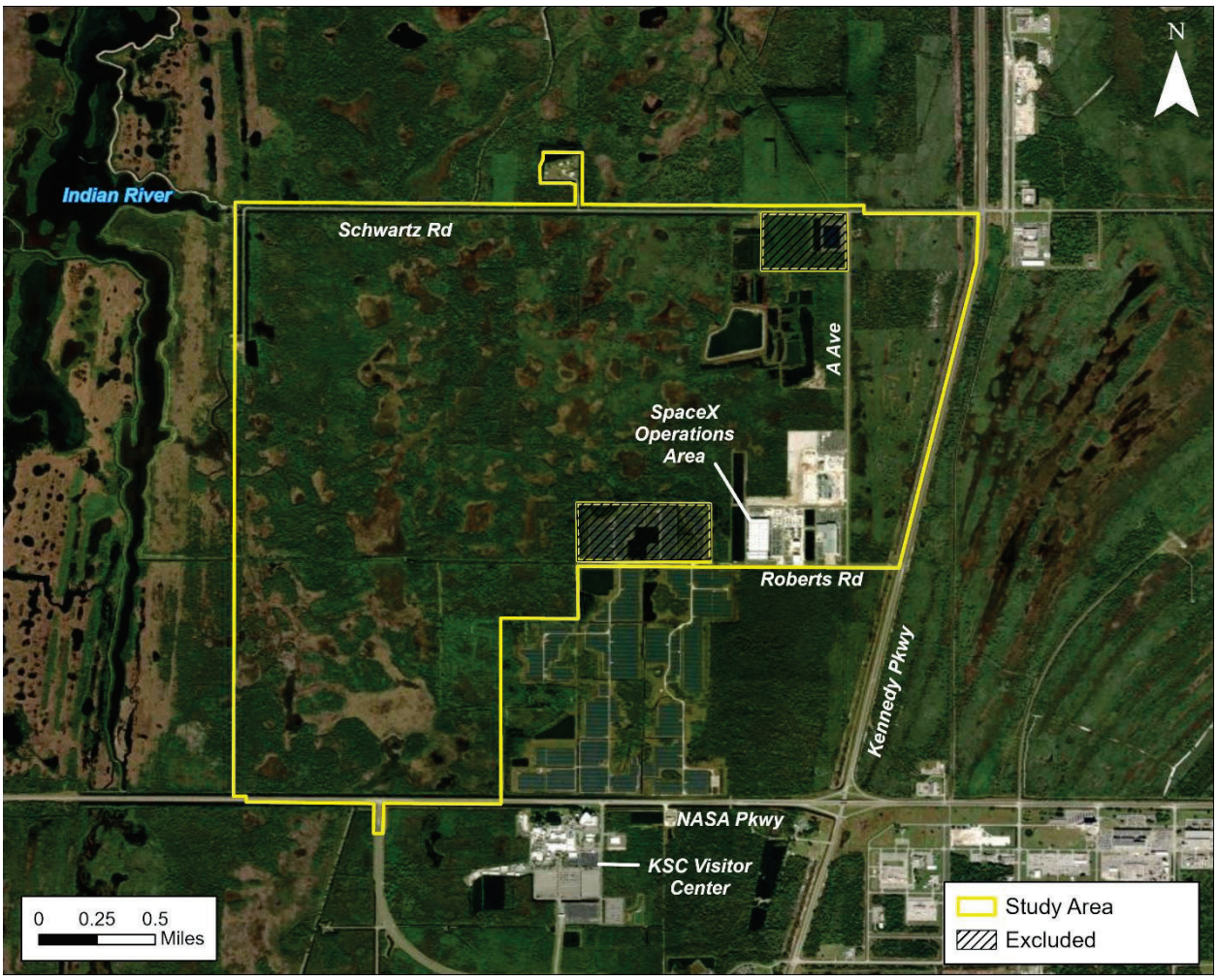
2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

NASA's Federal Action is to execute the necessary real property agreements for SpaceX's Proposed Action. Land use changes may be required for future development proposed under this PEA and future actions that would tier off this PEA. SpaceX would be required to submit a site plan for land use change requests, which NASA would evaluate through the Master Plan Amendment Process. During the Master Plan Amendment Process, NASA would consider the effects of the proposed land use change and site development not only at the site-level but the interaction with the overall vision and goals of KSC. Following approval of the Master Plan Amendment, execution of the necessary real property agreements, and acquisition of permits, SpaceX would be able to proceed with planned improvements as described below.

SpaceX's proposed action is the expansion of its existing campus at Roberts Road and construction of supporting infrastructure to increase the capabilities, efficiency, and cost effectiveness of SpaceX's production and launch support operations. Development would be expected to occur over several years in phases and would occur in the areas shown in Figure 2-1. The following sections provide more detail about potential development of the Proposed Action.

Figure 2-1. Proposed Action Study Area



2.1.1 Site Development

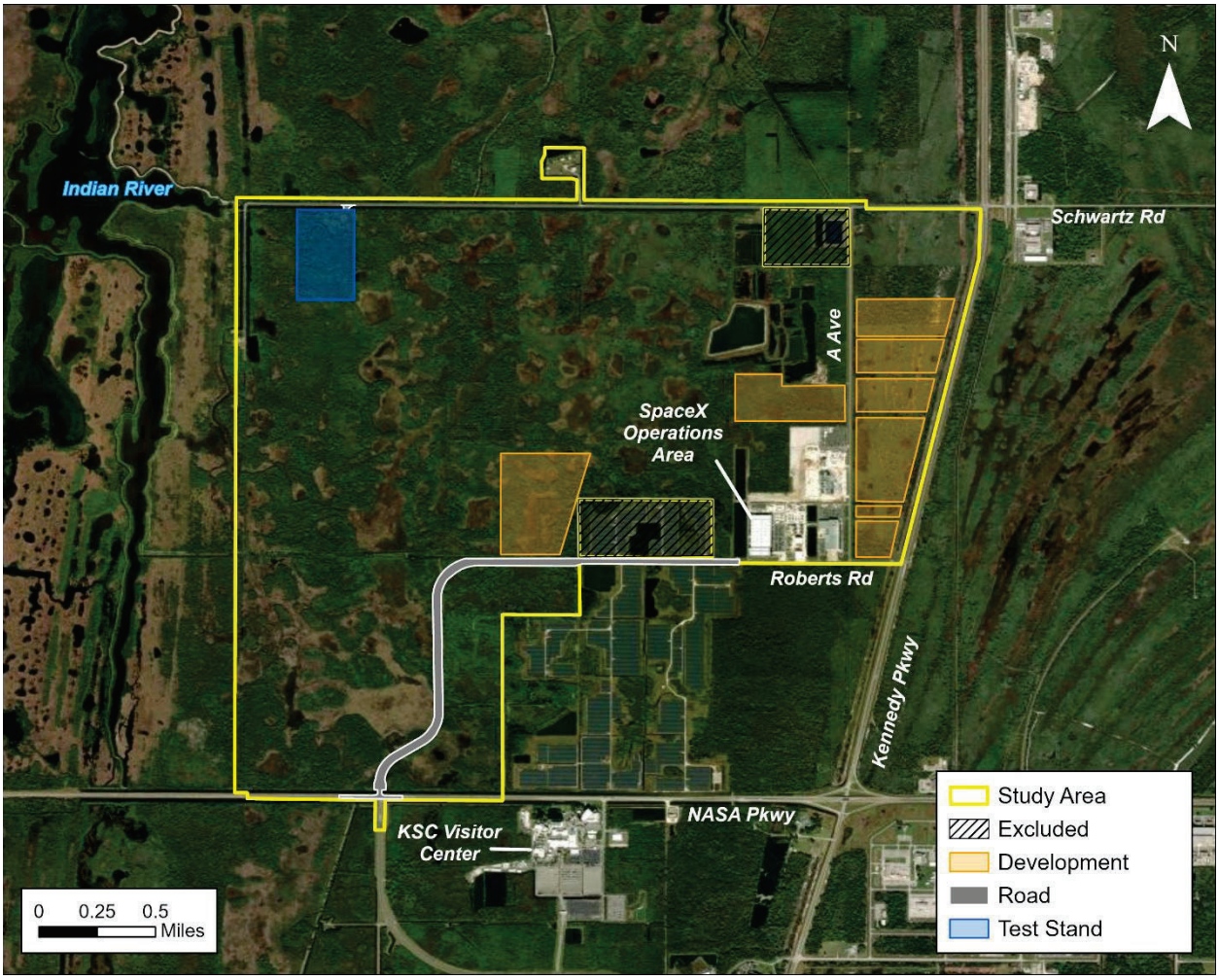
SpaceX would develop land within the study area shown in Figure 2-1. Development could include facilities for activities such as manufacturing, production, refurbishment, and warehousing. Development would be similar to existing facilities at the Roberts Road Operations Area, which includes refurbishment facilities for the Falcon launch vehicle, Dragon spacecraft, vehicle processing, and general manufacturing. New facilities would further support and expand these capabilities and could include but are not limited to manufacturing new spacecraft components, additional refurbishment, or other new types of manufacturing or refurbishment. For the purpose of analysis in this PEA, approximately 400 acres would be developed. Infrastructure, including utilities, to support this development would also be constructed and are discussed in more detail in Section 2.1.3 and 2.1.4.

Individual phases would be submitted to KSC for review as part of the KSC Master Plan site review process, and future analyses would tier off this PEA where applicable. For the purpose of analysis in this PEA, a notional development plan has been prepared and is shown in Figure 2-2.

The existing KSC Protective Service Office shooting range is located within this study area. If development were to occur in this area, it would require relocation of the shooting range elsewhere at KSC. Potential relocation would be considered in a future tiered analysis.

New development would be connected via an internal road network for traffic circulation. Roads would generally be two lanes wide, but some may be wider to facilitate the transport of oversized hardware. These would be similar to other internal roads found near development on KSC, including the KSC Industrial Area and the existing Roberts Road Operations Area.

Figure 2-2. Notional Site Development



2.1.1 Payload Processing

A payload processing facility could be constructed west of A Avenue. A payload processing facility was analyzed at SpaceX's existing campus in the 2024 SEA but was never constructed. The siting of the payload processing facility would be determined by potential impacts to other facilities due to required clears during hazardous operations. Clear distances are based on quantity distance arcs which are used to determine the siting of potentially explosive material. A clear distance of 1,250 feet was assumed. Toxic hazard corridors are developed using predicted atmospheric dispersion paths of hazardous materials and are used to reduce the exposure risk to personnel, other users of KSC, and the general public.

2.1.2 Test Stand

A test stand is proposed as part of the Proposed Action. The test stand would be used to verify post-production testing of Starship and support static fire tests. Tests would include tank tests, proof tests, spin prime tests, and static fire tests. Proof pressure tests are broken into two main categories: (1) pneumatic

and (2) cryogenic. Pneumatic proof pressure testing consists of pressurizing the launch vehicle's tank with gaseous media and holding pressure for an extended duration. Cryogenic proof pressure testing consists of loading the tank with a single propellant. The tanks are then pressurized to a predefined limit to confirm their structural integrity with appropriate factors of safety. These proof pressure tests do not release any propellant to the environment. Propellants are recycled back into the ground system tanks after the test is completed. Tank tests do not involve the mixing of explosive commodities and are designed to test an accepted safety limit. Spin-prime tests verify the engine system is operational. During a spin-prime test, the vehicle engines are chilled and pumps are spun to operating speed but are stopped prior to engine ignition. Static fire tests verify engine control and performance. During a static fire test, engines are ignited while the vehicle remains clamped to the test stand. The required clear distance for the test stand is approximately 5,600 feet.

The test stand would be sited in the northwest section of the notional site development area, as denoted in Figure 2-2.

2.1.3 Utilities

Power would be provided from existing sources, including the Mars and Saturn substations. Future power needs may also be met through the use of batteries, such as Megapacks. Future site-wide power needs would be determined on a phased, per-project basis. Infrastructure to connect new development to existing power sources may be required, but additional power service to KSC at-large is not proposed at the programmatic stage. Electrical power would continue to be provided by Florida Power and Light (FPL). No power infrastructure improvements are proposed at this time.

Water would be provided via the existing KSC supply lines from the City of Cocoa. Wastewater would be treated on-site or sent to existing or future wastewater treatment plants. Wastewater needs would be determined on a phased, per-project basis.

2.1.4 Roadways

SpaceX would construct a new roadway partially along an existing dirt road from NASA Parkway to Roberts Road that would relocate its expanded Roberts Road campus operations area outside the existing KSC secure fenceline to enhance operational efficiency and reduce administrative burdens at KSC. The proposed roadway typical section would be four-lanes. The proposed NASA Parkway Connector would generally follow the existing unpaved Roberts Road and access road adjacent to the FPL solar farm before connecting, on new location, with NASA Parkway at the signalized intersection with Space Commerce Way. The new leg at the intersection of NASA Parkway and Space Commerce Way would require traffic signal modifications to accommodate the additional signal phases. SpaceX would locate any necessary utilities within the proposed improvement area. Construction of this roadway would require minor intersection improvements (e.g., turn lanes) on NASA Parkway.

SpaceX would construct a gate along the proposed road to secure the facility and only allow approved personnel. Additional gates would be constructed along A Avenue and Roberts Road to prevent unauthorized access from the Roberts Road Operations Area to KSC. Fencing would be constructed between A Avenue and Kennedy Parkway and along Schwartz Road to maintain the KSC secure area.

When fully operational, SpaceX expects approximately 7,500 vehicle trips per day to and from the Roberts Road Operations Area. The vehicle trips per day are anticipated to be comprised of employees, customers, and contractors traveling to and from the site and trucks delivering materials in support of manufacturing and production activities. The proposed roadway would redirect this SpaceX-related traffic away from the

KSC Security Checkpoints. This infrastructure improvement would substantially decrease the support resources needed from KSC security teams by reducing the need for routine badge processing and security clearances for SpaceX personnel, contractors, and customers. This activity currently requires substantial effort from KSC security teams—including background checks, badge issuance, and escorted access protocols that can consume thousands of KSC staff-hours annually. By minimizing these requirements, the private road would alleviate delays that often impact time-sensitive activities, such as component and construction deliveries, operations for critical commercial and government-contracted launches. This streamlined access aligns with NASA's multi-user spaceport goals under the KSC Master Plan, promoting faster turnaround times, reducing logistical bottlenecks, and supporting high-cadence operations without compromising overall site security.

2.2 Alternatives

NEPA requires agencies to identify "a reasonable range of alternatives to the proposed agency action… that are technically and economically feasible, and meet the purpose and need of the proposal." 42 U.S.C. § 4332(C)(iii) (2023). The purpose and need is identified in Section 1.3 SpaceX proposed and NASA evaluated and accepted the following criteria to select potential alternatives to the Proposed Action.

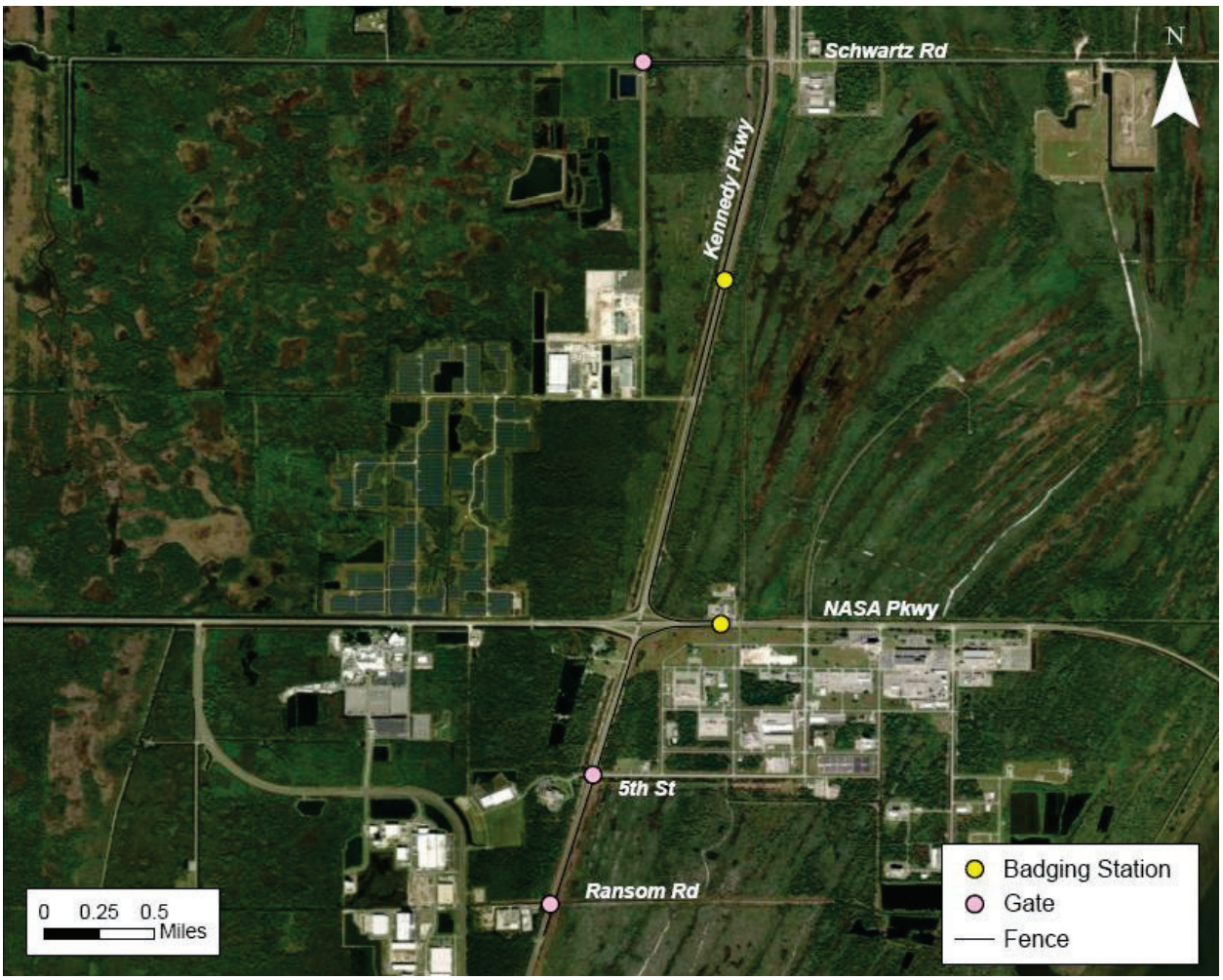
- Alignment with NASA's statutory and policy mandates (51 U.S.C. § 20112 and 51 U.S.C. § 50904) to encourage the fullest commercial use of space. Alternatives that do not facilitate expanded commercial access to land for phased development would not meet the purpose and need because they fail to address the need for multi-user spaceport growth amid rising launch demands.
- Achievement of SpaceX's operational efficiency and cost-effectiveness goals of expanding production, manufacturing, and launch support capabilities near existing sites while reducing transportation risks and KSC operational impacts. Alternatives that do not improve efficiency, such as those requiring off-site facilities or an unconsolidated footprint would not meet the purpose and need.

2.2.1 Gate Relocation Alternative

All aspects of the Proposed Action would occur with the exception of the connector road from NASA Parkway to the SpaceX campus. Under Alternative 1, the connector road would not be constructed.

Under Alternative 1, the KSC security gates (badging stations) on Kennedy Parkway and NASA Parkway would be relocated. KSC Gate 2, located on Kennedy Parkway, would be relocated north of the intersection of Kennedy Parkway and Roberts Road. KSC Gate 3 would be relocated east of the interchange of Kennedy Parkway and NASA Parkway. Additional fencing along Kennedy Parkway would be required to delineate the new KSC Secure Area. The existing fence would be extended to secure the east side of Kennedy Parkway north of Roberts Road and along NASA Parkway to the relocated badging stations. Fencing would also be constructed on the east side of Kennedy Parkway from Roberts Road to Schwartz Road and along Schwartz Road to A Avenue. A gate would be constructed on A Avenue, Ransom Road, and 5th Street to prevent unauthorized access to the KSC Secure Area. Notional gate and fencing locations are presented in Figure 2-3.

Figure 2-3. Notional Gate Relocation and Fencing – Alternative 1



2.2.2 No Action Alternative

Under the No Action Alternative, NASA would not enter into a real property agreement with SpaceX. The No Action Alternative would not meet NASA's mandate to encourage the fullest commercial use of space, advance NASA's mission to foster a commercial space launch and services industry, nor improve the return on taxpayer investment in KSC spaceport facilities. The No Action Alternative would negatively affect America's competitiveness in commercial space. Therefore, the No Action Alternative does not meet the purpose and need but is retained and carried forward as a baseline for comparison of environmental effects associated with the Proposed Action.

2.2.3 Alternatives Considered but Dismissed

The following alternatives were considered but dismissed from detailed analysis for overall site development.

<u>South of Roberts Road</u>

The parcel immediately south of the existing Roberts Road Operations Area, between Roberts Road and NASA Parkway, has been allocated by KSC to another user. The proximity of the parcel to primary roads could result in those facilities being cleared during operations at the test stand or payload processing facility. Therefore, it is not a practicable alternative and thus not carried forward for detailed analysis.

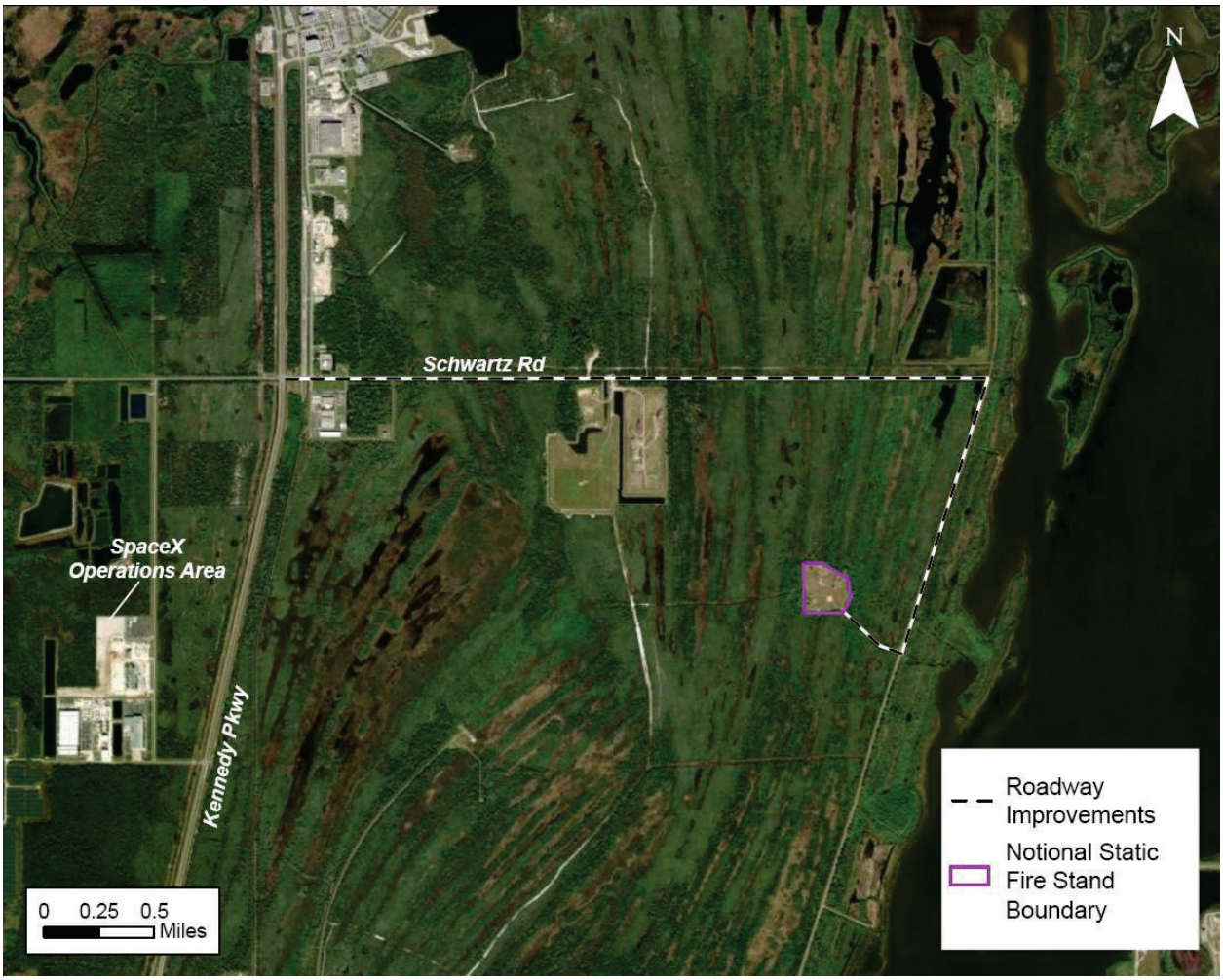
Launch and Landing Facility

Space Florida leases the Launch and Landing Facility, formerly known as the Shuttle Landing Facility, on the northern portion of the KSC secure area. This alternative was dismissed for detailed analysis because it would locate new facilities several miles from existing SpaceX development. This would then require extensive transport of oversized loads between sites, substantially impacting traffic on Kennedy Parkway, the primary north-south transportation route on KSC. This alternative does not meet the established criteria for the proposed action and thus was not carried forward.

East Test Stand

A test stand was considered at a location east of Kennedy Parkway. Schwartz Road would be improved east of the intersection with Kennedy Parkway to facilitate vehicle transport. This would include widening and potentially reconstructing Schwartz Road, as segments east of Kennedy Parkway are unpaved. The notional roadway improvements and site boundary are shown in Figure 2-4. This alternative was not carried forward as it has been allocated to another user, thus is not available for the Proposed Action.

Figure 2-4. Notional East Static Fire Stand – Alternative 2



Off-Center Alternatives

Alternatives outside of the KSC boundary were not considered as they would not meet the purpose and need of the Proposed Action.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter provides a description of the existing environment that could be affected by the Proposed Action at KSC, followed by an analysis of potential environmental impacts of the Proposed Action. As directed by NEPA, NASA's regulations for implementing NEPA (14 CFR 1216 *et. seq.*), and NASA NEPA management requirements (NPR 8580.1A), the description of the affected environment focuses on those resource areas potentially subject to impacts. Therefore, the level of detail used in describing a resource is commensurate with the anticipated level of environmental impact. The analysis in this PEA considers the current conditions of the affected environment and compares those to conditions that might occur should SpaceX implement any of the alternatives.

Impacts are assumed to be adverse unless specifically noted as positive or neutral. The following additional factors are used to evaluate potential impacts associated with the Proposed Action:

- Duration:
  - Long term – effect would last past the time of construction and is not related to construction
  - Short term – effect would occur for a limited time frame (during construction only)
- Magnitude:
  - Major – substantial effect or change that is easily defined, noticeable, and measurable, or exceeds a standard or regulatory threshold
  - Moderate – noticeable change in resource occurs, but the integrity of the resource stays intact
  - Minor – change in resource occurs, but effect is unsubstantial
  - Negligible – effect is at the lowest level of detection, is barely measurable, and has no perceptible consequences
  - None – no measurable consequences

This PEA examines the environmental impacts of the Proposed Action, Alternative 1, and No Action alternatives on the following resource areas: land use/visual resources/coastal zone management, noise, biological resources, cultural resources, air quality, hazardous materials and wastes, water resources, geology and soils, transportation, utilities, socioeconomics, and health and safety.

The geographic extent of the land encompassed by the study area as shown in Figure 2-1 is a total of approximately 3,100 acres. The notional buildout described in Chapter 2 is referred to as the "Notional Footprint" and includes approximately 400 acres. The region of influence (ROI) evaluated in this PEA varies based on the environmental impact category being analyzed. The ROI for each resource area is discussed in the detailed topic sections below. Specific designs, footprints, construction sequencing, and operational details would be refined through tiered, project-specific NEPA reviews prior to NASA and SpaceX authorization.

3.1 Land Use/Visual Resource

Land use can be defined as the human use of land resources for various purposes including economic production, natural resources protection, or institutional uses. Land uses are frequently regulated by mission objectives, program and project plans, policies, ordinances, and regulations that determine the types of uses that are allowable, or protect designated or environmentally sensitive land. The Proposed Action site is bound by NASA land use regulations. Visual resources are defined as the natural and man-

made features that give an area its aesthetic qualities. These features define the landscape character of an area and form the overall impression received by an observer of the property.

3.1.1 Region of Influence

Land Use

The ROI for land use is consistent with and limited to the study area.

Visual Resources

The ROI for visual resources includes the viewshed around the study area such as adjacent lands at and surrounding KSC within view of potential future facilities. Visual resources are any naturally occurring or man-made feature that contributes to the aesthetic value of an area. Areas such as coastlines, national parks, and recreation or wilderness areas are usually considered to have high visual sensitivity. NASA considers the extent to which any lighting or other visual impacts associated with an action would create an annoyance among people in the vicinity or interfere with their normal activities.

3.1.2 Affected Environment

A detailed discussion of land use at KSC was developed in the 2020 Vision Plan and the 2024 SEA. A summary is provided in the following paragraphs.

Land Use

Land use within the ROI consists of lands managed by NASA at KSC and administered in coordination with the USFWS as part of the MINWR. Operational areas in the ROI are supported by surrounding buffer and conservation lands, which function to separate mission-critical activities from sensitive natural resources while accommodating limited mission-support uses.

The ROI is largely undeveloped with vegetation other than the existing SpaceX Roberts Road Operations Area and access roadways. It is within a corridor characterized by NASA and commercial aerospace operational and industrial uses. Development at KSC occupies a relatively small portion of the Center's total acreage, with the majority of lands remaining relatively undisturbed and managed for conservation, wildlife refuge, and national seashore purposes in coordination with the USFWS and National Park Service. According to the 2020 Vision Plan and 2025 Master Plan, approximately 95 percent of KSC's land is relatively undisturbed from its natural conditions.

The Roberts Road location is within Fire Management Unit (FMU) 6.3. Fire managers at MINWR conduct prescribed fire and wildfire control operations in smoke sensitive areas of KSC. KSC facilities are intermixed with fire-dependent wildland habitats and subject to lightning strikes. Therefore, prescribed burns are conducted to enhance and restore wildlife habitats to pre-fire exclusion conditions, promote and benefit wildlife species that are dependent on fire-adapted ecosystems, aid the control of exotic plants and vegetation or "hazardous fuel loads" and protect critical spaceflight infrastructure on KSC.

Visual Resources

The existing conditions at KSC are characterized as having low visual sensitivity, because the site is currently an industrialized area that supports rocket launches. Visual resources within the ROI consist of a combination of undeveloped conservation lands and existing built features associated with NASA, SpaceX, and other non-government operational facilities. The visual character is defined by flat coastal terrain, managed vegetation, access roads, security infrastructure, and industrial-scale buildings associated with spaceflight processing and support activities.

Highly visible structures in the ROI include the SpaceX Roberts Road Operations Area buildings within the study area, lightning protection and launch towers at various launch complexes, the KSC Visitor Complex Space Shuttle Atlantis External Tank and Solid Rocket Booster Display to the south, the John F. Kennedy Space Center launch sites and Vehicle Assembly Building to the northeast, and KSC Headquarters Building site to the southeast. Most of these facilities use nighttime security lighting.

Coastal Zone

Federal activity affecting the coastal zone undergoes a Federal consistency review in accordance with the Coastal Zone Management Act (CZMA) of 1972 as implemented by the National Oceanic and Atmospheric Administration (NOAA) through State coastal zone management offices. The Federal review of consistency with the Coastal Zone Management Program is coordinated through the Florida State Clearinghouse. Because any federal action which may directly or indirectly affect the coastal zone would also be subject to NEPA, consistency review is typically addressed in the NEPA documentation which is submitted to the Clearinghouse for review.

3.1.3 Environmental Consequences

Proposed Action

Land Use

The ROI is within the Space Commerce District but outside of the Spaceport Growth Boundary as defined in the 2020 Vision Plan and 2025 Master Plan. Future development proposed within the ROI would require changes to existing land use designations to accommodate phased construction of mission support, industrial, and operational facilities, and would involve NASA approval for modification of the Spaceport Growth Boundary. These land use changes would support NASA's ongoing transition of KSC to a multiuser spaceport as described in the KSC Vision Plan and Master Plan that enables increased participation by commercial launch providers and other non-NASA partners.

The Proposed Action would involve a transition in land use within portions of the study area from Operational Buffer/Conservation to other land use types; however, this conversion would not occur uniformly or simultaneously across the entire study area. Rather, development associated with the SpaceX Campus Expansion is anticipated to occur incrementally through multiple phases and operational iterations over the design life of the Proposed Action.

As individual components are implemented, specific areas within the study area may be redesignated to accommodate facilities and infrastructure necessary to support spaceflight operations, manufacturing, processing, logistics, utilities, and associated administrative functions. This phased approach allows for flexibility in project delivery while maintaining compatibility with adjacent operational and conservation areas.

The Proposed Action would not significantly change the fire management programs at KSC. Static fire tests could potentially overlap with the prescribed burn schedule, it is not anticipated that current fire management program activities would be significantly affected. This is because prescribed fire planning and interagency coordination activities would continue and would adhere to the Memorandum of Understanding (MOU) for Prescribed Burning between the Space Launch Delta 45, USFWS, and KSC. Continued enforcement of the MOU would ensure that controlled burning of adjacent land and related issues are well communicated with the goal of limited, if any, effect to operations at KSC. The Prescribed Burn Working Group has been established for general scheduling and coordination of prescribed burning

activities on KSC, MINWR, and Cape Canaveral Space Force Station (CCSFS). When NASA KSC receives USFWS notification of a planned prescribed burn of a targeted burn unit (and back-up unit) at KSC, NASA KSC notifies SpaceX to allow coordination of prescribed burns. Under implementation of the Proposed Action, NASA KSC management would continue to assist the USFWS in resolving any operational or other barriers to accomplish prescribed burns. As such, it is not anticipated that fire program activities would be significantly affected due to implementation of the Proposed Action.

Portions of the study area currently managed as part of the MINWR would no longer be part of the MINWR under the Proposed Action and would therefore not be available to the USFWS for prescribed burning operations. SpaceX would clear and maintain a 30.5 meter (100 feet) wide buffer around the north and west sides of the developed areas for a defensible fire space. This change in land management would result in long-term, minor impacts to refuge management within the immediate footprint; however, implementation of the buffer would provide a long-term, minor, neutral effect by facilitating continued prescribed burning operations on adjacent MINWR lands.

Conversion of land to support services would reduce previously undeveloped land and could result in other effects such as changes in habitat availability, increased impervious surfaces, and increased operational activity. These changes would represent long-term, minor to moderate impacts to existing land use conditions within the ROI. Impacts associated with construction activities would be short-term and minor due to temporary disturbance and site preparation activities.

Considering the consistency with other land uses in the Space Commerce District and the implementation of the Master Plan Amendment Process, the Proposed Action would not result in significant impacts to land use.

Visual Resources

Construction of the Proposed Action would result in short-term, moderate impacts to visual character resulting from use of construction equipment and lighting. The Proposed Action would result in a change in visual character from predominantly undeveloped land to an operational and industrial setting suitable for manufacturing, production, refurbishment and warehousing facilities. This change would constitute a long-term, minor to moderate impact to visual resources within the ROI due to the introduction of built infrastructure and associated operational features. However, because development would occur adjacent to and contiguous with existing SpaceX and NASA facilities, and would be consistent with established development patterns along the Roberts Road and A Avenue corridors, the broader visual character of KSC would remain largely unchanged, resulting in negligible adverse impacts at the regional scale.

Programmatic design controls, including KSC exterior lighting standards, facility siting requirements, and vegetative buffering, would be applied to minimize visual contrasts with adjacent conservation lands. These measures, along with best management practices (BMPs), would reduce visual intrusion, particularly with respect to nighttime lighting and views from surrounding refuge areas. Exterior lighting would be designed and operated in accordance with Kennedy NASA Procedural Requirements (KNPR) 8500.1, Revision E, which establishes standards to minimize adverse effects from artificial lighting on wildlife and visual resources. Additional project-specific measures would be refined during tiered NEPA reviews.

Considering the consistency of the proposed change in visual character with the adjacent uses and implementation of design requirements, the Proposed Action would result in both short-term and long-

term minor to moderate impacts to visual resources and would not result in significant adverse impacts to visual resources.

Coastal Zone Management

The Proposed Action would result in short-term and minor, with negligible long-term to coastal resources. NASA has determined that the Proposed Action is consistent with the enforceable policies of the Florida Coastal Management Plan and would not result in significant impacts on coastal uses and resources. As part of the CZMA determination process, NASA has provided this PEA to the Florida State Clearinghouse for review. [Placeholder for CZMA outcome].

Gate Relocation Alternative

Land Use

Alternative 1 would require similar land use changes from Operational Buffer/Conservation to Support Services as the Proposed Action to accommodate campus expansion. Relocation of security gates and installation of additional fencing would not substantially alter overall land use patterns but would expand the developed and managed footprint associated with security infrastructure.

Visual Resources

Visual effects under Alternative 1 would be similar to the Proposed Action with respect to campus development; however, additional visual elements associated with relocated gates, fencing, and security infrastructure would be introduced along Kennedy Parkway, NASA Parkway, A Avenue, Ransom Road, and Schwartz Road. These features would incrementally increase the presence of built infrastructure within areas that currently exhibit a more open visual character. Visual effects would be minimized through application of KSC design standards, controlled lighting, and coordination with existing roadway and security features.

Coastal Zone Management

Alternative 1 would be subject to the same coastal zone management requirements and any associated effect regarding Coastal Zone Management would be similar to the Proposed Action.

No Action Alternative

Under the No Action Alternative, no new construction, land use changes, or facility expansions would occur. Therefore, there would be no impacts to land use, visual resources, or coastal zone resources.

3.2 Noise

Sound is a physical phenomenon consisting of pressure fluctuations that travel through a medium, such as air, and are sensed by the human ear. Noise is considered any unwanted sound that interferes with normal activities (e.g., sleep, conversation, student learning) and can cause annoyance. Noise sources can be constant or of short duration and contain a wide range of frequency (pitch) content. Determining the character and level of sound aids in predicting the way it is perceived. Static fire engine tests are classified as short-duration events.

Characteristics of noise that affect how it is perceived include its intensity, frequency content, and duration. Multiple noise metrics (i.e., units of measure) have been developed to best describe different types of noise and to support the prediction of specific types of noise effects. Noise metrics used in this PEA are described briefly below.

Decibel (dB): Noise levels are expressed in logarithmic units of dB. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB; sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 to 140 dB are felt as pain. The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. The human ear perceives a doubling (or halving) of a sound's loudness when the sound level changes by 10 dB and a quadrupling (or quartering) of loudness when the sound level changes by 20 dB.

Weighted Decibel (dB): Sound levels that have been adjusted to account for frequencies heard best by the human ear are designated A-weighted dB (dBA) levels. Noise frequencies with potential to induce structural vibrations include frequencies that are inaudible to the human ear, and structural effects are often assessed using unweighted dB.

Maximum Sound Level (Lmax): The Lmax is the highest sound level measured during a single event in which the sound level changes with time (e.g., a static fire test). Maximum A-weighted sound level (LAmax) is useful for prediction of activity interference (e.g., speech interference), while unweighted Lmax is one metric used in assessment of potential effects to structures.

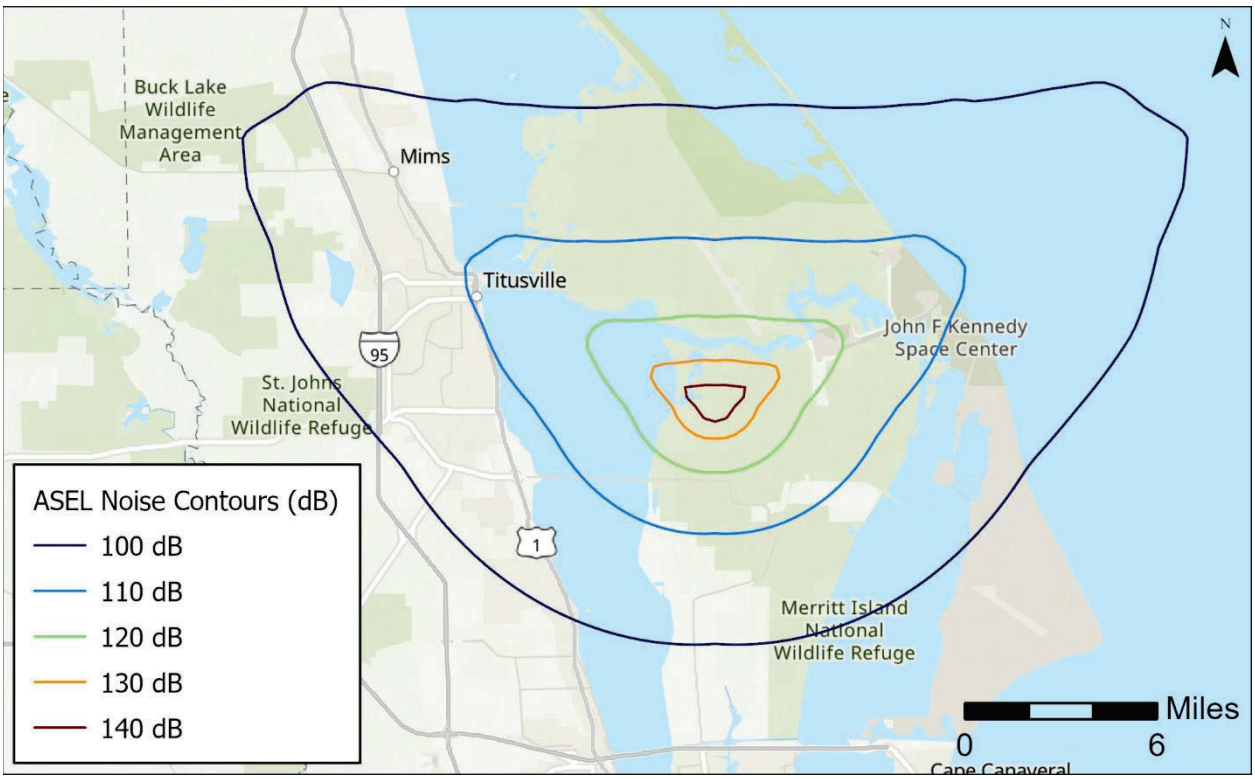
Sound Exposure Level (SEL): The SEL represents both the magnitude of a sound and its duration by stating total noise energy of an event as if the event occurred within a single second. The SEL metric is useful for prediction of sleep disturbance. SEL is an A-weighted metric and is sometimes referred to as ASEL. For events such as rocket launches, SEL is higher than Lmax because SEL reflects noise energy accumulated over multiple seconds.

Day-Night Average Sound Level is not used in this analysis, as the metric considers the cumulative exposure of a sound source over a 24-hour period. This metric is typically used for facilities such as airports and highways, where a constant noise source is present. Static fire tests are of short duration (60 seconds) and infrequent, thus are not an appropriate use of the Day-Night Average Sound Level metric.

3.2.1 Region of Influence

The ROI for noise includes the area with the potential to be affected by noise from the proposed project. The analysis focuses on areas within which individual noise would be most likely to be disturbing or impactful. For this analysis, the ROI is defined by the 100 dB SEL noise contour from static fire tests which would bound all other operational noise from the Proposed Action. This includes non-federal areas such as Titusville, Mims, Port St. John, and northern Merritt Island.

Figure 3-1. Region of Influence: A-weighted Sound Exposure Level



3.2.2 Affected Environment

The ROI routinely experiences elevated noise levels from rocket launches, landings, and tests at KSC and CCSFS. In recent years launch activity has increased, with more than one hundred launches occurring at KSC/CCSFS in 2025. Noise levels in the ROI when rocket operations are not underway vary by location depending primarily on the intensity and types of nearby human activity. For example, an industrial area near a highway in Titusville would be exposed to higher baseline noise levels than an undeveloped portion of KSC or MINWR.

3.2.3 Environmental Consequences

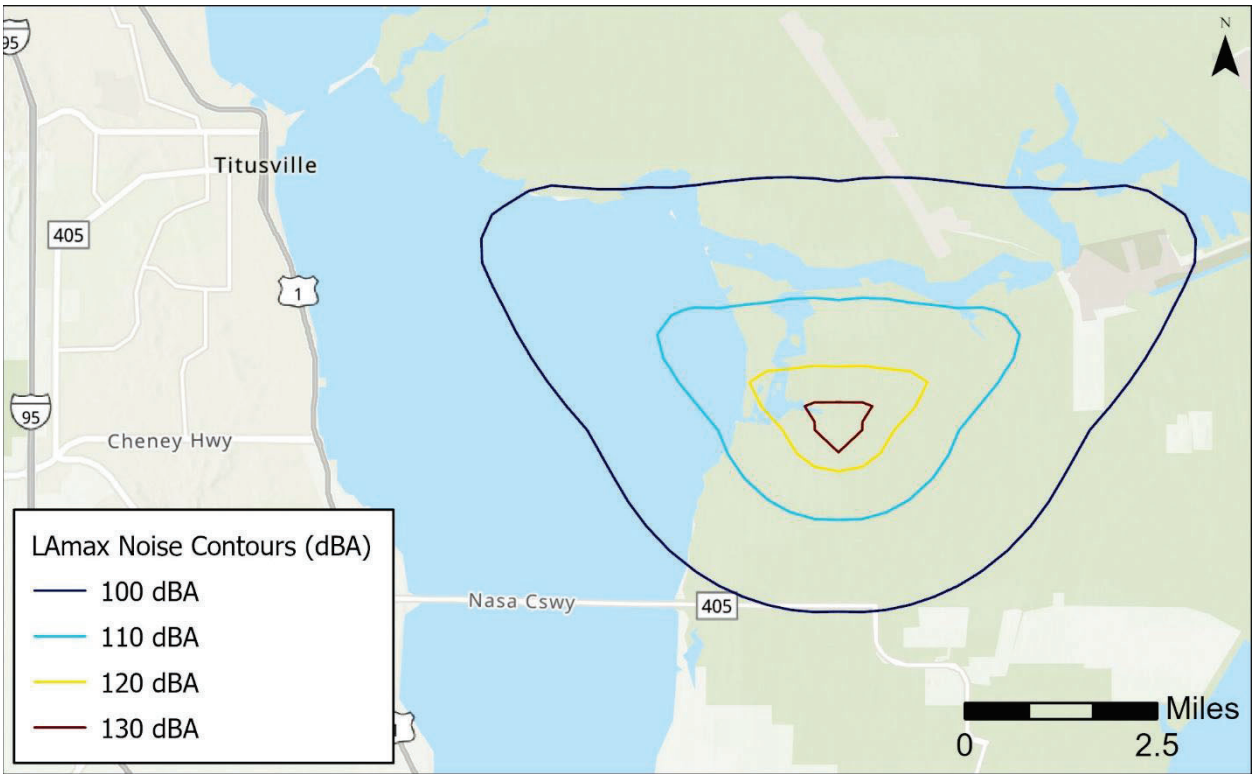
<u>Proposed Action</u>

Noise during construction would be limited primarily to the immediate vicinity of the area being developed. Noise levels would vary by type of construction but would be temporary in nature. Minimal increases in noise levels along A Avenue, Roberts Road, Schwartz Avenue, NASA Parkway, and Kennedy Parkway would be expected from the operation of delivery trucks, construction, and personnel vehicles. These heightened noise levels would typically be greatest during commuting hours, lasting for a relatively short duration and would generally be indiscernible from existing traffic patterns on these roadways. For these reasons, no significant impact from noise is expected from construction.

Noise during facility operations would generally be consistent with the noise environment at the SpaceX Operations Area today. The only noise that is expected to be audible outside of this area is operation of the test stand. Noise modeling for static fire test was conducted using a SpaceX developed model (Appendix A).

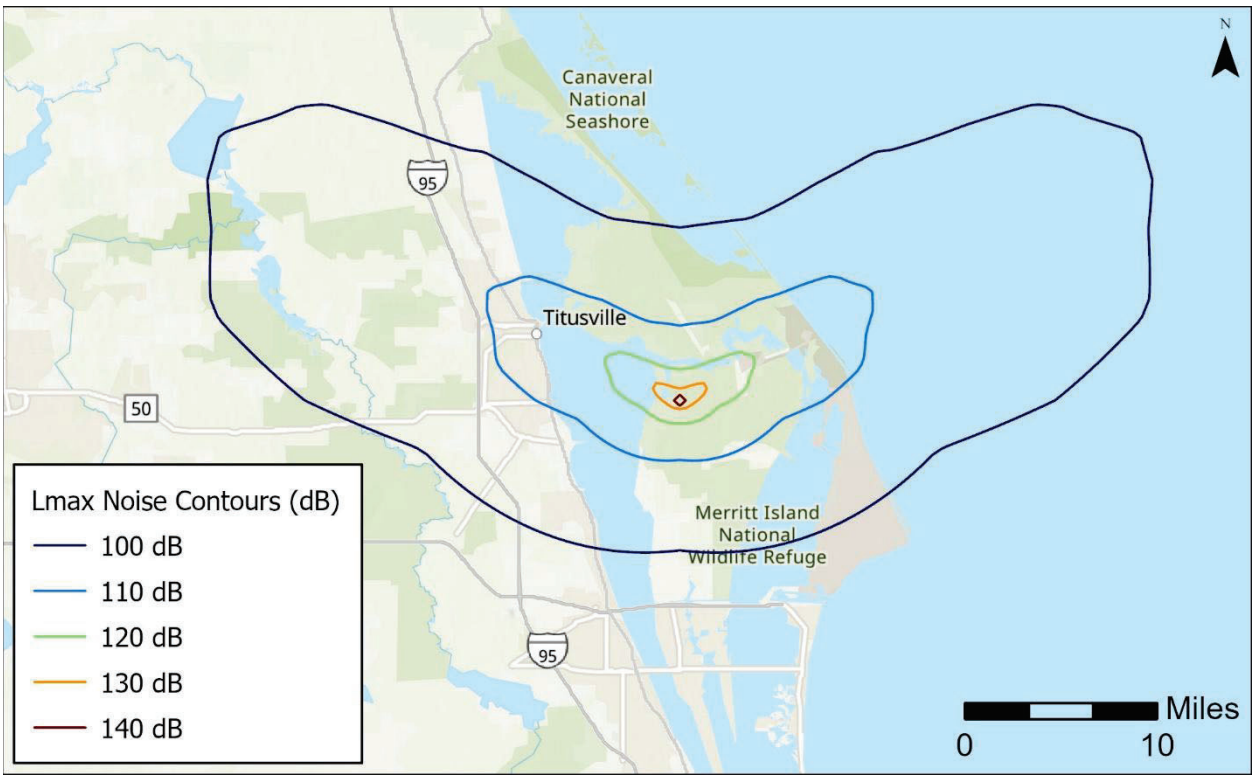
Operation of the test stand would result in elevated noise levels across the ROI during static fire tests. While static fire tests would be audible outside of KSC, noise levels are predicted to be below 100 dbA LAmax (Figure 3-2) and would last up to approximately 60 seconds. These noise levels are below what the area currently experiences by active launch programs and are much lower than upcoming launch programs at KSC/CCSFS for larger vehicles. Noise levels within occupied areas of KSC, such as the area around the Vehicle Assembly Building, are expected to experience between 100 dBA and 110 dBA LAmax.

Figure 3-2. Maximum A-weighted Sound Pressure Level (LAmax)



Structural damage is possible at high noise levels. The National Academy of Sciences' Guidelines for Preparing Environmental Impact Statements on Noise state that one may conservatively consider all sound lasting more than 1 second with levels exceeding 130 dB (unweighted) as potentially damaging to structures (National Academy of Sciences, 1977). As shown in Figure 3-3, the 130 dB Lmax contour remains within KSC and is concentrated in the vicinity of the static fire test stand. Structural damage is not anticipated, but SpaceX would be responsible for resolving any structural damage caused by its test operations.

Figure 3-3. Maximum Unweighted Sound Pressure Level (Lmax)



Considering the existing noise environment (frequent rocket launches), the relatively low number of maximum annual operations (20), the brief nature of the sound events (up to one minute per event and 20 minutes annually), and the fact that potential damage inducing noise levels would remain in the vicinity of the static fire stand on KSC there would be no significant impact due to noise.

Gate Relocation Alternative

Alternative 1 would have similar noise effects as the Proposed Action. Alternative 1 would not result in significant impacts due to noise.

No Action Alternative

Under the No Action Alternative, no new construction would occur. Launch, landing, and engine tests would continue at KSC and CCSFS and the area would continue to experience sporadic elevated noise levels during these events.

3.3 Biological Resources

Biological resources include vegetation communities, wildlife populations, and the habitats in which they occur. At KSC, biological resources are managed in coordination with the USFWS as part of the MINWR. These lands support a wide range of terrestrial, estuarine, and aquatic species, including federally protected species, state-listed species, migratory birds, and other wildlife.

In addition to compliance with the Endangered Species Act (ESA), the Proposed Action is subject to other applicable wildlife protection statutes, including the Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act (BGEPA), which protect migratory birds, their nests, and eagles from

disturbance, take, and habitat degradation, and the Florida Endangered and Threatened Species Act (Section 379.2291, F.S.).

The bald eagle was removed from protection under the ESA in August 2007, but is still protected under the MBTA (16 USC 703-712), BGEPA (16 USC 668668c), Lacey Act (16 USC 3371-3378), and Florida Administrative Code (FAC) Chapter 68A-16.002.

The MBTA was originally signed by the U.S. and Canada in 1918 for the purpose of ending the commercial trade in feathers. The treaty prohibits the hunting, killing, capturing, possession, sale, transportation, and exportation of migratory birds and their feathers, eggs, and nests. The MBTA protects both resident and migrant species. Birds that are considered non-native species are not protected. USFWS has jurisdictional responsibility for species covered under the MBTA.

Administered by the Florida Fish and Wildlife Conservation Commission (FWC), the State of Florida affords special protection to animal species designated as Threatened or Endangered pursuant to Chapter 68A-27, F.A.C. The State of Florida also protects and regulates plant species designated as endangered, threatened or commercially exploited as identified on the Regulated Plant Index (5B-40.0055, FAC), which is administered by the Florida Department of Agriculture and Consumer Services (FDACS), Division of Plant Industry, pursuant to Chapter 5B-40, F.A.C. Species that are federally listed are also considered state listed species.

NASA previously conducted formal consultation with the USFWS for the SpaceX Roberts Road Operations Area and expansion under FWS Log #: 04EF1000-2019-0193 and associated amendments. A Programmatic Biological Assessment (PBA) was prepared to evaluate potential effects of the Proposed Action including the proposed study area for the SpaceX Campus Expansion on federally listed species and designated critical habitat.

3.3.1 Region of Influence

The ROI for biological resources is defined the by the 100 dB SEL noise contour from static fire tests which would bound all other operational noise from the Proposed Action. Within this ROI includes the areas within the study area that could be directly or indirectly affected by construction. A 400-acre Notional Footprint is also included in this area. This encompasses all areas of proposed development and any potential for direct impacts to species.

3.3.2 Affected Environment

A detailed discussion of natural resources at KSC was developed in the 2018 EA (NASA, 2018) and updated in the 2024 SEA and SpaceX Campus Expansion on KSC Biological Assessment and Biological Opinion (placeholder), included in Appendix C. A summary is provided in the following paragraphs.

Fish

The wetlands and waterways of the ROI for the Proposed Action provide habitat for some of the 41 native and introduced fish species found on KSC (NASA, 2020), but no federally protected or game fish species would be expected within the ROI.

Amphibians and Reptiles

Suitable habitat is present within the ROI for the Proposed Action for numerous species of amphibians and reptiles that have been documented on KSC, including the eastern indigo snake (*Drymarchon couperi*) and state-listed gopher tortoise (*Gopherus polyphemus*) (NASA, 2020).

Gopher tortoises have been observed within the ROI during field reviews. Additionally, uplands within the ROI are poorly drained and have become overgrown. Previous studies at KSC have found local gopher tortoise populations densities to be similar in well drained and poorly drained soils (Breininger, Schmalzer, & Hinkle, 1994). Secondary marsh habitat used for feeding is also adjacent to the Notional Footprint.

There are four species of sea turtles known to nest on Brevard County beaches within the ROI: green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). Additionally, the USFWS indicates that hawksbill sea turtle (*Eretmochelys imbricata*) has potential to occur near the ROI. All these species are highly migratory and travel hundreds to thousands of miles between nesting, breeding, and feeding sites.

Birds

The ROI includes wetland and upland habitats that are suitable forage, roost, and nesting areas for some of the 318 migratory and year-round resident bird species documented on KSC (NASA, 2020b), including multiple state and federally listed species. The IPaC documented potential for seven federally-listed bird species. The FNAI Biodiversity Matrix documented five federally- or state-listed bird species as likely to occur within the ROI and the bald eagle (*Haliaeetus leucocephalus*) as documented within the ROI.

The federally listed bird species include Audubon's crested caracara (*Caracara plancus audubonii*), eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Florida scrub-jay (FSJ) (*Aphelocoma coerulescens*), piping plover (*Charadrius melodus*), rufa red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*). There is suitable foraging and nesting habitat for eastern black rail and Everglade snail kite. The ROI includes auxiliary, support, and core habitat for the FSJ. The Notional Footprint includes auxiliary and support habitat. Core habitat is primary and adjacent secondary habitat that provide for large, contiguous clusters of territories. Support areas are smaller clusters of primary and secondary territories outside of fire management units. Auxiliary areas are mostly tertiary territories, but include some primary and secondary territories generally outside of important fire management units. Some of these areas have value for connecting core areas, though connecting cores is less important than making core area populations sustainable. FSJ occur within the ROI, using the available scrub habitat located east of A Avenue. Following the formal consultation for the 100-acre expansion of the Roberts Road Operations Area (FWS Log #: 04EF1000-2019-0193 / 2023-0036318), a species-specific survey consisting of call vocalizations was performed within the ROI along A Avenue and within the 100-acre Operations Area. During these surveys, FSJs were observed using and defending the scrub habitat east of A Avenue. FSJs were not observed using the habitat west of A Avenue.

The state protected birds include the black skimmer (*Rynchops niger*), Florida sandhill crane (*Antigone canadensis pratensis*), least tern (*Sternula antillarum*), and wood stork (*Mycteria americana*). The Notional Footprint includes wetland and upland habitats that are suitable for foraging and nesting for sandhill cranes and wood storks. Shorebird habitat is present along the KSC and CCSFS beaches within the larger ROI.

A review of the Audubon EagleWatch database found two nest locations within the project study area. Additionally, bald eagles nest across KSC within the ROI. To reduce the potential for human activity to adversely affect bald eagles, USFWS Management Guidelines suggest the protection of a 660-ft habitat buffer around each active and alternate bald eagle nest (USFWS, 2007). One additional nest location is within the study area, outside of the Notional Footprint.

Mammals

Suitable habitat is present within the ROI for some of the twenty-nine species of mammals that have been documented on KSC (NASA, 2020b). The Project Footprint does not include habitat that would support any federally listed mammals; however, the tricolored bat (*Perimyotis subflavus*), a species that has been proposed for federal listing as Endangered, may utilize live and recently dead hardwood and pine trees within the ROI.

Plants

The USFWS IPaC Official Species List reported Carter's mustard (*Warea carteri*) and Lewton's polygala (*Polygala lewtonii*) within the ROI. The FNAI and USFWS presently consider Carter's mustard extirpated from Brevard County (FNAI 2000; USFWS 2021a). Because the species is considered extirpated from the ROI, the Proposed Action would have "no effect" on this species. There is one record for Lewton's polygala in Brevard County, Florida. However, the record was based on a misidentification (USFWS 2020a). Further, no plants of this taxon were observed during subsequent surveys on Merritt Island or mainland Brevard County (Schmalzer et al. 2003 as cited in USFWS 2020a).

Critical Habitat

The ROI was evaluated for the presence of Critical Habitat as defined by the Endangered Species Act of 1973, as amended and 50 CFR part 424. The USFWS is the authority, as a federal agency, to protect from destruction or adverse modification the biological or physical constituent elements essential to the conservation of listed species. Critical Habitat is defined as the specific areas within the geographical area occupied by a species on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection. Review of the USFWS database identified Proposed Critical Habitat for the green sea turtle and rufa red knot and Designated Critical Habitat for the loggerhead sea turtle within the ROI.

Table 3-1. ESA-Protected Species Summary

Species	Designated Status	Effect Determination
MAMMALS		
Florida panther *Puma concolor coryi*	FE	No effect
Southeastern beach mouse *Peromyscus polionotus niveiventris*	FT	May affect, not likely to adversely affect
Tricolored bat *Perimyotis subflavus*	PE	May affect, not likely to adversely affect
West Indian manatee *Trichechus manatus*	FE	May affect, not likely to adversely affect
BIRDS		
Crested caracara *Caracara plancus audubonii*	FT	May affect, not likely to adversely affect
Eastern black rail *Laterallus jamaicensis ssp. jamaicensis*	FT	May affect, not likely to adversely affect
Everglade snail kite *Rostrhamus sociabilis plumbeus*	FE	May affect, not likely to adversely affect

Species	Designated Status	Effect Determination
MAMMALS		
Florida scrub-jay *Aphelocoma coerulescens*	FT	May affect, likely to adversely affect
Piping plover *Charadrius melodus*	FT	No effect
Rufa red knot *Calidris canutus rufa*	FT	No effect
Whooping crane *Grus americana*	FE; EXPN	No effect
REPTILES		
Atlantic salt marsh snake *Nerodia clarkii taeniata*	FT	No effect
Eastern indigo snake *Drymarchon couperi*	FT	May affect, likely to adversely affect
Green sea turtle *Chelonia mydas*	FT	May affect, not likely to adversely affect
Kemp's ridley sea turtle *Lepidochelys kempii*	FE	May affect, not likely to adversely affect
Leatherback sea turtle *Dermochelys coriacea*	FE	May affect, not likely to adversely affect
Loggerhead sea turtle *Caretta caretta*	FT	May affect, not likely to adversely affect
Hawksbill sea turtle *Eretmochelys imbricata*	FE	May affect, not likely to adversely affect
INSECTS		
Monarch butterfly *Danaus plexippus*	PT	May affect, not likely to adversely affect
PLANTS		
Carter's mustard *Warea carteri*	FE	No effect
Lewton's polygala *Polygala lewtonii*	FE	No effect

FE = Federally Endangered; FT = Federally Threatened; NL = Not Listed; PT = Proposed Threatened; T = Threatened; USFWS = United States Fish and Wildlife Service

3.3.3 Environmental Consequences

Proposed Action

Construction and Daily Operations

Under the Proposed Action, approximately 400 acres of undeveloped available habitat would be converted to developed lands. Vegetation clearing and other construction site preparation activities that remove habitat features (e.g., cover, forage, dens, roosts) temporarily or permanently reduce the amount of habitat available to be used by a species.

Project activities may temporarily or permanently reduce the functional quality of habitat without completely removing the habitat. Downstream effects could cause degradation in the quality of habitat

in turn causing an impact to species use of the habitat. Invasive species might be accidentally introduced to the area through construction of the facilities or shipment of supplies and equipment to the proposed facilities. The spread of invasive species would degrade habitat by displacing native species and ultimately reducing food or important nesting or roosting habitat.

An increase in vehicle traffic during daily operations from construction and SpaceX operations personnel could potentially increase the likelihood of wildlife being killed by a collision with a vehicle. In addition, increased traffic and human presence could cause wildlife to avoid the operational area completely. These direct effects could also result in long-term changes to natural behavioral patterns. The increase in traffic may prevent species from crossing roadways and utilizing available foraging habitats.

Noise associated with construction and daily operations would be intermittent and localized, and is not expected to meaningfully increase ambient noise levels within the ROI. Individual wildlife may temporarily avoid areas of active construction or other localized disturbance; however, these responses would be expected to be short-term and would not be expected to render otherwise suitable habitat unusable. Noise effects would be minimized through implementation of applicable KSC operational requirements and standard construction practices.

Noise from static fire testing is best described as an exposure to high-intensity noise with much of the energy in the low-frequency spectrum occurring over a relatively short duration (each exposure lasting up to 60 seconds, representing acute rather than chronic exposure) and repeating relatively infrequently and irregularly. Noise could result in startle responses, stress responses, behavioral changes, or hearing loss. However, these effects are not anticipated based on the best available scientific literature and decades of past monitoring data at KSC. A detailed analysis of potential effects to ESA-listed species is included in Appendix B.

Visual Impacts

Construction activities may create temporary visual disturbance for wildlife in the immediate vicinity of active work areas. Construction activities may continue into non-daylight hours and could require artificial lighting; however, temporary lighting would be limited to the immediate vicinity of the active construction areas. Additional permanent lighting would be needed for operations at the facilities. Exterior lighting would be designed and operated in accordance with KNPR 8500.1, Revision E, and the KSC Lighting Operations Plan (KSC-PLN-1210) which establishes standards to minimize adverse effects from artificial lighting on wildlife and visual resources. Given the distance from nesting beaches and required lighting controls, lighting associated with the Proposed Action is not expected to adversely affect sea turtles or result in abandonment of nesting or roosting areas by terrestrial birds.

Summary of Impacts on Wildlife from the Proposed Action

ESA-Protected Species

Consistent with the PBA, the Proposed Action would result in either “no effect” or “may affect, not likely to adversely affect” determinations for the majority of federally listed and proposed species, with limited exceptions where a “may affect, likely to adversely affect” determination was identified. No effects to designated or proposed critical habitat are anticipated because critical habitat is located more the one (1) mile from the ROI and would not be subject to habitat modification, lighting effects, or other direct or indirect effects associated with the Proposed Action. The Final PEA will include the USFWS-prepared BO, which addresses effects on endangered and threatened species associated with the Proposed Action. Overall, the Proposed Action is not expected to result in population-level impacts to listed species and would be consistent with the effect determinations and consultation framework established under

Section 7 of the Endangered Species Act. USFWS prescribed reasonable and prudent measures/terms and conditions set forth in the Incidental Take Statement section of the BO will be implemented as part of SpaceX's site development plan.

Within the ROI, the Proposed Action would result in temporary and permanent modification of habitat through construction and operational activities. These effects are expected to be limited in extent and primarily associated with habitat conversion, disturbance from increased human activity, and localized changes in environmental conditions (e.g., noise, lighting, and traffic). Consistent with the PBA analysis, most species are anticipated to either tolerate these disturbances or relocate to adjacent suitable habitats, and effects are generally characterized as minimal to moderate at the individual level.

Other Wildlife

A pre-construction survey would be performed by a qualified biologist to ensure no active eagle's nests are located within 660 feet of project activities. Should a bald eagle nest be observed within 660 feet of the project construction limits during the nesting season, construction would be paused until the nest fledges.

Overall, the impacted area is small compared to the amount of suitable wildlife habitat available elsewhere on KSC. Accordingly, construction of the Proposed Action would result in short-term, moderate localized impacts to wildlife. Measures would be taken to control erosion and stormwater runoff, minimize invasive non-native species spread, minimize impacts from tall structures and nighttime lighting, and ensure adequate prescribed burning in adjacent habitats. Thus, operation of the Proposed Action would cause long-term, minimal to moderate impacts to some wildlife but would not result in significant impacts on wildlife at KSC. Based on these measures and the findings of the PBA and BO, the Proposed Action would not result in significant impacts to Biological Resources.

<u>Gate Relocation</u>

Under the Gate Relocation Alternative, biological resource effects from phased site development would be generally similar to the Proposed Action (permanent habitat loss, temporary or permanent habitat degradation, increased vehicular wildlife deaths and increased avoidance of the area; and increased disturbances to wildlife from noise and lighting for construction and operation activities), but the increased impacts from vehicular travel would be anticipated to be less than impacts from the Proposed Action.

<u>No Action Alternative</u>

Under the No Action Alternative, no additional phased development of the lease parcel would occur. There would be no increase in habitat loss, habitat degradation, vehicular travel, noise disturbances, or visual disturbances. Habitat and species conditions would remain generally similar to existing conditions.

3.4 Cultural Resources

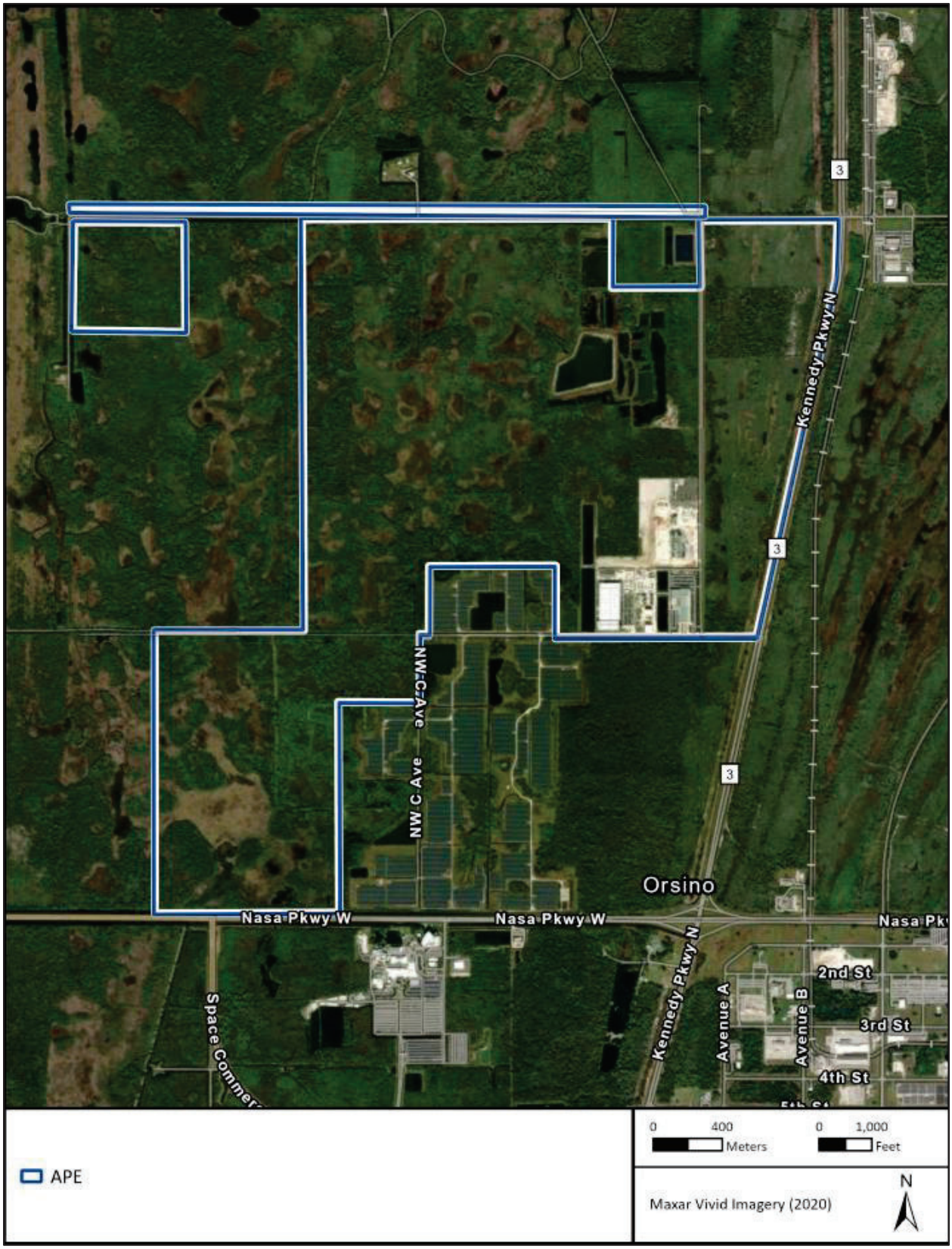
Cultural resources encompass a range of sites, properties, and physical resources relating to human activities, society, and cultural institutions. Such resources include past and present expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, buildings, structures, objects, and districts that are considered important to a culture or community. The major law that protects cultural resources is the National Historic Preservation Act (NHPA). Cultural resources listed in or determined eligible for the National Register of Historic Places (NRHP) are properly known as historic properties. Section 106 of the NHPA, and its implementing regulations 36 CFR Part 800, require a federal agency to consider the effects of its action on historic properties. Compliance with

Section 106 requires consultation with the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO) and other interested parties, including federally-recognized Native American tribes. Major steps in the Section 106 process require identifying the Area of Potential Effects (APE), identifying and evaluating any historic properties within the APE, and assessing the effect of the Proposed Action on any historic properties. If a historic property would be adversely affected by the undertaking, the Section 106 process includes continuing consultation to resolve adverse effects. NASA utilizes the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)* (Programmatic Agreement) to comply with Section 106.

3.4.1 Region of Influence

The ROI for cultural resources is equivalent to the APE. The APE has been developed to consider construction impacts associated with the Proposed Action. Long-term monitoring to understand potential archaeological impacts from noise is planned to begin at KSC in 2026. The results of this monitoring would be incorporated into an additional consultation for operations prior to operation of the test stand. The APE is shown in Figure 3-4.

Figure 3-4. Area of Potential Effects



3.4.2 Affected Environment

A Cultural Resources Assessment Survey was completed within the APE and is included in Appendix D. One previously recorded resource is within the APE and was revisited during the survey. Resource 8BR4444 is a steel tower used for communication and measuring meteorological conditions. It was previously determined to be ineligible for the NRHP and no new information was discovered to change this determination. The survey did not identify any new historic properties. NASA consulted with SHPO, THPOs, federally-recognized Indian Tribes and consulting parties on the results of this survey and determined that no historic properties would be affected by this undertaking. No comments were received from Tribes or consulting parties. SHPO concurrence was received on August 25, 2026.

3.4.3 Environmental Consequences

Proposed Action

Construction of the Proposed Action would not result in impacts to cultural resources protected under the NRHP as no known resources are present within the APE. In the event that any unexpected discovery of historical, archaeological, architectural, or other cultural artifacts, relics, vestiges, remains, or objects of antiquity are found during construction activities, SpaceX is required to cease activities in the immediate vicinity of the find, protect it from further disturbance, and notify KSC's Cultural Resources Manager or member of the Environmental Management Branch. KSC will then follow the procedures outlined in the Kennedy Space Center *Integrated Cultural Resources Management Plan 2024-2029* and the Programmatic Agreement. This would include determining the significance of the resources, consulting with the FL SHPO, Tribes and other consulting parties, and resolving any adverse effects prior to continued implementation of the Proposed Action. In the event that human remains are discovered, KSC would also comply with Florida State Laws and the Native American Graves Protection and Repatriation Act. There would be no significant impacts on cultural resources.

Gate Relocation Alternative

The Gate Relocation Alternative would result in similar impacts to cultural resources as the Proposed Action.

No Action Alternative

Under the No Action Alternative, no additional phased development of the lease parcel would occur. Therefore, there would be no impact to cultural resources.

3.5 Hazardous Materials/Hazardous Waste

A hazardous material is any item or agent (biological, chemical, radiological, and/or physical), which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Hazardous materials are defined and regulated in the U.S. primarily by laws and regulations administered by the EPA under 29 CFR 1910, Occupational Safety and Health Administration (OSHA) under 40 CFR 355, the U.S. Department of Transportation under 49 CFR 171-180, the Comprehensive Environmental Response, Compensation, and Liability Act, the Toxic Substance Control Act, the Emergency Planning and Community Right-to-Know Act, and the U.S. Nuclear Regulatory Commission under 10 CFR 20.

Hazardous waste is defined in the Resource Conservation and Recovery Act (RCRA) as any solid, liquid, contained gaseous, or semi-solid waste, or any combination of wastes that could or do pose a substantial

hazard to human health or the environment. Waste may be classified as hazardous because of its toxicity, reactivity, ignitability, corrosive properties, or listed status. All hazardous wastes generated on KSC must be managed, controlled, stored, and disposed of according to regulations found in 40 CFR Parts 260 through 282 and FAC Chapter 62-730.

Hazardous materials and solid and hazardous wastes are managed and controlled in accordance with federal, state, and local regulations. KSC has established plans and procedures to implement these regulations. The use, management, and disposal of hazardous materials on KSC is further described in Kennedy NASA Procedural Requirement 8500.1 - KSC Environmental Requirements.

3.5.1 Region of Influence

Assessment of hazardous waste and materials was limited to the generation of waste as a result of construction activities, and the on-site use of hazardous materials for day-to-day operations of the proposed facilities. For this reason, the ROI for hazardous waste and materials is consistent with and limited to the study area.

3.5.2 Affected Environment

A detailed discussion of hazardous materials at KSC was developed in the 2018 EA (NASA, 2018) and summarized below.

Hazardous materials and wastes associated with the Proposed Action would be managed under the existing environmental management framework at KSC and in accordance with applicable federal and State of Florida regulations. Routine activities typical of aerospace, industrial, and manufacturing facilities such as equipment maintenance, fabrication and shop work, cleaning and surface preparation, painting and coating, and materials management are sources of regulated hazardous waste and universal waste.

Hazardous Materials

Numerous types of hazardous materials are used to support the various missions and general maintenance operations at KSC. These materials range from common building paints to industrial solvents and hazardous fuels. Management of hazardous materials is the responsibility of each organization.

The KSC Spill Prevention, Control, and Countermeasures (SPCC) Plan (KSC-PLN-1919) outlines the criteria established by KSC to prevent, respond to, control, and report spills of oil. The KSC SPCC Plan describes both the facility-wide and site-specific (KSC-PLN-1920) approaches for preventing and addressing spills.

Hazardous materials would be handled in accordance with federal, state, and local laws and regulations. SpaceX trains employees to immediately report spills to the SpaceX Environmental Health and Safety team and contain spills if safe to do so. On pervious surfaces, SpaceX manages cleanup and reporting to NASA KSC. For spills of hazardous materials to impervious surfaces, off site discharges, or other emissions, SpaceX immediately reports to KSC emergency responders. Development within the ROI would utilize existing programs and maintain environmental compliance as per the real property agreement(s).

Hazardous Waste

Solid Waste Management Units, Potential Release Locations, and Areas of Concern are generally concentrated in operational areas such as the KSC Industrial Area. The most prevalent soil contaminants are petroleum hydrocarbons, RCRA metals, and polychlorinated biphenyls (PCBs). The most prevalent groundwater contaminants are chlorinated solvents and associated degradation products.

KSC maintains an established environmental remediation program to identify, evaluate, and manage contamination where it exists. This program operates under applicable corrective action authorities and State of Florida petroleum cleanup programs. Two contaminated sites are located within the ROI. Solid Waste Management Unit #075 is located on A Avenue and has groundwater and surface water contamination from chlorinated voliatile organic compounds. Remediation is currently conducted by KSC. Solid Waste Management Unit #124 is located south of Schwartz Road and is contaminated by polyfluoroalkyl substances (PFAS) in both groundwater and surface water in concentrations above the Florida provisional groundwater cleanup target level and provisional surface water screening level. Soil sample results to date are below provisional soil cleanup target levels for residential and industrial settings, but above the provisional cleanup target level for leachability. An interim land use control implementation plan is in place while the site is in the assessment phase.

3.5.3 Environmental Consequences

Proposed Action

Construction

Construction activities associated with phased campus development would include site clearing and grading, utility installation, roadway improvements, and facility construction. These activities would involve routine use of construction-related materials such as fuels, oils, lubricants, solvents, and paints, and would generate solid waste and construction and demolition debris. The Proposed Action is not proposing to impact either Solid Waste Management Unit due to construction. If construction were to occur within a Solid Waste Management Unit or contaminated site, it would occur in a manner that does not cause contamination to migrate. Contaminated soil would be retained within the site boundary or disposed of at a permitted facility in accordance with state and federal regulations. All activity would be coordinated with KSC prior to construction.

Potential environmental effects could occur if materials were spilled or wastes were improperly handled or disposed of. With implementation of standard operating procedures and BMPs, construction-related effects would be short-term and minor.

Operations

Operations associated with the campus expansion would likely involve hazardous materials typical of aerospace and industrial facilities, including shop chemicals, compressed gases, fuels, lubricants, and maintenance products. Operations would likely generate hazardous waste, universal waste such as batteries, lamps, and electronic devices, and non-hazardous solid waste. Potential effects would primarily relate to storage, accumulation, and the possibility of an unplanned release. Operation of the Proposed Action would not result in impacts to Solid Waste Management Units.

Hazardous materials and wastes would be managed in compliance with federal, state, and local regulations, as well as established KSC and SpaceX procedures. With continued implementation of these controls, operational effects would be long-term and minor.

Considering the limited extent of potential effects, implementation of standard operating procedures and BMPs, and adherence to regulatory requirements, the Proposed Action would result in short-term and long-term minor impacts, and would not result in significant impacts related to hazardous materials or hazardous waste.

Gate Relocation Alternative

Hazardous materials and waste effects under the Gate Relocation Alternative would be similar to those of the Proposed Action. Additional minor, localized construction related wastes and spill risks could result from gate relocation, fencing installation, and associated utility tie-ins. With application of the same management practices and controls as the Proposed Action, construction related effects would be short term and minor, and operational effects would remain long term and minor.

No Action Alternative

Under the No Action Alternative, NASA would not enter into a new real property agreement for the campus expansion or related infrastructure. No new construction or ground disturbance would occur, and no new hazardous materials would be introduced. There would be no new hazardous waste, solid waste, or pollution prevention impacts beyond existing operations, which would continue under current regulatory requirements.

3.6 Water Resources

A detailed discussion of water resources at KSC was developed in the 2018 EA (NASA, 2018) and updated in the 2024 SEA and through subsequent site evaluations. A summary is provided in the following paragraphs.

Key federal and state regulatory programs applicable to water quality and in-water work include:

- Clean Water Act (CWA) Section 401: State water quality certification for federal permits or licenses that may result in a discharge to Waters of the United States (WOTUS).
- CWA Section 404: U.S. Army Corps of Engineers (USACE) authorization for discharge of dredged or fill material into WOTUS, including wetlands.
- 62-330, F.A.C., Environmental Resource Permitting (ERP) (Florida Department of Environmental Protection (FDEP) and the Water Management Districts): authorization for work in wetlands and surface waters (Chapter 62-340, FAC) or construction/alteration of stormwater management systems.
- National Pollutant Discharge Elimination System (NPDES): Permits controlling pollutant discharges, including construction and (if applicable) industrial stormwater.
- FDEP construction stormwater requirements: construction general permit coverage and implementation of a Stormwater Pollution Prevention Plan (SWPPP), including erosion and sediment controls and inspections.

3.6.1 Region of Influence

While water resource impacts can be anticipated downstream of the project site, the ROI for water resources is consistent with and limited to the 400-acre Notional Footprint.

3.6.2 Affected Environment

Regional Hydrologic Setting

The ROI occurs within KSC on Merritt Island in a low-lying coastal setting influenced by the Indian River Lagoon (IRL) system. Hydrologic conditions are influenced by rainfall-driven runoff, shallow groundwater, and coastal storm processes, which are relevant to water quality, drainage performance, and protection of adjacent surface waters and refuge resources.

Water quality describes the chemical, physical, and biological characteristics of surface waters as influenced by natural processes and human activities. Surface waters in the vicinity of the parcel to be leased include estuarine waters associated with the IRL system and other drainage features within the KSC/MINWR landscape. Designated uses of receiving waters in the region include aquatic life support and wildlife habitat. Water quality in the IRL system is sensitive to nutrient and sediment inputs, stormwater runoff, and altered hydrology. This PEA describes water resources at a programmatic level; future tiered analyses would use site-specific monitoring data and final design information to evaluate compliance with applicable standards and permit conditions.

Wetlands and Surface Waters

Wetlands in the State of Florida are defined in accordance with FAC Rule 62-340 and Section 373.019 (27), F.S. Surface waters are defined as open water bodies. Approximate wetland boundaries were identified in accordance with the State unified wetland delineation methodologies as adopted by the FDEP and the water management districts per Chapter 62-340, F.A.C. and described in *The Florida Wetlands Delineation Manual* and the USACE 1987 Wetland Delineation Manual and regional supplement. Through a combination of desktop reviews and onsite informal wetland delineations, there have been four wetland habitat types and one surface water classification identified within the ROI (see Figure 3-5). The wetland habitats vary from forested to herbaceous and a combination of overgrown shrub systems. The surface waters are primarily conveyance ditches.

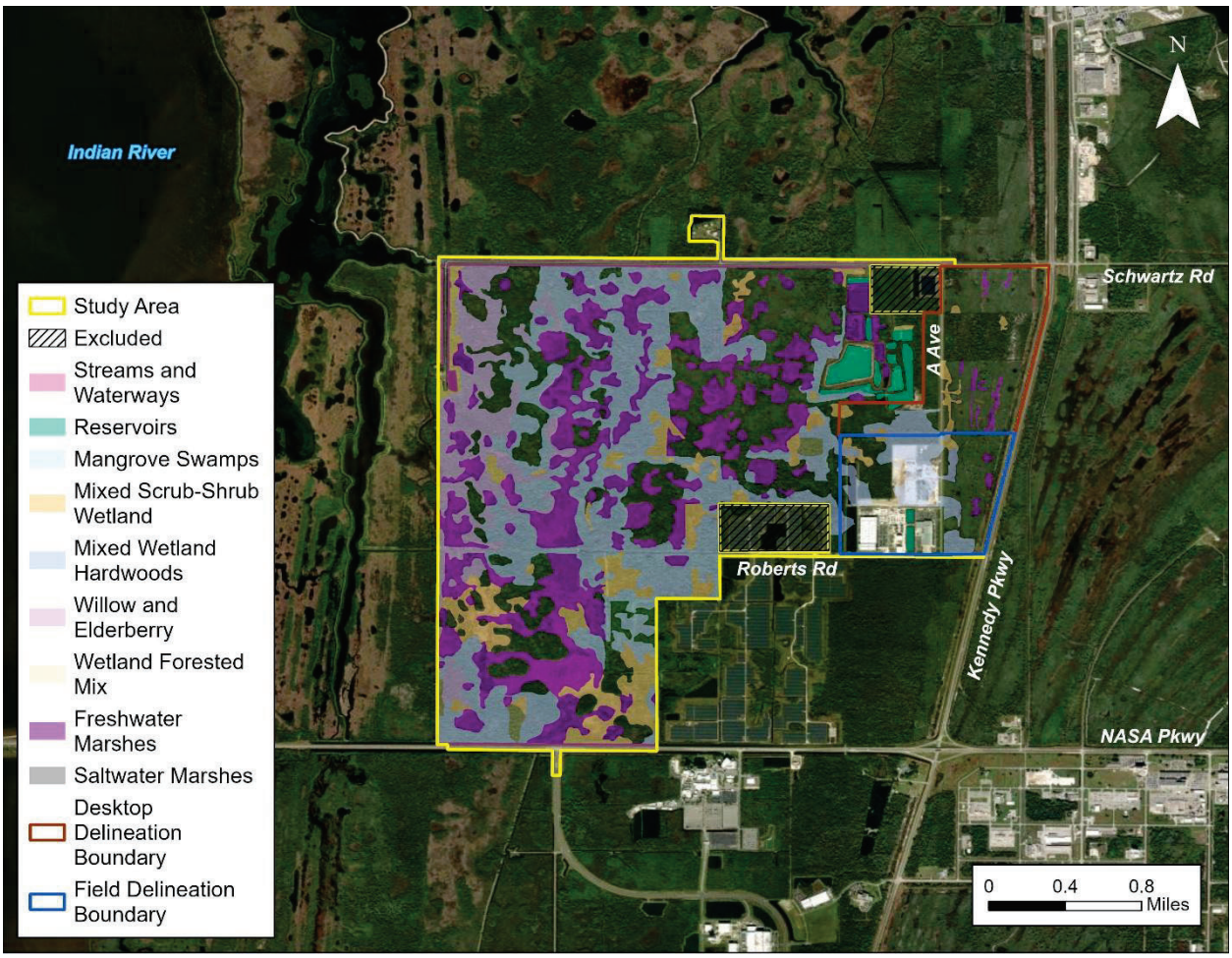
Typical vegetative structure found within the forested wetland communities include canopy species such as laurel oak (*Quercus laurifolia*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), cabbage palm (*Sabal palmetto*), swamp dogwood (*Cornus foemina*), Carolina willow (*Salix caroliniana*), and Brazilian peppertree (*Schinus terebenthifolia*) and a sparse growth of herbaceous species such as arrowhead (*Sagittaria spp.*) or Virginia chain fern (*Woodwardia virginica*).

The herbaceous wetland communities vary greatly based on presence of Brazilian peppertree and overgrowth of Carolina willow. They also exhibit great variation based on zonation of the individual wetland systems. Typical of the interior of these systems, vegetation includes species such as arrowhead, royal fern (*Osmunda regalis*), swamp fern (*Blechnum serrulatum*), sawgrass (*Cladium jamaicense*), cordgrass (*Spartina bakeri*), and St. John's wort (*Hypericum spp*.).

Due to lack of burning, many herbaceous wetland communities within the ROI have transitioned to shrub-dominant systems, with species such as Carolina willow and Brazilian peppertree becoming prevalent. Along the margins of these shrub wetland communities, there is a low gradient transitional zone supporting a mix of upland and facultative species such as saw palmetto (*Serenoa repens*), wax myrtle (*Morella cerifera*), gallberry (*Ilex glabra*), and saltbush (*Baccharis halimifolia*).

Figure 3-5 displays the wetlands and surface waters within the ROI based on data from the Florida Department of Transportation Florida Land Use, Cover, and Forms Classification System (FLUCFCS) and the field and desktop delineations conducted in 2025. Jurisdictional wetland boundaries and quality assessments will be determined on a case-by-case basis through coordination with USACE, FDEP, and St. Johns River Water Management District (SJRWMD) during design of individual phases.

Figure 3-5. Wetlands and Surface Waters



Sources: Kimley-Horn Delineation 2025; Florida Department of Transportation Florida Land Use, Cover, and Forms Classification System

Surface waters within and downstream of the proposed project ROI include wetlands, drainage features, and other receiving waters that are sensitive to changes in runoff quantity and quality. Surface water quality is defined by the physical, chemical, and biological characteristics of these waters, including parameters such as turbidity, nutrients, temperature, dissolved oxygen, and the presence of pollutants. These characteristics influence aquatic habitat function, wetland integrity, and downstream water uses, and are protected under the CWA, including Sections 301, 303, and 402. Accordingly, potential effects to surface water quality and hydrology are an important consideration for the project.

Because detailed engineering designs for future facilities and infrastructure are not available at the PEA stage, the surface water analysis applies a bounding approach to evaluate reasonably foreseeable development that could occur over the life of the real property agreements. This analysis considers the potential extent of phased grading, increases in impervious surface, internal circulation improvements, utility installation, and industrial operations within the ROI, as well as associated access and security features described under the alternatives. These activities have the potential to alter drainage patterns,

increase stormwater runoff volumes and velocities, and introduce sediments or pollutants to adjacent surface waters within and downstream of the ROI.

Individual development phases would be submitted for review, and subsequent project-specific NEPA analyses would tier from this PEA to refine the evaluation of surface water resources. Future reviews would identify wetland boundaries and quality assessments consistent with 62-340, F.A.C. and the CWA Section 404, confirm floodplain boundaries and elevations, and assess site-specific hydrologic and water quality effects. Design-phase analyses would also establish appropriate stormwater management strategies and BMPs, including erosion and sediment control measures and spill prevention controls, to avoid, minimize, or mitigate potential effects to receiving waters.

Floodplain

The ROI is located in a low-lying coastal setting on Merritt Island within KSC. Topography in and near KSC is generally flat with limited relief, and portions of the broader KSC/Merritt Island National Wildlife Refuge landscape may be subject to inundation from intense rainfall, high tides, storm surge, and tropical cyclones. Flood risk in this coastal environment can be influenced by compound flooding conditions (e.g., heavy rainfall coincident with high tides) and future conditions such as sea level rise. The 100-year and 500-year floodplains are located throughout the project study area.

Because detailed phase designs are not available at the programmatic PEA stage, floodplain conditions and potential effects are described using a programmatic “envelope” approach. Future tiered reviews would confirm phase-specific flood zones, base flood elevations, finished grades, and design elevations for each development phase and any connected actions prior to implementation.

Floodplain management for federal actions is guided by applicable federal requirements and NASA/KSC procedures, with consideration of applicable state and local stormwater and floodplain requirements as appropriate. Programmatic objectives include avoiding flood-prone siting where practicable, minimizing fill that would reduce flood storage, maintaining drainage pathways and overland flow conveyance, and incorporating flood-resilient design for critical infrastructure.

Groundwater

Groundwater beneath Merritt Island occurs within a coastal hydrogeologic setting where shallow groundwater levels may be present and can fluctuate in response to rainfall, tides, and seasonal conditions. Groundwater may be hydraulically connected to nearby surface waters and wetlands within the KSC/MINWR landscape.

Groundwater quality in coastal settings may reflect natural salinity gradients and can be affected by contaminant releases from industrial activities. This PEA describes groundwater resources programmatically; tiered analyses would evaluate site-specific groundwater conditions, dewatering needs, and protection measures based on final designs.

Groundwater protection is addressed through federal and state requirements related to spill prevention and response, waste management, underground storage tanks (if applicable), and stormwater and wastewater permitting. If construction dewatering is required, handling and discharge of pumped groundwater would be managed in compliance with applicable permits and water quality standards.

3.6.3 Environmental Consequences

Proposed Action

Wetlands and Surface Waters

Under the Proposed Action, site development would directly impact approximately 156 acres of wetlands and/or surface waters based on data from the FLUCFCS and the field and desktop delineations conducted in 2025. Reasonably foreseeable activities include clearing and grading, utility installation, building construction, and internal circulation improvements. In addition, the Proposed Action includes construction of the NASA Parkway connector roadway and associated access/security features, which would add impervious surface and require drainage controls within the roadway improvement area.

All wetland and surface water impacts would be reviewed and authorized during permitting with the USACE pursuant to Section 404 of the CWA and the SJRWMD under the ERP program, as required. Consistent with these regulatory frameworks, the Proposed Action would be required to demonstrate that the impacts to jurisdictional wetlands and surface waters have been avoided and minimized to the greatest extent practicable, and that compensatory mitigation would be provided to offset unavoidable impacts to lost wetland function and value in accordance with Chapter 62-330, F.A.C. and Section 404 of the CWA.

In addition to direct impacts, the Proposed Action has the potential to result in secondary impacts to wetlands and surface waters caused by the direct alteration of the habitats from development. Pursuant to 62-330.301(1)(f), F.A.C., projects must provide reasonable assurance that they will not cause adverse secondary impacts to water resources. Potential secondary impacts associated with the Proposed Action could include impacts to hydrologic regimes, habitat fragmentation and wildlife displacement, and increased edge-effects from introduction of invasive species. Avoidance and minimization measures such as implementation of upland buffers, stormwater treatment systems, or erosion and sediment controls would be used to help reduce the potential for secondary impacts. When necessary, additional mitigation will be provided to fully offset these impacts.

Stormwater runoff associated with site development represents the primary pathway by which the Proposed Action could affect surface water resources. These effects would represent long-term, minor impacts to surface water resources. Phased site development could temporarily increase stormwater runoff, turbidity, and sediment transport during rainfall events if disturbed soils are exposed. Potential impacts to surface water resources within the ROI are therefore primarily associated with changes in stormwater runoff quantity and quality, including increased runoff from impervious surfaces, sediment transport during construction, and the potential introduction of pollutants from operational activities.

During construction, erosion and sediment control BMPs would be required to manage stormwater runoff and minimize transport of sediments to adjacent surface waters. During operation, permanent stormwater management systems would be designed to treat runoff from developed surfaces, reduce pollutant loading, control runoff volumes and peak discharge rates, and maintain or improve pre-development water quality conditions. These systems would manage stormwater prior to discharge to receiving waters, thereby reducing the potential for downstream water quality degradation. Collectively, these measures are intended to prevent adverse effects to surface water resources and ensure consistency with applicable water quality standards and restoration objectives.

At buildout, additional impervious surfaces could increase stormwater runoff volumes and peak flows and could increase the delivery of pollutants (e.g., suspended solids, nutrients, hydrocarbons, and metals) to

downstream receiving waters if not properly managed. Long-term surface water quality outcomes would depend on the design and performance of permanent stormwater treatment and retention systems, as well as implementation of industrial good housekeeping and spill prevention practices. If future activities trigger industrial stormwater requirements, applicable NPDES permit coverage and monitoring would be required, and facility-specific controls would be established through tiered review based on materials handled, exposure potential, and final drainage design. With these controls, operational effects would be long term and minor.

For the Proposed Action, future design, buildout, and permitting would be required to incorporate stormwater management systems capable of achieving high-efficiency treatment consistent with the ERP program (up to approximately 95 percent pollutant removal, as applicable based on regulatory criteria). Implementation of these measures—including advanced BMPs, treatment systems, and operational controls—would substantially reduce potential sedimentation and pollutant loading to adjacent and downstream surface waters. High-efficiency stormwater treatment requirements of this magnitude are intended to maintain water quality conditions within regulated basins without substantial increases in pollutant loading and are consistent with Florida's Basin Management Action Plan(s) pollutant reduction goals.

With implementation of these measures and compliance with applicable federal and state permitting requirements, including compensatory mitigation and secondary impact minimization, impacts to wetlands and surface waters would be appropriately offset. Because potential impacts to these resources are mediated through stormwater runoff and would be effectively controlled through required design standards, BMP implementation, and regulatory permitting, the Proposed Action is not expected to result in measurable increases in pollutant loading or long-term degradation of surface water quality within or downstream of the ROI. It is anticipated that the Proposed Action would not result in significant impacts on regional wetland and surface water resources.

Floodplain

Under the Proposed Action, phased grading and construction could temporarily alter localized drainage patterns and shallow flow pathways during construction. Development would occur within portions of the 100- and 500-year floodplains. At buildout, increased impervious surface area associated with campus development and supporting infrastructure could increase runoff volumes and peak flows, which may incrementally elevate localized flooding potential if not managed through stormwater design sized for buildout conditions. Long-term floodplain effects would depend on final site grading and the capacity and performance of existing and future stormwater management infrastructure, which would be refined through tiered NEPA review and design development.

Stormwater management systems would be required to be designed for full buildout conditions, maintain pre-development hydrology to the extent practicable, and comply with applicable permitting requirements and tiered NEPA review. With these controls in place, the Proposed Action is not expected to measurably increase base flood elevations or adversely affect floodplain function. Therefore, impacts to floodplains would remain short-term and minor during construction and long-term and negligible during operation, and would not result in significant impacts.

Groundwater

Under the Proposed Action, phased site development could require localized excavation below the water table and temporary dewatering, depending on foundation depths, utility trenching, and roadway or

infrastructure construction. If unmanaged, dewatering discharges could mobilize sediments or introduce turbid water to drainage systems. In addition, accidental spills or leaks of fuels, lubricants, hydraulic fluids, or construction chemicals could affect soils and shallow groundwater. Because construction would occur over multiple years in phases, the potential for such effects would increase without controls; however, with implementation of dewatering controls, spill prevention measures, and standard construction BMPs, groundwater effects would be short-term and minor.

During long-term operations at buildout, groundwater quality could be affected by releases associated with material storage and handling, vehicle and equipment maintenance, and waste management activities. The likelihood of measurable groundwater impacts would be minimized through use of secondary containment, routine inspection and maintenance, and spill response procedures consistent with KSC and SpaceX requirements. Where infiltration-based stormwater practices are proposed, designs would account for groundwater depth and potential salinity conditions and would maintain appropriate separation distances to avoid mobilization of contaminants. With these measures, operational groundwater effects would be long-term and minor, and would not result in significant impacts.

Gate Relocation Alternative

Wetlands and Water Resources

Under the Gate Relocation Alternative, water quality effects would be generally similar to the Proposed Action, but roadway corridor stormwater and wetland effects associated with constructing the connector road would be avoided. In lieu of the connector roadway, gate relocation and associated access features could introduce localized grading, pavement, and drainage modifications near gate locations and along affected corridors. With BMPs and permitting, construction phase effects would remain short-term and minor, and operational effects long-term and minor.

Floodplains

Under the Gate Relocation Alternative, floodplain effects would be similar to the Proposed Action; however, connector-road corridor drainage effects would be avoided, while localized floodplain conveyance and drainage changes could occur near relocated gate facilities and along affected corridors where grading, pavement, and drainage structures are introduced. Because final gate relocation designs are not available at the PEA stage, tiered analyses would confirm corridor drainage features (e.g., culverts or openings), any floodplain interactions, and whether compensatory storage or additional drainage measures are needed.

Groundwater

Under the Gate Relocation Alternative, groundwater effects would be generally similar to those of the Proposed Action. In addition, localized excavation and utility work near gate relocation areas could encounter shallow groundwater and require temporary dewatering, and construction activities could introduce typical spill pathways associated with access features. Because final gate relocation designs are not available at the PEA stage, tiered review would confirm groundwater interactions, dewatering needs, and spill prevention measures specific to gate and corridor locations. With application of the same controls as the Proposed Action, groundwater effects would remain short-term and minor during construction and long-term and minor during operations.

No Action Alternative

Under the No Action Alternative, no additional development would occur. Therefore, water quality conditions would remain generally similar to existing conditions, subject to ongoing regional influences

such as precipitation-driven runoff, sea level rise, and broader watershed management actions. No new impervious area would be introduced by the program; therefore, changes in runoff quantity or quality attributable to the lease parcel would be minimal. Floodplain conditions and flood risks would remain generally unchanged, subject to ongoing climatic variability and regional sea level and storm trends. Existing site drainage systems and flood management practices would continue to govern conditions. Therefore, groundwater elevations and quality would not change. Existing KSC and tenant operational controls would continue to govern groundwater protection.

3.7 Geology and Soils

Evaluation of geology and soils supports compliance with associated permitting and resource protection requirements related to grading, fill placement, stormwater management, and hazardous material handling.

3.7.1 Region of Influence

Impacts to geology and soils are anticipated to be limited to the proposed construction area, comprised entirely within the study area. For this reason, the ROI for geology and soils is consistent with and limited to the study area.

3.7.2 Affected Environment

A detailed discussion of geology and soils at KSC was developed in the 2018 EA (NASA, 2018) and updated in the 2024 SEA. A summary is provided in the following paragraphs.

The KSC area reflects repeated marine deposition and erosion on the Florida Plateau. Surface materials are primarily unconsolidated quartz sands with localized coquina beds of Pleistocene and Holocene age, underlain by older marine formations. Merritt Island and Cape Canaveral are part of a barrier-island complex characterized by dune ridges and low-lying swales.

Soils at KSC have been mapped by the Soil Conservation Service, now the Natural Resources Conservation Service (NRCS). In the ROI, soils are generally nearly level, sandy, and poorly drained; permeability is typically rapid in sandy units and moderate in complex units (USDA, 2019). These conditions can increase susceptibility to temporary erosion, rutting, and localized dewatering needs during construction.

3.7.3 Environmental Consequences

<u>Proposed Action</u>

Under the Proposed Action, phased clearing, grading, excavation, utility installation, roadway construction, and facility development could result in short-term, localized soils disturbances. Potential effects include temporary erosion and sedimentation, compaction and rutting of wet soils, minor alterations to surface drainage patterns, and localized dewatering during excavation. Geologic conditions would not be altered because activities would not affect regional geologic formations. With implementation of standard erosion and sediment control measures, stormwater pollution prevention practices, construction phasing, and stabilization of disturbed areas, soils impacts would be short-term, localized, and minor to moderate. No additional impacts to geology or soils would occur during operation of the Proposed Action. Therefore, the Proposed Action would not have a significant impact on geology and soils.

<u>Gate Relocation Alternative</u>

Under the Gate Relocation Alternative, soils and geology effects would be similar to the Proposed Action. Localized soils disturbance could occur in areas where gate relocation, fencing installation, and utility

tie-ins require excavation or grading. Because the roadway footprint would be avoided, overall disturbance may be reduced relative to the Proposed Action; however, localized erosion, compaction, and dewatering could still occur near gate locations. With application of the same BMPs and design controls as the Proposed Action, soils impacts would remain short-term and minor to moderate, and geologic effects would remain none.

No Action

Under the No Action Alternative, no additional development would occur. Therefore, no new construction or ground disturbance would take place beyond existing and previously authorized activities. Soils and geologic conditions would remain unchanged from existing conditions.

3.8 Transportation

Transportation at KSC is supported by a limited-access roadway network designed to accommodate secure federal operations, oversized vehicle movements, and spaceport activities. The network includes paved and unpaved roads, internal circulation routes, and access roads that support launch operations, industrial activities, and site security.

3.8.1 Region of Influence

Based on the nature of transportation traffic analysis, existing access roads to the study area are included in this study. For this reason, the ROI for transportation extends beyond the study area to also include existing and proposed network of roads providing access to the study area.

3.8.2 Affected Environment

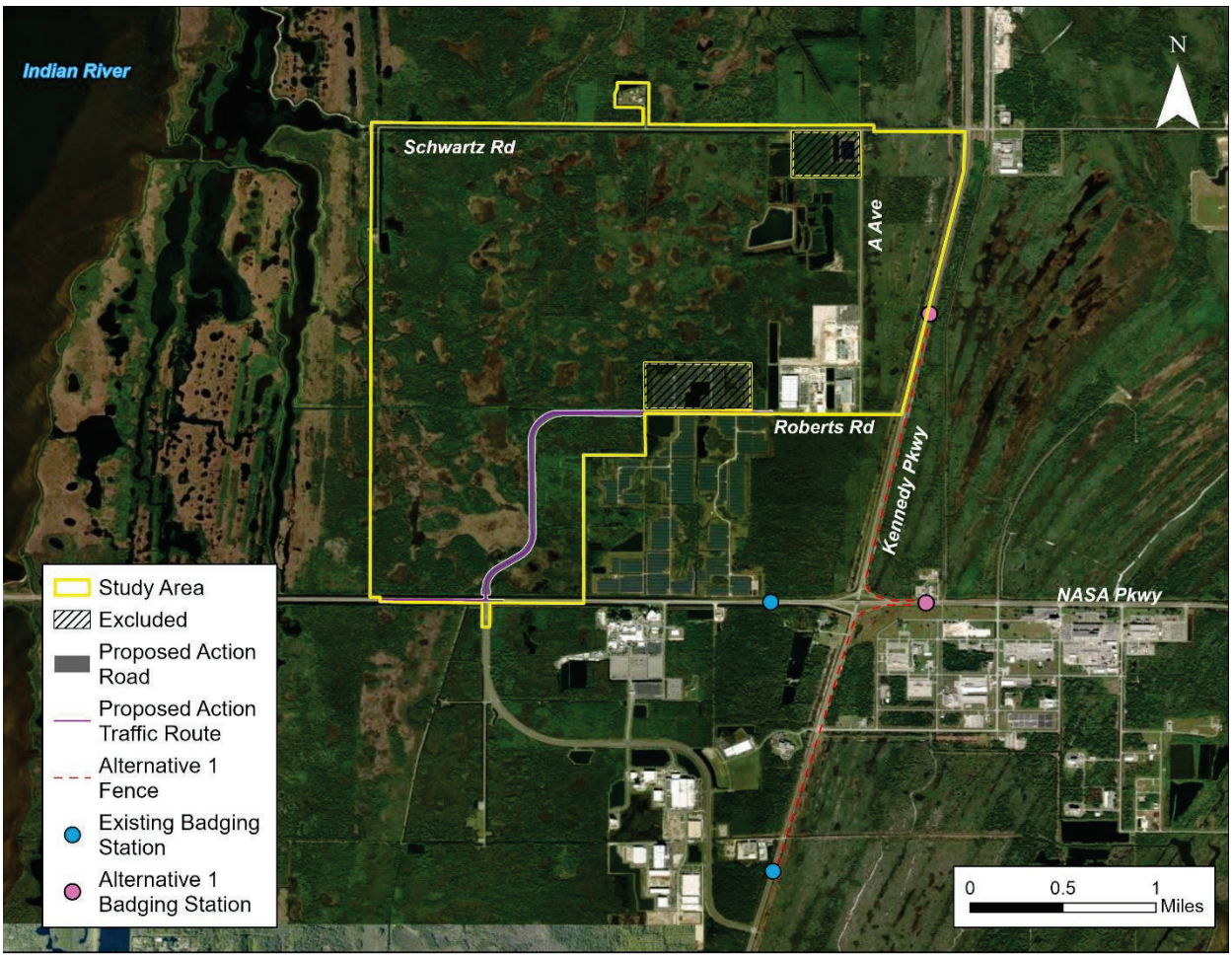
Primary access to the existing SpaceX Roberts Road Operations Area is provided via NASA Parkway, Kennedy Parkway, and internal KSC roadways. All access points to KSC are controlled, and routine entry by employees, contractors, customers, and delivery vehicles occurs through KSC security checkpoints and badging stations. While this controlled access system is effective for maintaining security, it requires coordination with KSC security operations and can contribute to queuing, administrative processing demands, and periodic operational inefficiencies during peak activity periods.

Transportation infrastructure supporting SpaceX operations has been incrementally improved through prior NEPA reviews, including roadway paving, intersection improvements, internal circulation enhancements, and upgrades to accommodate oversized vehicle transport. These previously approved improvements establish the baseline transportation conditions for evaluation of the Proposed Action and alternatives.

3.8.3 Environmental Consequences

A Traffic Impact Analysis (TIA) was completed in September 2025 for the Proposed Action. The TIA analyzed a future buildout of the study area with 3,300 employees by 2045. Traffic signal improvements are anticipated at several intersections for the Proposed Action and the Gate Relocation Alternative to address increased traffic volumes. The existing and proposed traffic routes and gate locations are shown in Figure 3-6.

Figure 3-6. Traffic Routing and Gate Locations



Proposed Action

When fully operational, SpaceX expects approximately 7,500 vehicle trips per day to and from the SpaceX Operations Area. Under the Proposed Action, SpaceX would construct a new connector roadway between NASA Parkway and Roberts Road. This roadway would allow the expanded SpaceX Roberts Road Operations Area and associated development to be located outside the existing KSC secure fenceline, thereby reducing the need for routine SpaceX traffic to pass through KSC security checkpoints.

The Proposed Action would also include construction of security fencing and controlled access gates consistent with NASA physical security requirements. A gate along the connector roadway would restrict access to authorized personnel, and additional gates along A Avenue and Roberts Road would prevent unauthorized access between the SpaceX Roberts Road Operations Area and the KSC secure area. The primary KSC security checkpoint on NASA Parkway would remain in place and would not require relocation.

Transportation effects of the Proposed Action would include:

- Redistribution of SpaceX-related traffic away from KSC security checkpoints;
- Improved access reliability for employees, contractors, customers, and delivery vehicles;
- Reduced congestion and queuing at KSC gates;

- Increased traffic volumes on the connector roadway and at modified intersections along NASA Parkway; and
- Use of internal campus roadways to support on-site circulation without affecting internal KSC routes.

During construction, roadway and infrastructure development activities would result in short-term, minor impacts to the transportation network due to temporary increases in construction traffic, localized congestion, and minor disruptions to traffic flow. As detailed in the TIA, long-term improvements are recommended to the NASA Parkway and Roberts Road/Space Commerce Way intersection so it does not operate at an unacceptable level of service by the 2045 buildout year.

Although increased traffic volumes would occur on the adjacent roadways, the Proposed Action would also include necessary improvements to traffic signal timing, resulting in an overall neutral effect on the transportation network, and no significant impacts.

Gate Relocation Alternative

Under the Gate Relocation Alternative, the connector roadway between NASA Parkway and Roberts Road would not be constructed. Instead, KSC security gates and fencing would be relocated to redefine the boundaries of the KSC secure area while allowing SpaceX to expand its campus. This alternative would result in the following:

- Continued reliance on KSC security checkpoints for routine SpaceX access
- Redistribution of traffic to relocated security gates along NASA Parkway and Kennedy Parkway
- Increased internal circulation within the KSC secure area
- Higher long-term demand on KSC security staffing and infrastructure compared to the Proposed Action

The Gate Relocation Alternative would provide similar transportation efficiency benefits compared to the Proposed Action. As detailed in the TIA, improvements are recommended to the following intersections so they do not operate at unacceptable levels of service by the 2045 buildout year: Kennedy Parkway and Roberts Road (including adding a traffic signal), Kennedy Parkway and NASA Parkway Eastbound Ramps, and NASA Parkway and Space Commerce Way.

The Gate Relocation Alternative would also result in short-term, minor impacts during construction and neutral impacts during operation on the existing transportation network.

No Action Alternative

Under the No Action Alternative, no additional employees or trips would be added to the study area, no new roadway would be constructed, and no changes would be made to the existing access configuration. Therefore, the No Action Alternative would do the following:

- Maintain existing traffic patterns on NASA Parkway, Kennedy Parkway, and internal KSC roadways
- Continue current administrative and operational demands on KSC security resources
- Result in incremental increases in congestion and queuing as SpaceX operations expand within the constraints of existing access infrastructure

Transportation effects under the No Action Alternative would be localized and would not improve operational efficiency or reduce security-related access constraints.

3.9 Air Quality

Air quality at KSC is regulated under the federal Clean Air Act and implementing regulations (40 CFR Parts 50 through 99) and Florida Administrative Code (FAC Chapters 62-200 through 62-299). The United States Environmental Protection Agency (U.S. EPA) has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3) and its precursors such as oxides of nitrogen (NOx) and volatile organic compounds (VOCs), particulate matter (PM10 and PM2.5), and sulfur dioxide (SO2). Consistent with programmatic NEPA practice, the analysis also considers the extent to which the alternatives could contribute to greenhouse gas (GHG) emissions from construction and operations.

Under NEPA, a NASA federal action is considered to have a significant impact on air quality if it results in emissions that would cause or contribute to a violation of the NAAQS as established by the U.S. EPA under the CAA. Specifically, an impact is significant if the Proposed Action's estimated emissions exceed the prevention of significant deterioration (PSD) thresholds, or if the action results in a net increase in pollutant concentrations that exceeds any federal, state, or local air quality standard for the analysis period. The PSD thresholds are 250 tons per year for criteria pollutants in attainment. Furthermore, an action is significant if it increases the frequency of severity of an existing NAAQS violation or delays the attainment of any air quality standard within the applicable State Implementation Plan (SIP). Additionally, the static test stand is subject to permitting at the State level, which will ensure no significant impact from those activities.

3.9.1 Region of Influence

Air quality impacts from construction and operations of the proposed facilities could span from local to regional effects. Attainment status is monitored by the U.S. EPA at the county level. For this reason, the ROI for air quality is defined as Brevard County.

3.9.2 Affected Environment

A detailed discussion of air quality at KSC was developed in the 2018 EA (NASA, 2018) and updated in the SpaceX Campus Expansion on KSC Project Construction Air Quality Impact Assessment (AQIA) (July 2026), included in Appendix B. A summary is provided in the following paragraphs.

KSC is located in Brevard County, Florida, which is designated as an attainment area for all criteria pollutants under both federal and state standards. Ambient air quality in the region is influenced by routine spaceport and support activities such as vehicle traffic, utility operations, fuel combustion, and maintenance and refurbishment activities associated with NASA and SpaceX operations. NASA currently holds a Title V Air Operation Permit that governs permitted emission units and identifies insignificant emission units across the Center. However, under implementation of the Proposed Action, SpaceX would obtain air pollutant operating permits as required under federal and state law.

3.9.3 Environmental Consequences

<u>Proposed Action</u>

As described in the July 2026 AQIA, the Proposed Action would result in temporary increases of criteria pollutants during the construction phases and potentially substantive increases in emissions of criteria pollutants during operations at full buildout. Although this PEA is programmatic in nature, the AQIA has provided a worst-case estimate of operational emissions based on the details of reasonably foreseeable development for the PEA, and operations of the test stand and other SpaceX programming are not

anticipated to exceed applicable significance thresholds. Additional details for the construction and operations phases are provided below.

Construction

Implementation of the Proposed Action would involve construction activities that would generate short term, localized criteria air pollutant emissions from heavy-duty construction equipment activity, ground-disturbing activities, truck haul trips, construction workers, and vendor/material truck trips to and from the site. Activities would include paving a portion of the site for parking areas and construction buildings. Construction emissions of criteria pollutants NOx, CO, SO_2, VOC, PM10, and PM2.5, would be temporary in nature, varying by phase and intensity of construction, and would cease upon completion of construction activities.

Due to the phased approach to construction anticipated in this PEA, it is unlikely emissions during construction would exceed applicable thresholds (250 tons per year (tpy) of each pollutant), and violations of applicable air quality standards or contribution to a change in attainment status is not anticipated. However, if construction phases overlap each other, it is possible that annual emissions could exceed 250 tpy. Therefore, future project-level reviews would assess construction emissions in greater detail based on project-specific plans and data.

With implementation of standard construction controls and BMPs, the Proposed Action is anticipated to result in short-term impacts to air quality due to temporary increases in criteria pollutant emissions during construction activities. These emissions would typically be limited in duration and extent and would not measurably affect ambient air quality within Brevard County. The incremental increases in emissions would likely have a negligible effect on regional air quality and would not affect the area's attainment status or result in any violations of the NAAQS.

GHG emissions under the Proposed Action would be generated by phased construction activities (e.g., construction equipment, material delivery, and workforce commuting). At the programmatic level, these emissions are expected to represent a small incremental contribution relative to regional and global inventories and would not be expected to measurably influence climate trends.

Operations

Calculations were performed to estimate exhaust emissions of the test stand emissions. The worst-case CO and NOx emissions are predicted to be 0.29 pounds mass per second (lbm/s) and 9.19 lbm/s respectively, per engine, under nominal power (100 percent) operation. No soot is predicted to be generated by this engine cycle. CO_2 emissions from a single engine is 986.3 lbm/s. Assuming 20 operations annually with six engines per operation, test stand emissions of CO, NOx, and CO_2e would be approximately 0.71, 62.7, and 8,212.9 tons per year, respectively, and negligible VOC or PM. See the July 2026 AQIA for full operational assumptions and calculations.

Passenger vehicles are recognized as potential substantial sources of CO and VOC emissions but result in relatively low NOx emissions. Heavy duty diesel trucks, on the other hand, are potential sources of high diesel emissions. The Proposed Action is expected to generate approximately 7,500 total vehicle trips per day, which would also contribute to operational criteria pollutant and GHG emissions. For high-level evaluation, the resultant annual operational emissions of the test stand operations and expected vehicle trips are unlikely to exceed applicable thresholds. Future project-level reviews would assess operational emissions in greater detail based on project-specific plans and data.

As summarized in the TIA, there would be one intersection that would have a failing Level of Service[2] in the future buildout with intersection improvements. Given the favorable local meteorological conditions and low traffic volumes, the Proposed Action would be unlikely to trigger an emission hotspot under 40 CFR 93.123, however future project-level reviews would assess potential emission hotspots in greater detail based on project-specific plans and data. See Section 3.9 of this PEA for more details on the TIA and transportation impacts.

Overall, expected construction and operation of the Proposed Action would not have significant air quality impacts.

GHG emissions under the Proposed Action would be generated by long-term operations (e.g., facility energy use and mobile sources). At the programmatic level, these emissions are expected to represent a small incremental contribution relative to regional and global inventories and would not be expected to measurably influence climate trends.

Gate Relocation Alternative

Air quality effects under the Gate Relocation Alternative would be similar to those of the Proposed Action. Construction-related emissions associated with campus development and gate relocation would be minor, temporary, and localized, and operational emissions would remain below applicable significance thresholds.

No Action Alternative

Under the No Action Alternative, no new development associated with the campus expansion would occur beyond what is currently authorized, and there would be no new construction or operations emissions.

3.10 Utilities

Evaluating utilities helps ensure compliance with permitting, public service planning, and infrastructure management requirements necessary to support safe and reliable facility operations.

3.10.1 Region of Influence

Based on the nature of utility analysis, existing utility networks which will connect to the study area are included in this study. For this reason, the ROI for utilities extends beyond the study area to also include the existing electric, drinking water, wastewater collection and treatment, stormwater management, solid waste services, and communication networks in the general vicinity of the Proposed Action.

3.10.2 Affected Environment

Utilities serving the SpaceX Roberts Road Operations Area at KSC include electrical power, drinking water, wastewater collection and treatment, stormwater management infrastructure, solid waste services, and communications. These services are provided through a combination of existing KSC-owned infrastructure and regional utility providers and support spaceflight, manufacturing, and launch-support activities in the Roberts Road area. Prior NEPA reviews for the SpaceX Roberts Road Operations Area evaluated utility capacity and infrastructure improvements supporting SpaceX operations, establishing baseline utility conditions for this PEA.

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[2] *Under 40 CFR 93.123, a hot spot analysis may be required for projects affecting intersections that are at Level of Service D, E, or F, or those that will change to Level of Service D, E, or F because of increased traffic volumes related to the project.*

Drinking Water

Florida is divided into five regional water management districts. Brevard County is located in the St. Johns River Water Management District (SJRWMD). The source of KSC's drinking water supply is surface water from the Taylor Creek Reservoir and groundwater from wells located in east Orange County. Water from the Claude H. Dyal Water Treatment Plant, operated by the City of Cocoa, is transmitted to KSC via primary distribution system entering the study area from the South Gate.

Wastewater

To manage domestic wastewater, KSC and CCSFS have a collection and transmission system that transports wastewater to the Cape Canaveral Regional Wastewater Treatment Facility (WWTF) located on CCSFS. Wastewater generated by future development would be treated on-site and/or conveyed to existing or future wastewater treatment facilities; specific wastewater service configurations would be determined as individual phases are defined. Treatment plant effluent and groundwater monitoring are stipulated by the plant(s) NPDES permit(s) to ensure no significant degradation of groundwater, and to ensure effluent is not discharged to surface waters.

Stormwater

Stormwater is managed through engineered drainage features and would be designed and permitted in accordance with applicable requirements as phased development proceeds. Stormwater infrastructure associated with individual development phases would be reviewed and permitted separately and would tier from this PEA. Further analysis of stormwater impacts can be found in Section 3.6 of this PEA.

Natural Resources and Energy

The electrical power for KSC is purchased from FPL. The main natural gas pipeline runs through KSC property but is owned by Florida City Gas, the regional natural gas utility.

3.10.3 Environmental Consequences

Because detailed facility layouts and final utility designs are not available at the PEA stage, utility needs and effects are evaluated using a phased/bounding approach, with project-specific analyses and approvals completed during tiered NEPA reviews as design details become available.

<u>Proposed Action</u>

Under the Proposed Action, utility services would be provided primarily through KSC infrastructure and regional systems. Electrical demand associated with new facilities would be served by sources at KSC, with power demand evaluated on a phased, project-by-project basis. Operational flexibility may include battery energy storage systems (e.g., Megapacks) within developed areas. Infrastructure to connect new development to existing power sources may be required, but additional power service to KSC at-large is not proposed at the programmatic stage. Electrical power would continue to be provided by FPL.

Drinking water demand would be met through existing KSC distribution lines connected to the City of Cocoa system. Wastewater would be managed through on-site treatment and/or connection to existing or future wastewater treatment facilities, with service requirements determined during phase design and permitting. Stormwater management features would be designed and permitted as projects advance and would incorporate erosion/sediment controls during construction and permanent stormwater controls at buildout to protect downstream receiving waters. Based on the programmatic development envelope and available information, the Proposed Action is not anticipated to result in utility demands that exceed the

capacity of existing systems; any required utility extensions or upgrades would be evaluated through tiered NEPA review and applicable permitting as specific phases are proposed.

During construction, installation of utilities and associated infrastructure could result in short-term, minor impacts due to localized disturbance, temporary service disruptions, and construction-related activities. These effects would be limited in extent and duration and would be managed through standard construction controls and BMPs.

During operations, the Proposed Action is not expected to exceed the capacity of existing utility systems. Utility use and service demands would be managed through phased development, regulatory permitting, and coordination with service providers. As a result, operational effects would be long-term and minor, associated with incremental increases in demand on existing systems. The Proposed Action would not result in significant impacts to utilities.

Gate Relocation Alternative

Under the Gate Relocation Alternative, utility demands for the campus expansion would be similar to the Proposed Action and would continue to rely primarily on existing KSC and regional utility systems. The absence of the connector roadway would generally reduce the need for roadway-corridor utility placement associated with that feature, though localized utility tie-ins may be required to support relocated gate infrastructure (e.g., lighting, communications, access controls).

No Action Alternative

Under the No Action Alternative, no additional utility demand would occur beyond existing conditions. Utility systems would continue to serve current users, and no new utility extensions or upgrades would be required.

3.11 Socioeconomics

3.11.1 Region of Influence

The socioeconomic ROI for the Proposed Action is Brevard County.

3.11.2 Affected Environment

The unemployment rate for the ROI was 4.8% in 2025, slightly higher than the Florida rate of 4.3%. The population of the ROI increased at a rate of 8.9% from 2020 to 2024, slower than the rate of 9.5% for the State of Florida. Between 2020 and 2024, the median household income for the ROI was $78,476 and $74,568 for the State of Florida (U.S. Census Bureau, 2026).

3.11.3 Environmental Consequences

Proposed Action

Construction activity would result in short-term, moderate, beneficial impacts to the local economy through increased employment, labor income, and demand for goods and services. Project-related spending by employees, contractors, and material suppliers would generate additional economic activity and contribute to local tax revenues. Aerospace industry jobs pay on average 20% more than all other industries (Florida Department of Economic Activity, 2021). A total of 3,300 employees are anticipated by the buildout of 2045; the workforce employed by the expanded operations is expected to have a long-term beneficial impact on employment and income in the local economy. This increase in employment, coupled with higher-than-average wages associated with the aerospace industry, would result in long-

term, moderate, beneficial impacts to employment, income, and overall economic conditions within the region. The Proposed Action would not have a significant impact on socioeconomic conditions.

Gate Relocation Alternative

Under the Gate Relocation Alternative, short-term and long-term employment and other economic benefits are anticipated to be the same as with the Proposed Action Alternative.

No Action Alternative

Under the No Action Alternative, these project-driven benefits would not occur and socioeconomic conditions would be expected to change only in accordance with broader regional trends.

3.12 Health and Safety

KSC complies with applicable regulations of other federal agencies exercising regulatory authority over NASA in specific areas (e.g., the Department of Labor's OSHA, and the U.S. Department of Transportation), as well as internal NASA safety policies and requirements. In the event of conflicting standards or regulations, the more stringent requirements are applicable.

3.12.1 Region of Influence

The ROI for health and safety includes areas that could be affected by facility construction, operation, testing activities, and hazardous material transportation both within and near the study area.

3.12.2 Affected Environment

Health and safety concerns focus on regions within and surrounding KSC that might be impacted by both the construction and operation of the facility, as well as the test stand. KSC conducts operations within a comprehensive safety framework, adhering to relevant OSHA standards and U.S. Department of Transportation regulations concerning the management and transport of hazardous materials. Emergency response capability includes private KSC fire and police services, as well as a mutual aid agreement between KSC, CCSFS, the City of Cape Canaveral, and Brevard County (NASA, 2018).

3.12.3 Environmental Consequences

Proposed Action

Potential adverse impacts on human health and safety may arise throughout the construction phase and industrial activities as a result of the Proposed Action. During construction activities, compliance with OSHA regulations, as well as other recognized standards would be implemented.

Daily industrial operations would result in an increase in potential hazards. SpaceX would implement protective measures that minimize risk to workers, including compliance with all applicable laws and regulations related to operations. Potential effects associated with noise are included in Section 3.2. Workers operating within a threshold of concern for noise would have access to the appropriate hearing protection.

With these measures in place, the Proposed Action would have a short-term and long-term minor impact on health and safety, and would not result in a significant impact on health and safety.

Gate Relocation Alternative

Under the Gate Relocation Alternative, short-term and long-term health and safety requirements would be the same as with the Proposed Action Alternative.

No Action Alternative

Under the No Action Alternative, there would be no construction, and no addition to industrial operations. Therefore, there would be no additional impacts to health and safety.

4.0 LIST OF PREPARERS AND INDEPENDENT EVALUATORS

The following section lists the primary individuals responsible for preparing and reviewing this EA.

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APPENDIX A. NOISE ANALYSIS

STARSHIP STATIC FIRE STAND NOISE ANALYSIS

SUMMARY

In this document, we present a noise analysis for the proposed Starship static fire test stand at KSC. The underlying model is based on NASA SP-8072 for the source spectra and ISO 9613 for atmospheric attenuation.

MODEL DEVELOPMENT

Eldred's basic model amounts to a breakdown of sound sources along the exhaust plume, parametrized principally by a few quantities:

1. The acoustic efficiency, or net conversion of mechanical to sound power
2. The geometry of the exhaust plume, particularly for the deflector geometry of the static-fire test stand
3. The distribution of power over the plume length
4. The spectral distribution of source power (per element)
5. The directivity function, characterizing the non-isotropicity of emission

These have been revised with specificity to the Raptor engine using test measurements executed by the Air Force Research Lab of single-engine static fire at McGregor, TX in July 2022, and results for both near-field and far-field acoustics have been corroborated in SpaceX's dozens of test operations of its Starship and Super Heavy Booster vehicles, including both static fires and test flights.

The model as used in this analysis is anchored to both near-field and far-field measurements taken during Starship static fires at the Massey's test site in Starbase, TX, particularly with regard to the assumed geometry of the sound-emitting sources in the exhaust plume, which alongside the plume's directivity function yields the characteristic "lobed" shape of the acoustic contours for this case. SpaceX continues to tune and re-anchor this model as it collects test data and upgrades hardware – on the test stand, on the vehicle, and the engines themselves.

For the farther distances relevant to this report, atmospheric attenuation is calculated spectrally according to ISO 9613, assuming a broadly representative baseline of 20°C and 70% humidity.

ASSUMPTIONS AND COMPUTED METRICS

The operational assumptions for each static fire are

- The test stand architecture is similar to that built at the Masseys Test Site in Starbase, Texas.

- The static-fire operation is performed by a Starship with 9 engines and 28MN total thrust.
- The flame deflector will inject 200k GPM of water into the exhaust plume, yielding approximately 3 dB of acoustic suppression.

The assumptions for yearly operations are

- The static fire is 60 seconds long.
- There will be 20 operations per year, 10 during the day and 10 at night.

The proposed location of the test site is located near the western terminus of Schwartz Road, with the flame trench pointed north.

The noise metrics presented are:

- L_{max}, the maximum unweighted sound pressure level
- L_{Amax}, the maximum A-weighted sound pressure level
- ASEL, the A-weighted sound exposure level

A-weighting is a scale to approximate the relative loudness of sounds in air as perceived by the human ear. L_{max}, or the maximum unweighted sound pressure level is the maximum sound level of a sound event. It does not consider the duration of a sound event. L_{Amax} is similar to L_{max} but is A-weighted. ASEL, or the A-weighted sound exposure level, represents all acoustic energy of an individual noise event as if that event had occurred within a one second time period. It captures both the level (magnitude) and duration of a sound event by incorporating all the noise energy from the event into a single second.

Day-Night Average Sound Level is not presented, as the metric considers the cumulative exposure of a sound source over a 24-hour period. This metric is typically used for facilities such as airports and highways, where a constant noise source is present. Static fire tests are of short duration (60 seconds) and infrequent, thus are not an appropriate use of the Day-Night Average Sound Level metric.

NOISE CONTOURS

Figure 1. Starship Static Fire Test: Maximum Unweighted Sound Pressure Level (L_{max})

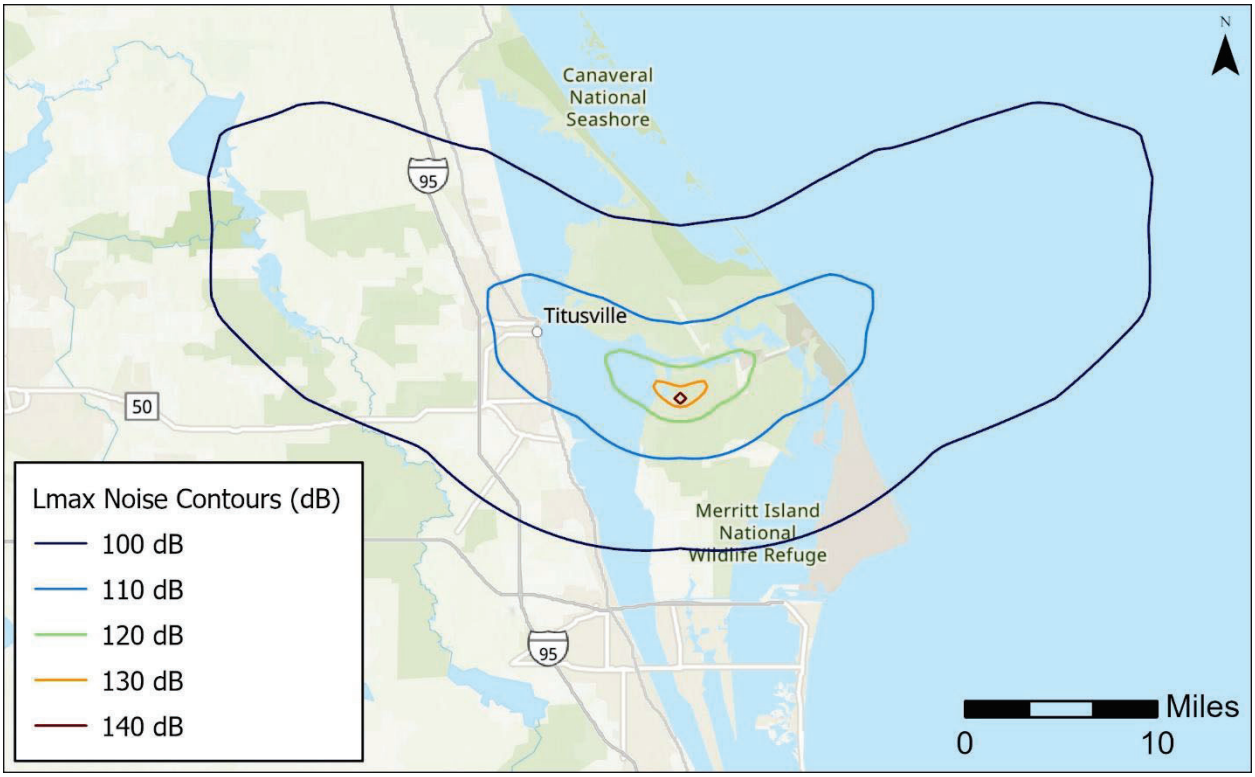


Figure 2. Starship Static Fire Test: Maximum A-weighted Sound Pressure Level (L_{Amax} SPL)

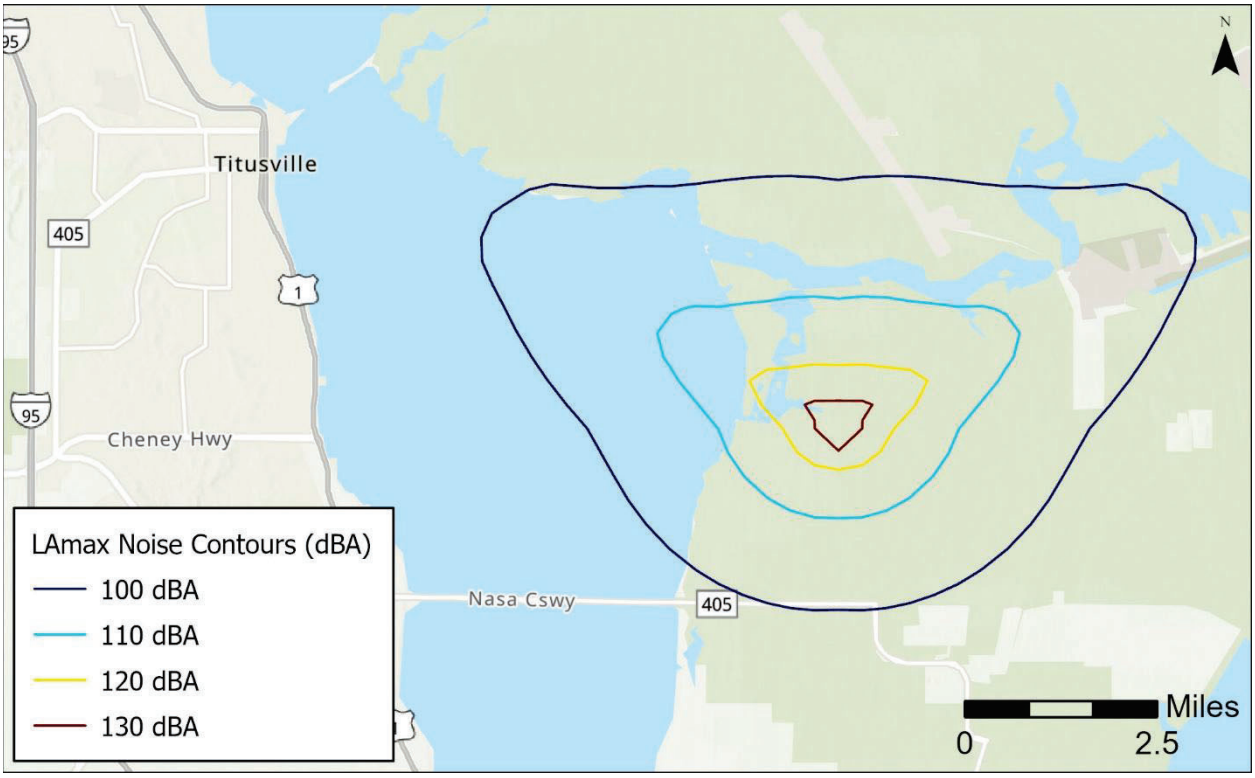
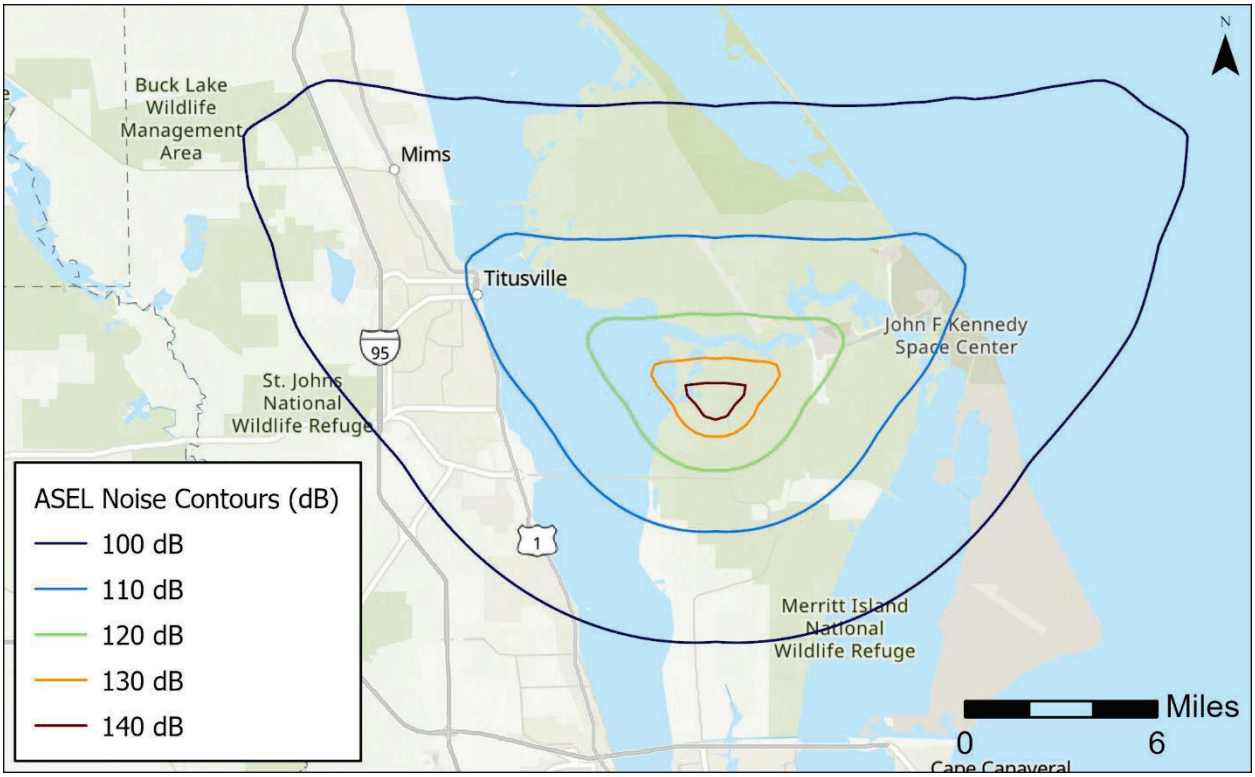


Figure 3. Starship Static Fire Test: A-weighted Sound Exposure Level (ASEL)



APPENDIX B. AIR QUALITY IMPACT ASSESSMENT

MEMORANDUM

To: Brian Pownall, P.E., SpaceX

From: Teresa Gresham, P.E., Kimley-Horn and Associates, Inc.
Heidi Rous, CPP, Kimley-Horn and Associates, Inc.
Daniel Karz, Kimley-Horn and Associates, Inc.

Date: July 8, 2026

Subject: SpaceX Campus Expansion on Kennedy Space Center (KSC) Project Construction Air Quality Impact Assessment (AQIA)

Purpose

This Air Quality Impact Assessment (AQIA) evaluates potential air quality impacts associated with the National Aeronautics and Space Administration's (NASA's) proposed Enhanced Use Lease (EUL) of land to SpaceX, the associated Build Alternative, and the foreseeable development of currently undeveloped land within the Study Area to support SpaceX's Campus Expansion over the planning horizon of the Programmatic Environmental Assessment (PEA). Preparation of this AQIA was conducted in accordance with the NASA National Environmental Policy Act (NEPA) regulations (14 CFR Part 1216), and applicable guidance from the United States Environmental Protection Agency (US EPA).

This AQIA provides a programmatic level assessment that includes an analysis of construction activities based on the notional long-term build-out of the site, as well as an analysis of operations associated with the proposed test stand and increased vehicle travel. More detail on the assumptions and methodology is below.

Project Description

The Proposed Action evaluated in this AQIA is NASA's potential issuance of an EUL with SpaceX to allow future expansion of its campus at the Kennedy Space Center (KSC). Any future installation or operation of stationary air emissions by SpaceX would be required to obtain the appropriate permits and approvals prior to construction and operation, in accordance with applicable federal, state, and local regulations.

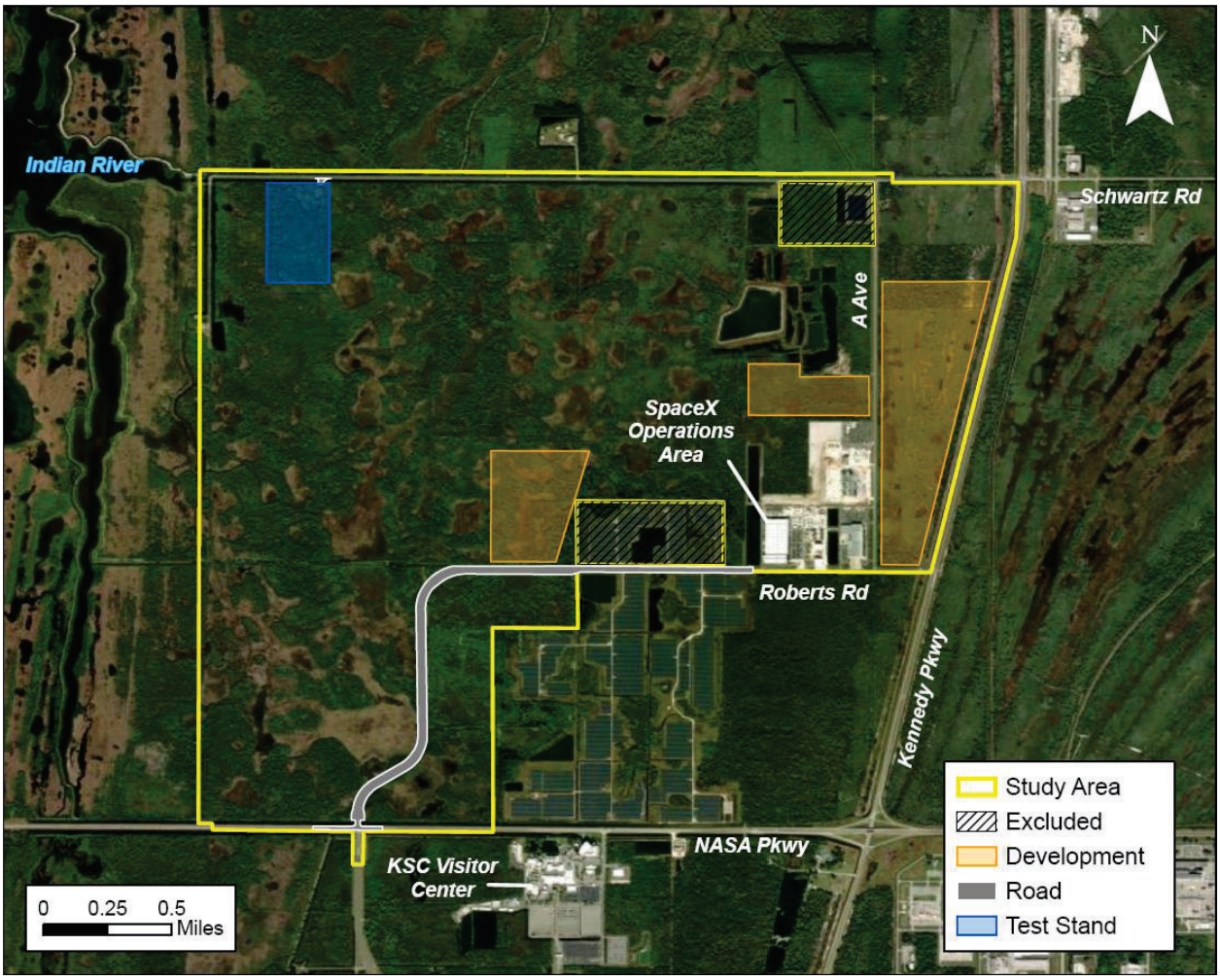
SpaceX's proposed action is the expansion of its existing campus at Roberts Road and construction of supporting infrastructure. Development would be expected to occur over several years in phases and would occur in the areas shown in Exhibit 1. Proposed Action Study Area.

Development could include facilities for uses such as manufacturing, production, refurbishment, and warehousing, as well as internal roads, utilities, and a test stand. The test stand would include up to nine engines firing up to 60 seconds at a time for static fires, with up to 20 operations per year. Exhibit 1 illustrates a notional build-out of the site,

which includes approximately 330 acres of buildings, a 35-acre site for the test stand, and supporting infrastructure.

According to the KSC Master Plan Traffic Impact Analysis (September 2025), the ultimate build-out of the site would include approximately 3,300 employees and 7,500 daily trips by 2045. Approximately 95 percent of the trips would be employee generated, with guests and vendor trips (potentially heavy duty vehicles) comprising the remaining 5 percent.

Exhibit 1. Proposed Action Study Area



Project Location

The Proposed Action involves land within the KSC, which is located in Brevard County, Florida. The Study Area would be roughly bound by NASA Parkway to the south, Kennedy Parkway to the east, and Schwartz Road to the north, and undeveloped land and the Indian River to the west.

The existing land use conditions of the Study Area consist of undeveloped land within Florida's coastal zone. The land is predominantly designated as Operational Buffer/Conservation. The Proposed Action would require a land use change from

Operational Buffer/Conservation to Support Services to support SpaceX's campus expansion under an EUL. The Study Area is currently managed as part of the Merritt Island National Wildlife Refuge.

Alternatives

There are three Alternatives under consideration in this AQIA. Each is described in more detail below.

No-Action Alternative: In accordance with NEPA regulations, the No Action Alternative is evaluated. Under the No-Action Alternative, NASA would not execute the lease, and SpaceX would not expand onto the proposed lease parcel. No new development associated with the campus expansion would occur beyond what is currently authorized.

Build Alternative: The Proposed Action is NASA's decision whether to execute an EUL with SpaceX to allow expansion of its campus at KSC. Under the Action Alternative, NASA would execute the lease, authorizing phased, multi-year development of the lease parcel to support activities such as manufacturing, production, refurbishment, and warehousing. Future site-specific development projects would be subject to separate future NEPA reviews.

Alternative 1 (Build Action Alternative with Security Gate Relocation): Alternative 1 includes all elements of the Action Alternative and additionally assumes relocation of the KSC security gates on Kennedy Parkway and NASA Parkway as a connected action to support changes in site access and circulation.

Scope of Analysis

This AQIA provides a programmatic level assessment of air quality conditions and potential impacts associated with implementation of the EUL and the Build Alternative to support NASA decision making and compliance with the NEPA. This AQIA includes a qualitative assessment of temporary emissions anticipated during construction activities for the Proposed Action and Build Alternative, as well as a quantitative operational emission analysis of the proposed test stand and qualitative discussion of emissions associated with increased vehicle travel. All other operational emissions analyses are excluded; future site specific projects would be required to undergo separate environmental review for both construction and operations, as appropriate. This would include Operational Safety and Health Administration (OSHA) review and requirements.

Typical stationary sources associated with the future SpaceX Campus Expansion may include combustion units (e.g. boilers, heaters, emergency generators), test stand combustion or exhaust systems, manufacturing and production equipment, surface coating operations, parts cleaning systems, fuel storage and transfer equipment, and other ancillary support equipment used in warehousing, refurbishment, and facility maintenance. Any future site-specific projects may require air permits as appropriate, and additional air quality impact assessments may include qualitative or quantitative operational emissions analysis.

Regulatory Overview

Air quality regulations in the United States are based on concerns that high concentrations of air pollutants can harm human health, especially for children, the elderly, and people with compromised health conditions; as well as adversely affect public welfare by damage to crops, vegetation, buildings, and other property. Information on applicable air quality standards and current attainment/nonattainment designations are detailed throughout this section. For the Proposed Action, this includes information on attainment/nonattainment designations, and applicable regulatory criteria and/or thresholds that will be applied to the results of the air quality assessment.

The US EPA has established National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3) and its precursors such as oxides of nitrogen (NO_x) and volatile organic compounds (VOCs), particulate matter (PM10 and PM2.5), and sulfur dioxide (SO_2). In complying with the NEPA, NASA must determine if "the action would cause pollutant concentrations to exceed one or more of the NAAQS, as established by the US EPA under the Clean Air Act (CAA), for any of the time periods analyzed, or to increase the frequency or severity of any such existing violations." This AQIA evaluates if the emissions caused by the Proposed Action would result in a significant impact under the US EPA's NEPA threshold.

Applicable Thresholds

Under NEPA, a NASA federal action is considered to have a significant impact on air quality if it results in emissions that would cause or contribute to a violation of the NAAQS as established by the US EPA under the CAA. Specifically, an impact is significant if the Proposed Action's estimated emissions exceed the prevention of significant deterioration (PSD) thresholds, or if the action results in a net increase in pollutant concentrations that exceeds any federal, state, or local air quality standard for the analysis period. The PSD thresholds are 250 tons per year for criteria pollutants in attainment. Furthermore, an action is significant if it increases the frequency of severity of an existing NAAQS violation or delays the attainment of any air quality standard within the applicable State Implementation Plan (SIP). Additionally, the static test stand is subject to permitting at the State level, which will ensure no significant impact from those activities.

The region of influence (ROI) for air quality is Brevard County. Brevard County is not located within a US EPA-designated nonattainment or maintenance area for any of the NAAQSs, and thus the PSD threshold for an attainment area (250 tons per year for criteria pollutants) is used in this AQIA for both construction and operational emissions analysis.

Existing Meteorological and Air Quality Conditions

The Proposed Action is located in Brevard County, Florida, which is characterized by a subtropical climate with warm, humid summers and mild winters. Average annual precipitation is primarily associated with convective thunderstorms during the summer months and occasional tropical systems during the Atlantic hurricane season, which typically extends from June through November. Prevailing winds are generally from the

east and are influenced by regular sea breeze circulation patterns. Topography within Brevard County is generally flat and low lying.

Ambient air quality at KSC is primarily influenced by routine activities such as vehicle traffic, utility operations, fuel combustion, and standard maintenance and refurbishment activities. Brevard County is classified as unclassifiable/attainment for all criteria pollutants. A lack of substantial emission sources, sea breezes, and frequent precipitation limit the buildup of air pollutants and promote improved air quality.

Air Quality Monitoring

The Florida Department of Environmental Protection (FDEP) and US EPA monitor local air quality for the state of Florida, maintaining a network of over 180 monitoring sites throughout the state. FDEP and US EPA monitor for the following pollutants: CO, NO_2, O_3, PM10, PM2.5, and SO_2. The nearest monitoring site is the Cocoa Beach Monitoring Station (12-009-4001) which is approximately 15 miles south of the Proposed Action. Air monitoring data for the most recent years available (2023 to 2025) near the Proposed Action is included in Table 1. Air Monitoring Data from the Project Vicinity. As shown in Table 1, the monitoring stations in Brevard and Orange County demonstrated compliance with federal, health-based air quality standards.

Table 1. Air Monitoring Data from the Project Vicinity

Pollutant	2023	2024	2025
CO (ppm)	2.9	1.3	1.4
O_3 (ppb)	69.0	67.0	69.0
NO_2 (ppb)	114.4	27.6	41.4
PM10 (µg/m3)	187.0	83.8	71.1
PM2.5 (µg/m3)	124.4	65.9	63.8
SO_2 (ppb)	5.0	9.0	5.3

Source: US EPA. AirData Air Quality Monitors.

https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=5f239fd3e72f424f98ef3d5def547eb5&extent=-146.2334,13.1913,-46.3896,56.5319. Accessed January 2026.

ppm = parts per million, ppb = parts per billion; µg/m^3 = micrograms per cubic meter; PM10 = particulate matter with diameter less than 10 microns; PM2.5 = particulate matter with diameter less than 2.5 microns.

1. *O_3 was measured at Cocoa Beach Monitoring Station (12-009-4001); PM10 and PM2.5 were measured at Melbourne Monitoring Station (12-009-0007); CO, SO_2, and NO_2 were measured at Winter Park Monitoring Station (12-095-2002). Cocoa Beach and Melbourne are located in Brevard County. Winter Park is located in Orange County.*
2. *Parameter for all pollutants are measured as the annual maximum.*

Air Quality Impacts

Construction

Implementation of the Proposed Action and Alternative 1 would involve construction activities that would generate short term, localized criteria air pollutant emissions from heavy-duty construction equipment activity, ground-disturbing activities, truck haul trips, construction workers, and vendor/material truck trips to and from the site. Activities would include paving a portion of the site for parking areas and construction buildings.

Construction emissions of criteria pollutants NO_X, CO, SO_2, VOC, PM10, and PM2.5, would be temporary in nature, varying by phase and intensity of construction, and would cease upon completion of construction activities.

Due to the phased approach to construction anticipated, it is unlikely emissions during construction would exceed applicable thresholds (250 tons per year (tpy) of each pollutant), and violations of applicable air quality standards or contribution to a change in attainment status is not anticipated. However, if construction phases overlap each other, it is possible that annual emissions could exceed 250 tpy. Therefore, future project-level reviews would assess construction emissions in greater detail based on project-specific plans and data.

With implementation of standard construction controls and BMPs (best management practices), the Proposed Action is anticipated to result in short-term impacts to air quality due to temporary increases in criteria pollutant emissions during construction activities. These emissions would typically be limited in duration and extent and would not measurably affect ambient air quality within Brevard County. The incremental increases in emissions would likely have a negligible effect on regional air quality and would not affect the area's attainment status or result in any violations of the NAAQS.

Operations

Calculations were performed to estimate exhaust emissions of the test fire stand emissions. The worst case CO and NO_x emissions are predicted to be 0.29 pounds mass per second (lbm/s) and 9.19 lbm/s respectively, per engine, under nominal power (100 percent) operation. No soot is predicted to be generated by this engine cycle. CO_2 emissions from a single engine is 986.3 lbm/s. Table 2. Static Fire Stand Operational Emissions shows the annual operational emissions for the static fire stand tests. As mentioned above, CO and NO_X are criteria pollutants and would be subject to the PSD threshold, whereas CO_2e is not classified as a criteria pollutant and is not subject to the PSD thresholds. These emissions would remain below 250 tons per year for the criteria pollutants, therefore not triggering PSD thresholds.

Table 2. Static Fire Stand Operational Emissions

CO (tons/yr)	NO_X (tons/yr)	CO_2e (MT/yr)
0.71	62.7	8,212.9

1. *Assumes nine engines per operation, 20 operations annually.*

See Attachment A for calculations

Passenger vehicles are recognized as potential substantial sources of CO and VOC emissions but result in relatively low NOx emissions. Heavy duty diesel trucks, on the other hand, are potential sources of high diesel emissions. The Proposed Action is expected to generate approximately 7,500 total vehicle trips per day, which would also contribute to operational criteria pollutant and GHG emissions. For high-level evaluation, the resultant annual operational emissions of the test stand operations and expected vehicle trips are

unlikely to exceed applicable thresholds. Future project-level reviews would assess operational emissions in greater detail based on project-specific plans and data.

As summarized in the KSC Master Plan Traffic Impact Analysis (TIA), there would be one intersection that would have a failing LOS[1] in the future buildout with intersection improvements for both the Proposed Action (referred to as Scenario 2 in the TIA) and Alternative 1 (referred to as Scenario 1 in the TIA). Given the favorable local meteorological conditions and low traffic volumes, the Proposed Action would be unlikely to trigger an emission hotspot under 40 CFR 93.123, however future project-level reviews would assess potential emission hotspots in greater detail based on project-specific plans and data.

Conclusion

This AQIA demonstrates that the Proposed Action and Alternative 1 would result in temporary, limited, and marginal increases of criteria pollutants during the construction phases. These increases in emissions would have a negligible effect on Brevard County's air quality and attainment status. Given the size of the Study Area, anticipated disturbed area, and type of proposed development, even if various phases of construction and operations were to overlap, emissions are unlikely to exceed the PSD threshold (250 tpy) in any calendar year. Additionally, operations of the static fire stand are not anticipated to exceed the 250 tons per year standard. Assuming expected daily truck trips, the Proposed Action would not have significant air quality impacts. Therefore, implementation of the Proposed Action would not cause any new violation of the NAAQS, delay any attainment of any of the NAAQS, nor increase the frequency or severity of any existing NAAQS violations.

Future Steps

Below are the next steps for operational air emissions:

- Any future site-specific projects would be required to obtain applicable air permits with the State and undergo air quality assessments.
- Title V air permits and quantitative emission calculations or dispersion modeling may be required for construction and/or operations.

[1] *Under 40 CFR 93.123, a hot spot analysis may be required for projects affecting intersections that are at LOS D, E, or F, or those that will change to LOS D, E, or F because of increased traffic volumes related to the project.*

ATTACHMENT A: STATIC FIRE TEST EMISSIONS

Emission Calcs (Static Fires)

From Sierra Analysis Report dated 19 and 26 Dec 2024 for LC-39A

20 operations/yr

9 engines/operations

CO

0.29	lbm/s	per engine (eng) of CO for booster and SL Starship engines
0.053	lbm/sec	per engine (eng) of CO for RVac Starship engines

Note: Starship has 3 Sea Level (SL) Engines and 6 Rvac Engines (engines which operate in the vacuum of space)

Starship SL (3 eng)	0.87	lbm/s
Starship Rvac (6 eng)	0.318	lbm/sec

Static Fire	**Per Operation**	**Annual**	**Tons**	**Metric Tons (MT)**		
Starship SL (60 sec)	52.2 lbm	1044 lbm	0.522 tons	0.47	**Operations/ year**	
Starship Rvac (60 sec)	19.08 lbm	381.6 lbm	0.1908 tons	0.17	20	Static Fire Ship

0.65	MT from 20 static fires (cell I21)	
6.73	MT Ship: Residual propellant ranges remaining following a nominal static fire, if vented	
135.25	MT Methane per yr	
3,381	**MT CO_2e/yr**	25 is the Global Warming Potential (GWP) of Methane to CO_2e

0.71 tons **0.65 MT**

GHG

CO_2	986.3 lbm/sec	per engine for SL Starship engines (3)
CO_2	955.5 lbm/sec	per engine for RVac Starship engines (6)

Static Fire	**Per Operation**	**Tons**	**Metric Tons (MT)**
Starship SL (60 sec)	177,534 lb	1,775.34	1,610.56
Starship Rvac (60 sec)	355,068 lb	3,550.68	3,221.12
		5,326.02 tons	4,831.69 MT

8,212.85 MT with methane operations described above for CO2e

Emission Calcs (Static Fire)

From Sierra 2024 report

20 Static Fires/yr for Starship

Note: Starship has 3 Sea Level (SL) Engines and 6 Rvac Engines (engines which operate in the vacuum of space)

9.19 lbm/s	per engine (eng) of NOx at Sea Level (SL)	
12.82 lbm/s	per engine (eng) of NOx of RVac Eng	

Starship-SL engines (3 engines)	27.57 lb/s	76.92 lb/s	Starship RVac Engines

Static Fire	**Per Operation**	**Annual**	**Tons**	**Metric Tons (MT)**
Starship SL (60 sec)	1,654.20 lb	33,084.00 lb	16.5	15.0
Starship RVac (60 sec)	4,615.20 lb	92,304.00 lb	46.2	41.9
		Total:	**62.7 Tons**	**56.9 MT**

APPENDIX C. ENDANGERED SPECIES ACT CONSULTATION

PROGRAMMATIC BIOLOGICAL ASSESSMENT

for the SpaceX Campus Expansion

at

Kennedy Space Center

Brevard County, Florida

USFWS Project Code: 2026-0033075

Lead Federal Agency

National Aeronautics and Space Administration

with assistance from

SpaceX
1 Rocket Road
Hawthorn, CA 90250

and

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Tampa, FL 33602

October 2026

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1.0 INTRODUCTION

Space Exploration Technologies Corporation (SpaceX) currently leases 167 acres from the National Aeronautics and Space Administration (NASA) north of Roberts Road (SpaceX Campus) where it operates, facilitates, and conducts rocket processing and refurbishment. The SpaceX Campus is located within the Kennedy Space Center (KSC) located on Merritt Island, Brevard County, Florida. The lands surrounding the SpaceX Campus are owned by NASA and managed by the Merritt Island National Wildlife Refuge (MINWR). The SpaceX Campus is generally situated between the Indian River to the west and the Banana River to the east. SpaceX is currently seeking to lease additional land from NASA in which SpaceX must enter into and execute a real property agreement with NASA for this expansion.

1.1 Federal Action

NASA's Federal Action is to issue Enhanced Use Leases (EUL) for SpaceX's Proposed Action.

SpaceX's Proposed Action is the expansion of its existing campus at Roberts Road and construction of the required supporting infrastructure. Development would be expected to occur in phases over several years within the boundary shown below in **Figure 2-1. Section 5.1** provides further detail about the anticipated development of the long-term SpaceX Proposed Action.

1.2 Purpose and Need for the Biological Assessment

SpaceX's Proposed Action is related to NASA's federal action (i.e., the Project would not occur but for the federal action, and the Proposed Action is reasonably certain to occur) and contributes to the effects of the action. The purpose of this Programmatic Biological Assessment (PBA) is to evaluate the effects of the Proposed Action on species and critical habitats protected by the Endangered Species Act (ESA) and other species and habitats that are proposed or under review for ESA protection. NASA, as the lead federal action agency, has made effect determinations for each species and critical habitat considered in this PBA.

1.3 Effect Determination Summary

Based on the effect determinations, NASA submits this PBA to the U.S. Fish and Wildlife Service (USFWS) to initiate federal interagency consultation and conference in accordance with Section 7(a)(2) and Section 7(a)(4) of the ESA. NASA seeks USFWS concurrence with the effect determination of "may affect, not likely to adversely affect" for the following federally listed species and therefore requests informal consultation under ESA Section 7(a)(2):

- Audubon's crested caracara (*Caracara plancus audubonii*)
- Eastern black rail (*Laterallus jamaicensis ssp. jamaicensis*)
- Everglade snail kite (*Rostrhamus sociabilis plumbeus*)
- Southeastern beach mouse (*Peromyscus polionotus niveiventris*)
- West Indian manatee (*Trichechus manatus*)
- Atlantic salt marsh snake (*Nerodia clarkii taeniata*)
- Green sea turtle (*Chelonia mydas*)
- Hawksbill sea turtle (*Eretmochelys imbricata*)
- Kemp's Ripley sea turtle (*Lepidochelys kempii*)
- Leatherback sea turtle (*Dermochelys coriacea*)
- Loggerhead sea turtle (*Caretta caretta*)

NASA has determined the Proposed Action "may affect, but is not likely to adversely affect" the tricolored bat (*Perimyotis subflavus*) and monarch butterfly (*Danaus* plexippus). These determinations are provided to USFWS for conference purposes pursuant to ESA Section 7(a)(4). Based on the effects analysis presented in this PBA, NASA anticipates that the Proposed Action is not likely to jeopardize the continued existence of either proposed species.

NASA determined that the Proposed Action is "likely to adversely affect" and seeks to initiate formal consultation with USFWS pursuant to ESA Section (7)(a)(2) for the following federally listed species:

- Florida scrub-jay (*Aphelocoma coerulescens*; FSJ)
- Eastern indigo snake (*Drymarchon couperi*)

1.4 Consultation History

In 2018, NASA entered into formal consultation with the USFWS under FWS Log #: 04EF1000-2019-0193 to evaluate the SpaceX proposal to lease 67 acres from NASA for

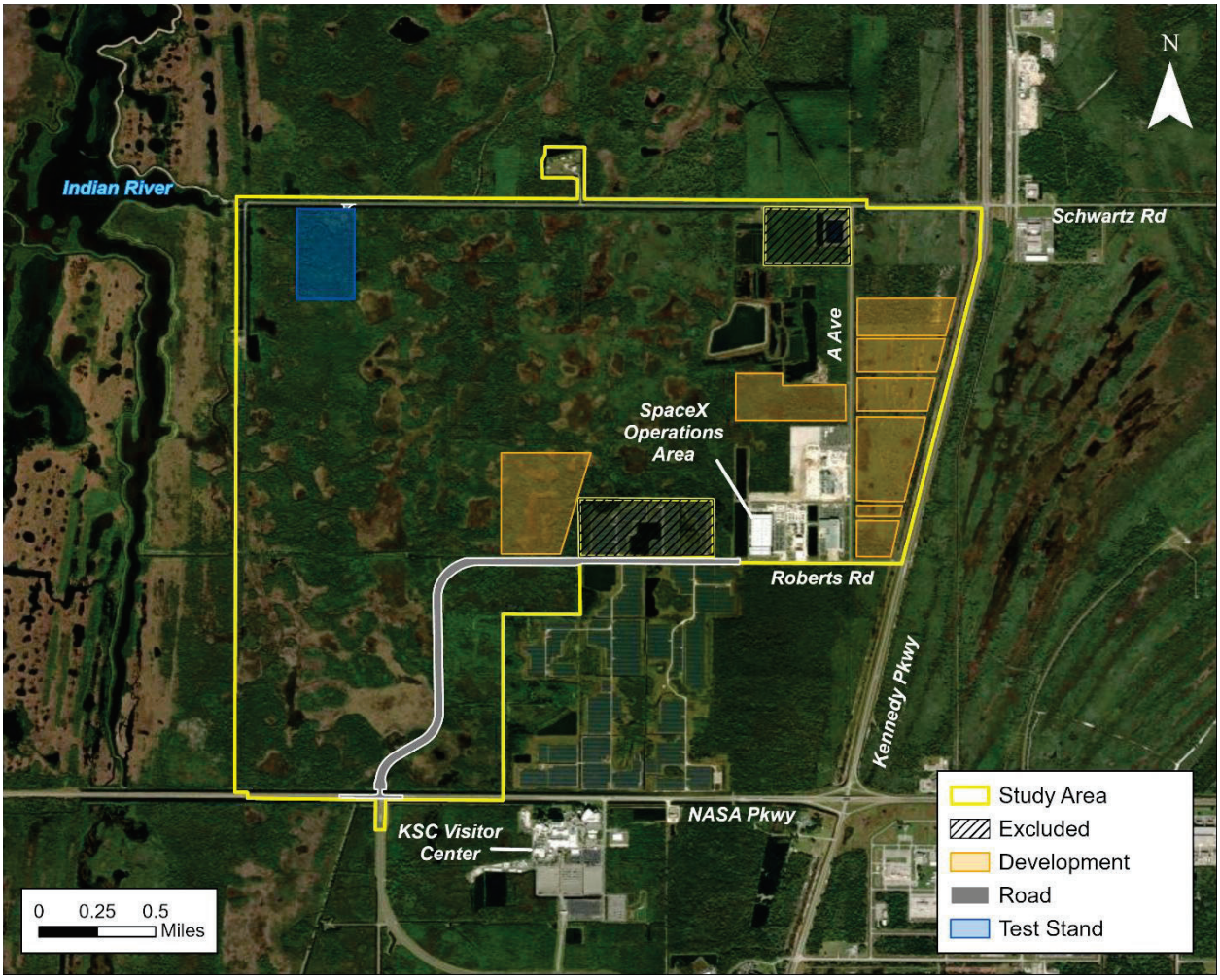
construction of the SpaceX Operations Facility. The consultation was reviewed under the same USFWS formal consultation as the adjacent Florida Power and Light (FPL) Photovoltaic Solar Facility. Subsequently in 2023, NASA entered into formal consultation with the USFWS under FWS Log #: 04EF1000-2019-0193 / 2023-0036318 which amended the 2018 Biological Opinion (BO) for the 100-acre expansion of the SpaceX Operations Area. In 2026 the 2018 BO was further amended for the construction of an approximately 6.4-acre parking lot. The SpaceX Operations Facility has since been constructed and the expansion area is currently under construction.

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 Action Overview

The Proposed Action is the expansion of the existing SpaceX Campus at Roberts Road. This expansion would be expected to occur in phases over several years and include facilities for manufacturing, production, refurbishment, and warehousing and referred to as "study area" in **Figure 2-1**. The SpaceX Proposed Action is intended to increase the capabilities, efficiency, and cost effectiveness of SpaceX's production and launch support operations in Brevard County, Florida. Locating testing, production, manufacturing, and other facilities near launch sites reduces the impact on nearby transportation networks as oversized or otherwise sensitive components would not need to be transported over public roads or waterways meeting NASA's mandate of supporting the commercial space industry with fewer impacts to the public. This expansion addresses specific challenges, such as current transportation impacts on State Road 405 and the Indian River Lagoon, by shortening transport distances from miles to on-site movements, aligning with Federal Aviation Administration (FAA) spaceport licensing standards (e.g., 14 CFR Part 420) for efficient operations. A notional site development plan (**Figure 2-1**) was developed by SpaceX which proposes a payload processing facility, test stand, utility expansion, and roadway expansion. For the purposes of this PBA, the notional site development plan is here-in referred to and defined as the Study Area. Details on these proposed facilities are included in the following subsections.

Figure 2-1 Notional Site Development



2.2 Proposed Development

The SpaceX campus expansion is anticipated to occur over several years and, therefore, the exact development footprint or phasing of the campus is unknown at this time but would occur within the Study Area shown in **Figure 2-1**. Development would include facilities for activities such as manufacturing, production, refurbishment, and warehousing. Supporting infrastructure such as additional roadways, parking lots, and stormwater infrastructure would also be required to accommodate the development. Vertical structures up to 400 feet in height may be constructed within the Study Area and are anticipated to occur within the "proposed development" shapes on **Figure 2-1**. The following facilities discussed below, and included in the National Site Development Plan, would assist in meeting the long-term purpose and need of SpaceX's Proposed Action. Additional development would be re-evaluated as the development plan progresses. Should all of the notional developments shown in **Figure 2-1** occur, approximately 400 acres would be converted to developed lands. Of this acreage, approximately 53 acres would be occupied by a production test stand and approximately 44 acres would be occupied by roadway. The existing KSC Protective Service Office shooting range is

located within this study area. If development were to occur in this area, it would require relocation of the shooting range elsewhere at KSC. Potential relocation would be considered in a future tiered analysis.

2.2.1 Payload Processing

A payload processing facility is proposed to be constructed west of A Avenue. The siting of the payload processing facility would be determined by potential impacts to other facilities due to required clear distance during hazardous operations. Clear distances are based on quantity distance arcs which are used to determine the siting of potentially explosive material. A clear distance of 1,250 feet was assumed for the Proposed Action. Toxic hazard corridors are developed using predicted atmospheric dispersion paths of hazardous materials and are used to reduce the exposure risk to personnel, other users of KSC, and the general public.

2.2.2 Test Stand

A test stand is proposed as part of the Proposed Action. The test stand would be used to verify post-production testing of Starship and support static fire tests. Tests would include tank tests, proof tests, spin prime tests, and static fire tests. Proof pressure tests are broken into two main categories: (1) pneumatic and (2) cryogenic. Pneumatic proof pressure testing consists of pressurizing the launch vehicle's tank with gaseous media and holding pressure for an extended duration. Cryogenic proof pressure testing consists of loading the tank with a single propellant. The tanks are then pressurized to a predefined limit to confirm their structural integrity with appropriate factors of safety. These proof pressure tests do not release any propellant to the environment. Propellants are recycled back into the ground system tanks after the test is completed. Tank tests do not involve the mixing of explosive commodities and are designed to test an accepted safety limit. Spin-prime tests verify the engine system is operational. During a spin-prime test, the vehicle engines are chilled and pumps are spun to operating speed but are stopped prior to engine ignition. Static fire tests verify engine control and performance. During a static fire test, engines are ignited while the vehicle remains clamped to the test stand.

2.2.3 Utilities

Power would be provided from existing sources, including the Mars and Saturn substations. Future power needs may also be met through the use of batteries, such as Megapacks. Future site-wide power needs would be determined on a phased, per-project basis. No power infrastructure improvements are proposed at this time within the Study Area. Minor impacts to habitat may occur from the connections to existing power; however, power utility is not expected to have a major effect on federally listed and proposed listed species or their habitats.

Water would be provided via the existing KSC supply lines from the City of Cocoa. Wastewater would be treated on-site or sent to existing or future wastewater treatment plants. Wastewater needs would be determined on a phased, per-project basis. Therefore, wastewater impacts would be contained within the development sites shown in **Figure 2-1**.

2.2.4 Roadways

SpaceX would construct a new roadway, partially along an existing dirt road, from NASA Parkway to Roberts Road that would relocate its expanded Roberts Road campus operations area outside the existing KSC secure fenceline to enhance operational efficiency and reduce administrative burdens at KSC. The proposed roadway typical section would be four-lanes. The proposed NASA Parkway Connector would generally follow the existing unpaved Roberts Road and access road adjacent to the FPL solar farm before connecting via a new alignment, with NASA Parkway at the signalized intersection with Space Commerce Way. The new intersection of NASA Parkway and Space Commerce Way would require traffic signal modifications to accommodate the additional signal phases. SpaceX would locate any necessary utilities within the proposed improvement area. Construction of this roadway would require minor intersection improvements (e.g., turn lanes) on NASA Parkway.

SpaceX would construct a gate along the proposed road to secure the facility and allow only approved personnel access. Additional gates would be constructed along A Avenue and Roberts Road to prevent unauthorized access from the SpaceX Operations Area to KSC. Fencing would be constructed between A Avenue and Kennedy Parkway and along Schwartz Road to maintain the KSC secure area.

When fully operational, SpaceX expects approximately 7,500 vehicle trips per day to and from the SpaceX Operations Area. The vehicle trips per day are anticipated to be comprised of employees, customers, and contractors traveling to and from the site and trucks delivering materials in support of manufacturing and production activities. The proposed roadway would redirect this SpaceX-related traffic away from the KSC security checkpoints. This infrastructure improvement would significantly decrease the support resources needed from KSC security teams by reducing the need for routine badge processing and security clearances for SpaceX personnel, contractors, and customers. This activity currently requires substantial effort from KSC security teams—including background checks, badge issuance, and escorted access protocols that can consume thousands of KSC staff-hours annually. By minimizing these requirements, the private road would alleviate delays that often impact time-sensitive activities, such as component and construction deliveries, operations for critical commercial and government-contracted launches.

2.3 Construction Activities

The proposed development of the SpaceX campus expansion would occur in a phased approach. For the purposes of this PBA, it is assumed proposed development, roads, and test stand areas shown in **Figure 2-1** would undergo mass grading and development. Converting approximately 400 acres of undeveloped available habitat to developed lands. It is assumed that construction would occur primarily during daylight hours although some night activities may be required. Access routes would be determined for each phased development; however, it is anticipated existing roadways would be the primary access and haul routes in the initial development phases. Any proposed roadways would likely be constructed first to accommodate access throughout the expanded campus and could help facilitate access to future development phases.

3.0 ACTION AREA

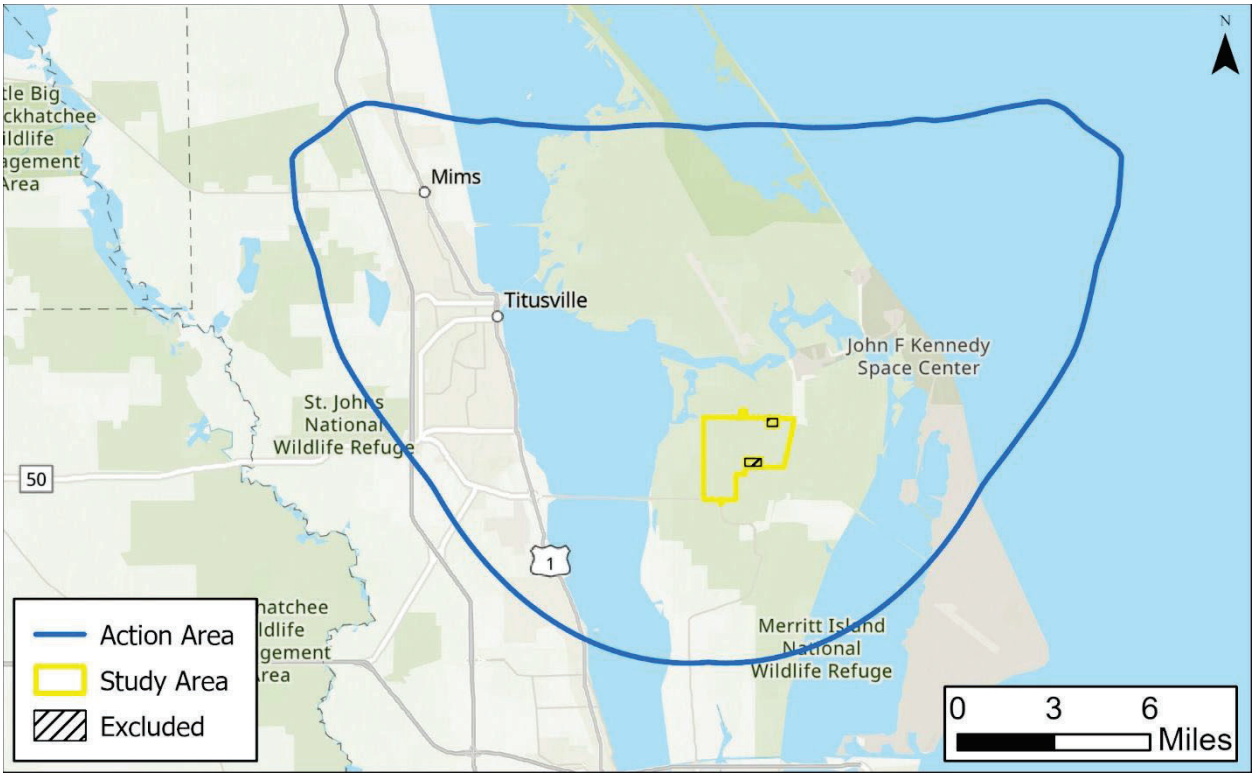
The Action Area is defined as the area within which all direct and indirect effects by the federal action will occur and not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] 402.02). The Action Area establishes the geographic scope of the PBA for the purposes of identifying the species and critical habitats that may be exposed to the effects of the action, describing the environmental baseline for the species and critical habitats considered in the PBA, and identifying future non-federal activities contributing to cumulative effects. The Action Area includes: (1) areas that would be physically disturbed, (2) areas where facility lighting may be visible due to building height, and (3) areas surrounding KSC that would be exposed to noise.

Noise disturbances are expected from construction, operational, and engine testing noise. Different organisms are typically most sensitive to sounds within a limited frequency range and hence would perceive sounds with different frequency spectra differently, even if the sound levels are identical. Noise studies tailored to human health and safety typically weight noise intensities to the human hearing spectrum in a process known as A-weighting. A-weighting decibel (dBA) values are not necessarily appropriate for analysis of wildlife impacts given that species perceive noise differently; for example, high-frequency echolocating bats will have drastically different frequency sensitivities than humans. However, most noise monitoring and studies are geared towards the human environment and are reported in dBA. It may be difficult to find comparative metrics in unweighted decibels. Humans and many species of terrestrial wildlife do not perceive very low frequency sound, which is a substantial component of rocket engine noise. Therefore, use of unweighted estimates could potentially inflate the analysis of impacts beyond those that would realistically occur.

A metric for noise effects on wildlife has not been universally adopted, but some research indicates sound exposure level (SEL) is the most useful predictor of responses (FRA, 2012). SEL values represent the total sound energy of a noise event in terms of an equivalent event which only lasts 1 second, providing a consistent comparison basis for sound events of differing durations. Much of the research has lacked systemic documentation of the source noise event. Many studies report "sound levels" without specifying the frequency spectrum or duration. A notable exception is a study sponsored by the Department of the Air Force that identifies SEL as the best descriptor for response of domestic turkey poults to low-altitude aircraft overflights (Bradley et al., 1990). This study identifies a threshold of response for disturbance of domestic turkeys (100 percent rate of crowding) as an A-weighted SEL (ASEL) of 100 decibels. Another report questions whether an A-weighted sound level used in the SEL for aircraft overflights is appropriate for animals since their hearing differs from humans (Manci et al., 1988). However, because no weighting has been established for representing the hearing characteristics of wild animals, the A-weighted sound level continues to be used. Accordingly, NASA delineated the 100 dBA SEL contour to be the Action Area. This area encompasses all areas that would be directly or indirectly affected by construction activities and daily operations.

Effect considerations on federally listed and proposed listed species are further discussed below in **Section 5.1**. The Action Area and Study Area are shown below in **Figure 3-1.**

Figure 3-1 Action Area



3.1 Environmental Context

3.1.1 Ecoregion

The Action Area is contained within the U.S. Level III Southern Coastal Plain Ecoregion. This ecoregion consists of mostly flat plains and also contains barrier islands, coastal lagoons, marshes, and swampy lowlands along the Gulf of Mexico and Atlantic coasts (U.S. Environmental Protection Agency 2013).

3.1.2 Land Cover within Study Area

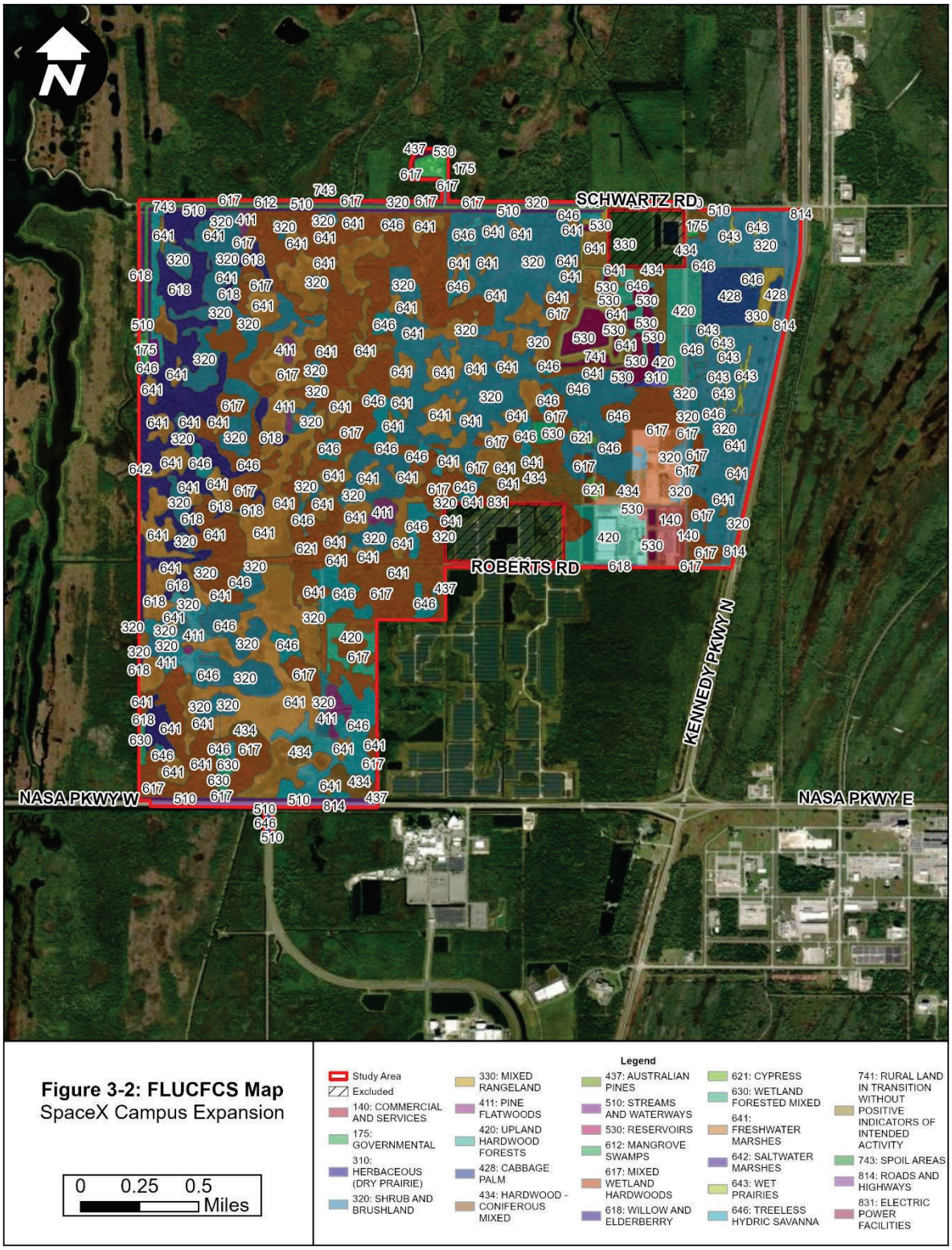
Land cover within the Study Area is described following the Florida Land Use, Cover and Forms Classification System (FLUCFCS) (FDOT 1999) and is shown in **Figure 3-2**. The FLUCFCS is a partnership venture between the Florida Fish and Wildlife Conservation Commission (FWC) and Florida Natural Areas Inventory (FNAI), and represents ecologically based, statewide land cover mapping using existing sources and expert aerial photography review.

Land cover within the Study Area consists primarily of shrub and brushland (FLUCFCS 3200) (24.7%), mixed wetland hardwood (FLUCFCS 6170) (24.7%), and freshwater marshes (FLUCFCS 6410) (20.0%). Wetlands represent 62.8% of the Study Area and upland/developed cover represent 37.2% of the Study Area.

Table 3-1 Florida Land Use, Cover, and Forms Classification within the Study Area

FLUCFCS Code	Land Cover Classification	Acres	% of Study Area
1400	Commercial and Services	29.1	0.9%
1750	Governmental	15.4	0.5%
3100	Herbaceous Dry Prairie	10.8	0.3%
3200	Shrub and Brushland	795.4	24.7%
3300	Mixed Rangeland	15.6	0.5%
4110	Pine Flatwoods	26.3	0.8%
4200	Upland Hardwood Forests	115.3	3.6%
4280	Cabbage Palm	41.6	1.3%
4340	Hardwood - Coniferous Mixed	79.0	2.5%
4370	Australian Pines	1.5	0.0%
5100	Streams and Waterways	47.6	1.5%
5300	Reservoirs	50.6	1.6%
6120	Mangrove	7.8	0.2%
6170	Mixed Wetland Hardwoods	795.1	24.7%
6181	Cabbage Palm Hammock	207.0	6.4%
6210	Cypress	7.4	0.2%
6300	Wetland Forested Mixed	16.2	0.5%
6410	Freshwater Marshes	642.7	20.0%
6420	Saltwater Marshes	0.5	0.0%
6430	Wet Prairies	9.8	0.3%
6460	Mixed Scrub-Shrub Wetland	236.7	7.4%
7410	Rural Land in Transition	21.5	0.7%
7430	Spoil Areas	28.9	0.9%
8140	Roads and Highways	19.5	0.6%
8310	Electric Power Facilities	8.9	0.3%
TOTAL		**3,230.3**	

Figure 3-2 FLUCFCS Map



3.1.3 Vegetative Cover within Study Area

Wetland Communities

Typical plants found in the forested wetland communities of the Study Area include canopy species such as laurel oak (*Quercus laurifolia*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), cabbage palm (*Sabal palmetto*), swamp dogwood (*Cornus foemina*), Carolina willow (*Salix caroliniana*), and Brazilian peppertree (*Schinus terebenthifolia*).

The herbaceous wetland communities vary greatly based on presence of Brazilian peppertree and overgrowth of Carolina willow. They also exhibit great variation based on zonation of the individual wetland systems. Typical of the interior of these systems, vegetation includes species such as arrowhead (*Sagittaria spp.*), royal fern (*Osmunda regalis*), swamp fern (*Blechnum serrulatum*), sawgrass (*Cladium jamaicense*), cordgrass (*Spartina bakeri*), and St. John's wort (*Hypericum spp*.).

Due to lack of burning, many herbaceous wetland communities within the Study Area have been overtaken by shrubby species such as Carolina willow and Brazilian peppertree. Within the edges of these shrub wetland communities there is a low gradient transitional zone where typical upland or transitional species such as saw palmetto (*Serenoa repens*), wax myrtle (*Morella cerifera*), gallberry (*Ilex glabra*), and saltbush (*Baccharis halimifolia*) occur.

Upland Communities

From low lying scrub to upland hardwood forests, the upland communities within the Study Area are also variable. In the eastern portion of the Study Area where elevations are higher, scrub habitats are dominant. Typical species of these scrub habitats include a variety of scrub oaks (*Quercus spp*.), saw palmetto, dahoon holly (*Ilex cassine*), fetterbush (*Lyonia lucida*), rusty staggerbush (*Lyonia ferruginea*), and gallberry.

Within the lower lying uplands, the species are dominanted by canopy trees such as live oak (*Quercus virginiana*), slash pine (*Pinus elliotti*), eastern red cedar (*Juniperus virginiana*), and cabbage palm. Fire surppression frequently allows vine species such as muscadine (*Vitis rotundifolia*), Virigina creeper (*Parthenocissus quinquefolia*), or poison ivy (*Toxicodendron radicans*) to dominate the subcanopy, resulting in dense vegetation that can restrict wildlife movement through the community.

4.0 SPECIES AND CRITICAL HABITATS CONSIDERED

This Proposed Action was evaluated for impacts to habitat resources, including federally listed and proposed listed species, in accordance with 50 CFR 402 of the ESA of 1973, as amended, and the Florida Endangered and Threatened Species Act (Section 379.2291, F.S.). Listed species are afforded special protective status by federal and state agencies. This special protection is federally administered by the United States Department of the Interior, USFWS, and National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NOAA-NMFS) pursuant to the ESA of 1973 (as amended). The USFWS

administers the federal list of animal species (50 CFR 17) and plant species (50 CFR 23). Federal protection of marine species is the responsibility of the NOAA-NMFS.

4.1 Listed Species with Potential to Occur in the Action Area

Available site-specific data was collected and evaluated to determine federally listed and proposed listed plant and animal species that have potential to occur within the Action Area. The USFWS's Information for Planning and Consultation (IPaC) system was queried on July 1, 2026, for an official species list for the Action Area (USFWS Project Code: 2026-0033075).

The USFWS IPaC Official Species List reported the following federally listed, proposed listed, and experimental population species: Florida panther (*Puma concolor coryi*), southeastern beach mouse (*Peromyscus polionotus niveiventris*), tricolored bat (*Perimyotis subflavus*), West Indian manatee (*Trichechus manatus*), crested caracara (*Caracara plancus audubonii*), eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Florida scrub-jay (*Aphelocoma coerulescens*), piping plover (*Charadrius melodus*), rufa red knot (*Calidris canutus rufa*), whooping crane (*Grus americana*), Atlantic salt marsh snake (*Nerodia clarkii taeniata*), eastern indigo snake (*Drymarchon couperi*), green sea turtle (*Chelonia mydas*), Hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's Ridley sea turtle (*Lepiochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta)*, monarch butterfly (*Danaus plexippus*), Carter's mustard (*Warea carteri*), and Lewton's polygala (*Polygala lewtonii*). The Action Area is located within the USFWS Consultation Areas (CAs) of the West Indian manatee, crested caracara, Everglade snail kite, Florida scrub-jay, piping plover, and Atlantic salt marsh snake. There is USFWS designated critical habitat within the Action Area for the green sea turtle, loggerhead sea turtle, and rufa red knot. The Southeast U.S. distinct population segment (DPS) of the wood stork has been removed from the Federal List of Endangered and Threatened Wildlife effective March 12, 2026 (USFWS 2026). Therefore, effects to the wood stork are not considered in the PBA.

Based upon the information collected, a total of 21 federally listed and proposed listed species were reviewed to determine the potential for occurrence within the Action Area. The potential of occurrence for each species was ranked as None, Low, Moderate, or High based on the habitat requirements for each species, the presence of the habitat within the Action Area and documented occurrence of the species within one (1) mile of the Action Area. A None ranking indicates that suitable habitat is not found within the Action Area and the species has not been documented within one (1) mile of the Action Area or, alternatively, the species is considered extirpated from the Action Area. A Low ranking indicates that suitable habitat exists within the Action Area, but the species has not been documented within one (1) mile of the Action Area. A Moderate ranking indicates that suitable habitat exists within the Action Area, and the species has been documented within one (1) mile of the Action Area. A High ranking indicates that the species has been documented within the Action Area.

Table 4-1 presents the list of these federally listed and proposed listed species, their federal and state protection status, preferred habitat, habitat suitability within the Study Area, and a ranking of potential for occurrence within the Action Area.

Table 4-1 Listed Species with Potential for Occurrence within the Action Area

Species	Designated Status	Habitat Preference	Suitable Habitat within Study Area	Potential for Occurrence within Action Area
MAMMALS				
Florida panther *Puma concolor coryi*	FE	Prefer forested areas, pinelands, tropical hardwood hammocks and mixed freshwater swamp forests	No	None
Southeastern beach mouse *Peromyscus polionotus niveiventris*	FT	Primary, secondary, and occasionally tertiary sand dunes with a moderate cover of grasses and forbs	No	High
Tricolored bat *Perimyotis subflavus*	PE	Roosts in caves, tree foliage, tree cavities, and occasionally buildings and other man-made structures	Yes	Moderate
West Indian manatee *Trichechus manatus*	FE	Shallow, slow-moving waters of rivers, estuaries, saltwater bays, canals, and coastal areas	No	High
BIRDS				
Crested caracara *Caracara plancus audubonii*	FT	Wet prairies with cabbage palms, wooded areas with saw palmetto, cypress, scrub oaks, and pastures	Yes	High
Eastern black rail *Laterallus jamaicensis ssp. jamaicensis*	FT	Salt and brackish marshes with dense cover but can also be found in upland areas of these marshes	Yes	Low
Everglade snail kite *Rostrhamus sociabilis plumbeus*	FE	Large freshwater lakes and marshes; favors shallow waters, with stands of sawgrass and cattails mixed with areas of open water and with a few shrubs or low trees	Yes	High
Florida scrub-jay *Aphelocoma coerulescens*	FT	Sand pine and xeric oak scrub, and scrubby flatwoods	Yes	High
Piping plover *Charadrius melodus*	FT	Sandy beaches, sand flats, and mudflats along coastal areas	No	High
Rufa red knot *Calidris canutus rufa*	FT	Coastal marine and estuarine habitats with large areas of exposed intertidal sediments	No	Low
Whooping crane *Grus americana*	FE; EXPN	Inhabit shallow marshes and open grasslands	No	None
REPTILES				

Species	Designated Status	Habitat Preference	Suitable Habitat within Study Area	Potential for Occurrence within Action Area
Atlantic salt marsh snake *Nerodia clarkii taeniata*	FT	Saltmarsh tidal flats that contain grasses such as glasswort (Salicornia), Spartina, and Juncus, as well as scattered black mangroves in Volusia and Indian River counties along the Florida Atlantic Coast	No	None
Eastern indigo snake *Drymarchon couperi*	FT	Pine flatwoods, hardwood forests, moist hammocks, and areas that surround cypress swamps	Yes	High
Green sea turtle *Chelonia mydas*	FT	In U.S. Atlantic and Gulf of Mexico waters, found in inshore and nearshore waters from Texas to Maine, the U.S. Virgin Islands, and Puerto Rico	No	High
Kemp's ridley sea turtle *Lepidochelys kempii*	FE	Marine waters of the Gulf of Mexico and the western North Atlantic Ocean	No	High
Leatherback sea turtle *Dermochelys coriacea*	FE	Marine waters of the Atlantic; nest almost exclusively on the east coast of Florida, with the exception of a few nests on the west coast each year	No	High
Loggerhead sea turtle *Caretta caretta*	FT	Atlantic and Gulf of Mexico beaches host one of the largest loggerhead nesting aggregations in the world	No	High
Hawksbill sea turtle *Eretmochelys imbricata*	FE	Found primarily on reefs in the Florida Keys and along the southeastern Atlantic coast	No	Moderate
INSECTS				
Monarch butterfly *Danaus plexippus*	PT	Habitat depends on the availability of the larval host plant, milkweed (genus Asclepias), which can be found in a variety of habitats	No	Moderate
PLANTS				
Carter's mustard *Warea carteri*	FE	Scrub and sandhills with longleaf pine and wiregrass	No	None
Lewton's polygala *Polygala lewtonii*	FE	Oak scrub, sandhill, and transition zones between high pine and turkey oak barrens	No	None

Legend:
USFWS = United States Fish and Wildlife Service
FWC = Florida Fish and Wildlife Conservation Commission
E = Endangered
EXPN = Non-Essential Experimental Population
T = Threatened
PT = Proposed Threatened

Species	Designated Status	Habitat Preference	Suitable Habitat within Study Area	Potential for Occurrence within Action Area
(S/A) = Similarity of Appearance *None = Suitable habitat is not found within the Action Area, and the species has not been documented within one (1) mile of the Action Area or, alternatively, the species is considered extirpated from the Action Area* *Low = Suitable habitat exists within the Action Area, but the species has not been documented within one (1) mile of the Action Area* *Moderate = Suitable habitat exists within the Action Area, and the species has been documented within one (1) mile of the Action Area* *High = The species has been documented within the Action Area*				

4.2 No Effect Determinations

The official species list includes some species that, in consideration of the best available science, either do not or are not expected to occur in the Action Area. Others would not be exposed to effects of the Proposed Action due to the type of habitat that they occupy. The species listed in **Table 4-2** would not be exposed to the effects of the Proposed Action and are not considered further in this document. Proposed Critical Habitat for the green sea turtle and rufa red knot and Designated Critical Habitat for the loggerhead sea turtle within the Action Area. However, the nearest critical habitat occurs more than one (1) mile from the Study Area and would not be subject to habitat modification, lighting effects, or other direct or indirect effects associated with construction, operation, or static fire testing. The Proposed Action would have "***no effect***" on Designated or Proposed Critical Habitat.

Table 4-2 No Effect Determinations

Species	Rationale for No Effect Determination
MAMMALS	
Florida panther *Puma concolor coryi*	The Action Area does not provide suitable habitat for panthers, and no panthers have been documented in Brevard County (FWC 2026f). The Proposed Action would have "***no effect***" on this species.
BIRDS	
Piping plover *Charadrius melodus*	The piping plover was listed as threatened in 1986 (51 FR 15422). In Florida, piping plovers occur primarily in coastal habitats during the nonbreeding season, including ocean beaches, sparsely vegetated beachfronts, overwash areas, tidal flats, sandy spits, and other intertidal habitats used for foraging and roosting. Suitable piping plover habitat is not present within the Study Area. The nearest suitable coastal habitat occurs more than five (5) miles east of the Study Area. Given the absence of suitable habitat within the Study Area and the distance separating the Proposed Action from habitats used by piping plovers, the Proposed Action is not expected to result in direct, indirect, or noise-related effects to the piping plover. Therefore, the Proposed Action would have **"*no effect*"** on this species.
Rufa red knot *Calidris canutus rufa*	The USFWS listed the rufa red knot as threatened in 2014 (79 FR 73705). The species winters in Florida, where it feeds along the shoreline of sandy beaches and occasionally in salt marshes, brackish lagoons, tidal mudflats, and mangroves (Baker et al. 2020). Florida serves as an important wintering area for adult and hatch-year populations (USFWS 2024a). Suitable wintering and foraging habitat is not present within the Study Area. The

Species	Rationale for No Effect Determination
	closest wintering habitat is located over five (5) miles east of the Study Area. Given the absence of suitable habitat within the Study Area and the distance separating the Proposed Action from occupying wintering habitat, the Proposed Action is not expected to result in direct, indirect, or noise-related effects to the red knot. The Proposed Action would have "***no effect***" on this species.
Whooping crane *Grus americana*	USFWS listed the whooping crane as endangered on March 11, 1967 (48 FR 4001). The Aransas-Wood Buffalo population is the only wild and self-sustaining population of the species. These whooping cranes nest in Canada and winter along the central Texas coast. Individuals from the Aransas-Wood Buffalo population do not occur in Florida. On June 26, 2001, USFWS designated a non-essential experimental population of whooping cranes in the Eastern United States, with a geographic boundary that includes Florida (66 FR 33903). A non-essential experimental population is one that has been established within a species' historical range to aid in recovery of the species. The USFWS has determined that nonessential experimental populations are not necessary for the continued existence of a species. Individuals within these populations are treated as threatened under the ESA only when occurring on a National Wildlife Refuge or on National Park land. MINWR is within the Action Area; however, whooping cranes are not known to occur on MINWR (USFWS 2026). Whooping cranes from the Eastern migratory population are observed infrequently in Florida, with two individuals having been documented in the state (outside the Action Area) in winter 2022-2023 (International Crane Foundation 2023). Because whooping cranes are not expected to occur in the Action Area, the Project would have no effect on this species.
REPTILES	
Atlantic salt marsh snake *Nerodia clarkii taeniata*	The Atlantic salt marsh snake was listed as threatened by the USFWS in 1977 (42 FR 28165). Surveys for this species conducted between 2010 and 2012 discovered that the current distribution of the species appears limited to the coastal marshes of Volusia County, Florida (USFWS 2019a). Volusia County is not within the Action Area. Because this species is not believed to be present within the Action Area, the Proposed Action would have "***no effect***" on this species.
PLANTS	
Carter's mustard *Warea carteri*	This species occurs in both sandhill and scrubby flatwoods habitats, but populations are not densely or evenly distributed across the known range. The FNAI database contains historic occurrence records within Brevard County, Florida, from 1987. However, the FNAI and USFWS presently consider Carter's mustard extirpated from Brevard County (FNAI 2000; USFWS 2021a). Because the species is considered extirpated from the Action Area, the Proposed Action would have "***no effect***" on this species.
Lewton's polygala *Polygala lewtonii*	This species occurs primarily in sandhill habitats and may also be found in scrub areas that probably were former sandhill areas prior to logging and fire suppression activity (USFWS 2020a). There is one record for Lewton's polygala in Brevard County, Florida. However, the record was based on a misidentification (USFWS 2020a). Further, no plants of this taxon were observed during subsequent surveys on Merritt Island or mainland Brevard County (Schmalzer et al. 2003 as cited in USFWS 2020a). Because the species is unlikely to occur in the Action Area, the Proposed Action would have "***no effect***" on this species.

5.0 EFFECTS OF THE ACTION

5.1 Analysis Framework

This section presents an analysis of potential direct and indirect effects on federally listed and proposed listed species from implementation of the Proposed Action. Potential activities that may affect federally listed and proposed listed species include construction activities and daily operations.

Direct effects are the direct or immediate effects of the Proposed Action on the species or its habitat. Direct effects result from the Proposed Action including the effects of interrelated actions and interdependent actions. Indirect effects are those that are caused by the Proposed Action and are later in time, but still are reasonably certain to occur (e.g., attraction of predators due to development and human presence). All direct and indirect Proposed Action effects on federally listed and proposed listed species have been further classified and evaluated based on their anticipated longevity (i.e., temporary or permanent effects). Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, and interdependent with, that action. Interrelated actions are those that are part of a larger action and depend on the larger action for its justification. Interdependent actions are those that have no independent utility apart from the action under consideration. The SpaceX campus expansion includes all development proposed under this Proposed Action; therefore, there are no interrelated or interdependent actions considered in this review.

As they relate to the federally listed species considered in this PBA, direct and indirect effects from proposed activities within the action area have been evaluated herein based upon: (1) an understanding of the methods and equipment that would be used during construction and operations within the SpaceX campus expansion, (2) knowledge of the potential for such methods and equipment to disturb the natural resources on which the subject species depend, and (3) awareness of the types of effects that have resulted from similar actions in the past.

Direct effects from the Proposed Action for which consequences are reasonably foreseeable include habitat loss, habitat degradation, disruption from an increase in vehicular traffic, and visual disturbance to wildlife movement and sight lines from vertical structures, roadways, and lighting. Indirect effects may include spread of invasive species causing further habitat degradation, long-term increase in vehicular traffic, long-term increase in ambient noise from operational activities and increase in traffic, and long-term disruption from lighting.

5.1.1 Habitat Loss

Habitat loss would occur as the phased site developments are constructed. If all proposed developments shown in **Figure 2-1** were to occur, approximately 400 acres of undeveloped available habitat would be converted to developed lands within the Study Area. Vegetation clearing and other construction site preparation activities may remove habitat features (e.g., cover, forage, dens, roosts) and reduce the amount of habitat available within the affected area. Habitat loss may alter the distribution of a species by reducing the amount of suitable habitat available within an area. Effects to a species

from habitat loss would generally occur only where occupied habitat is affected and the loss reduces the availability of resources used for breeding, feeding, sheltering, or movement. The likelihood and extent of such effects depend on the species' use of the affected habitat and the availability of alternative suitable habitat in the surrounding landscape.

5.1.2 Habitat Degradation

The Proposed Action activities may temporarily or permanently reduce the functional quality of habitat without completely removing the habitat from the Action Area. Habitat degradation may occur where changes to hydrology, vegetation structure, or disturbance reduce the stability of habitat for use by wildlife. For example, construction or development activities could result in secondary effects to nearby habitats if seasonal water levels or flow patterns are altered, potentially affecting the distribution or extent of upland or wetland conditions. When severe, habitat degradation can result in functional habitat loss. Similar to habitat loss, habitat degradation may alter local species distribution or reduce species abundance through significant impairment of essential life-history behaviors such as feeding, breeding, sheltering, or movement.

Hydrology within and adjacent to the Action Area is highly modified and actively managed through an existing network of canals, ditches, and associated control structures (e.g., perimeter conveyance features surrounding the campus expansion area). Large-scale upstream and downstream hydrologic effects are not anticipated. However, localized and short-term changes in hydrologic conditions could occur during construction, maintenance, or modifications of existing stormwater infrastructure. The Proposed Action would include stormwater management intended to maintain post-construction conditions and protect wetland functions. Additionally, wetland mitigation would be provided where necessary to offset wetland impacts due to the Proposed Action. Nonetheless, short-term and localized reductions of habitat function could occur and could affect habitat quality.

The movement or introduction of invasive plant and animal species within the Action Area could degrade habitat in areas where nonnative species are currently limited or absent. An increase in invasive species could reduce habitat quality and function, which may result in direct or indirect effects on federally listed or proposed species through reduced suitability of affected habitats for essential life-history behaviors. Invasive species including Brazilian peppertree, Old World climbing fern (*Lygodium microphyllum*), and cogongrass (*Imperata cylindrica*) are already present within portions of the Action Area. The Proposed Action is not expected to introduce new invasive species; however, these species may be spread through construction activities, including ground disturbance, movement of equipment, or shipment of materials and supplies to the proposed facilities. Increase and spread of invasive species degrade habitat by displacing native vegetation, reducing plant community diversity, and diminishing the availability of native food resources and suitable nesting, roosting, or cover habitat.

5.1.3 Vehicular Traffic

Construction of new roadways would introduce additional vehicle and human activity within the Action Area. When fully operational, SpaceX expects approximately 7,500

vehicle trips per day to and from the SpaceX Operations Area. An increase in vehicular traffic during construction and routine operations would increase human activity within the Action Area and could result in direct effects, such as the potential for wildlife-vehicular interactions. These effects would be limited to areas immediately adjacent to roadways.

These direct effects could also result in indirect effects by altering habitat conditions adjacent to roadways over the long term. Increased roadway infrastructure and the associated traffic would introduce localized disturbance near transportation corridors. Such changes may reduce the suitability of habitats immediately adjacent to roadways and limit their use by wildlife relative to baseline conditions. Any indirect effects would be localized to areas near roadways and would not be expected to substantially alter overall habitat availability or function within the Action Area.

5.1.4 Noise Disturbance

Noise events associated with construction and facility operations are generally thought to result in short-term behavioral responses, but sustained noise from the increase in use may indirectly render habitat unusable.

Noise from static fire testing is best described as an exposure to high-intensity noise with much of the energy in the low-frequency spectrum occurring over a relatively short duration (each exposure lasting several seconds to a few minutes, representing acute rather than chronic exposure) and repeating relatively infrequently and irregularly.

The body of scientific study has identified the following means by which noise and overpressure may, under certain circumstances, adversely affect wildlife. Because noise produced by static fire-related activities tends to be intense, acute, irregular, and infrequent, the types of impacts to wildlife identified below are most likely. Communication masking, another frequently considered type of impact in the scientific literature, is more associated with chronic or continuous noise exposure and therefore not strongly relevant to launch-related noise.

- Hearing Loss: When the frequency range of a loud noise source overlaps with the hearing range of an animal, such noise may cause temporary or permanent hearing loss (i.e., acoustic overexposure causing threshold shift in hearing sensitivity). Typically, such impairment involves certain frequencies of sound rather than the complete loss of hearing ability. Most hearing loss from acoustic overexposure is temporary; hearing sensitivity may recover with time. Hearing loss may be permanent with greater duration, repetition, and/or intensity of sound exposure. Hearing loss may be caused directly by the physical pressure of sound waves on the structure of the ear or indirectly by physiological changes such as reduced blood flow, oxidative stress, inflammation, and endocrine changes. Hearing loss has been demonstrated in some laboratory or captive studies of animals, with most studies involving continuous or repeated exposure to high-intensity noise for many hours or even days. Hearing damage in wildlife in a natural setting has been inferred from these studies but not demonstrated under field conditions (Dooling and Popper 2007; Clark 1991; Engel 2024; Shannon et al. 2016).

- Stress Responses: Physiological stress, such as the production of stress hormones, elevated heart rate, and neurological change, can decrease individual health (Arcangeli et al. 2022; Erbe, Dent, et al. 2022). Decreased fitness consequences from physiological stress may include increased susceptibility to disease, decreased body condition, or impaired mental acuity, which may lead to reduced reproduction or early death. Physiological stress may cause changes in animal behavior, such as reduced predator vigilance, reduced foraging, reduced communication, and reduced caretaking of young that then may influence reproductive success and mortality (Erbe, Dent, et al. 2022). Francis and Barber (2013) note that a direct link between increased physiological stress due to noise exposure and decreased survival or reproductive success has not been shown in wild animals.
- Startle Responses: Noise that is infrequent, abrupt, and unpredictable can trigger threat-avoidance behavior such as fleeing, hiding, and flushing (Francis and Barber 2013). Startle responses may also include assuming alert postures. Startle responses interrupt other behaviors, such as foraging, resting, or care of young. While the startle response is a behavioral adaptation to reduce mortality from potential threats in the environment, repeated startling may accumulate markers of physiological stress or substantially decrease engagement in other important life history behaviors (Erbe, Dent, et al. 2022).
- Behavior Changes: Some animals change their behavior to avoid or adapt to noise exposure. Behavioral changes can include habituation, altered communication patterns, or avoidance of noisy areas. Habituation may indicate that an animal experiences less stress when exposed to a noise that is not an indicator of actual predation risk or other imminent harm. Other behavioral adaptations to noise may include shifting the timing or frequency range of calls to reduce overlap with background noise or avoiding or limiting use of noisy habitats. These mitigating behaviors may not fully address potentially adverse impacts from noise exposure and can also be indicators of habitat loss affecting wildlife populations (Erbe, Dent, et al. 2022; Duquette et al. 2021; Kok et al. 2023; Shannon et al. 2016).

Noise contours of the ASEL, maximum A-weighted instantaneous sound pressure level (L_{Amax}) and unweighted maximum instantaneous sound pressure level (L_{max}) are shown in the figures below.

Figure 5-1. A-Weighted Sound Exposure Level Contours

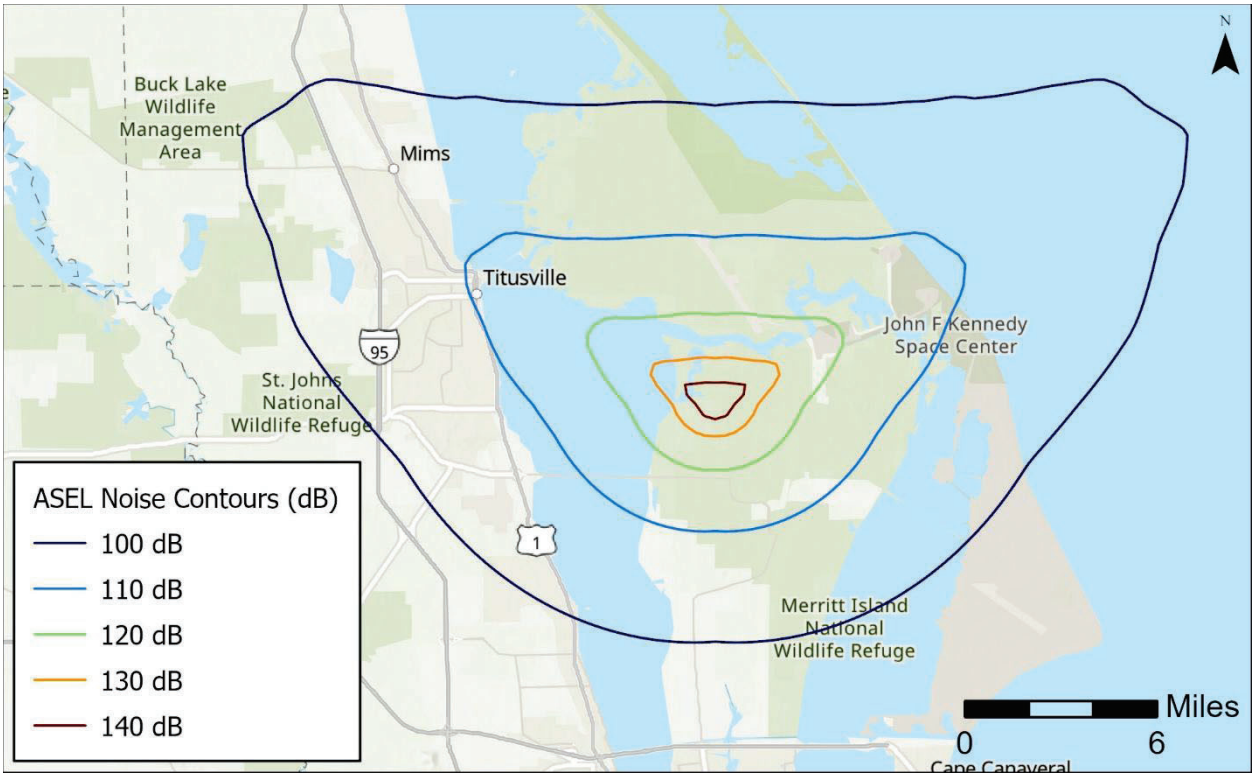


Figure 5-2. A-Weighted Maximum Instantaneous Sound Pressure Level Contours

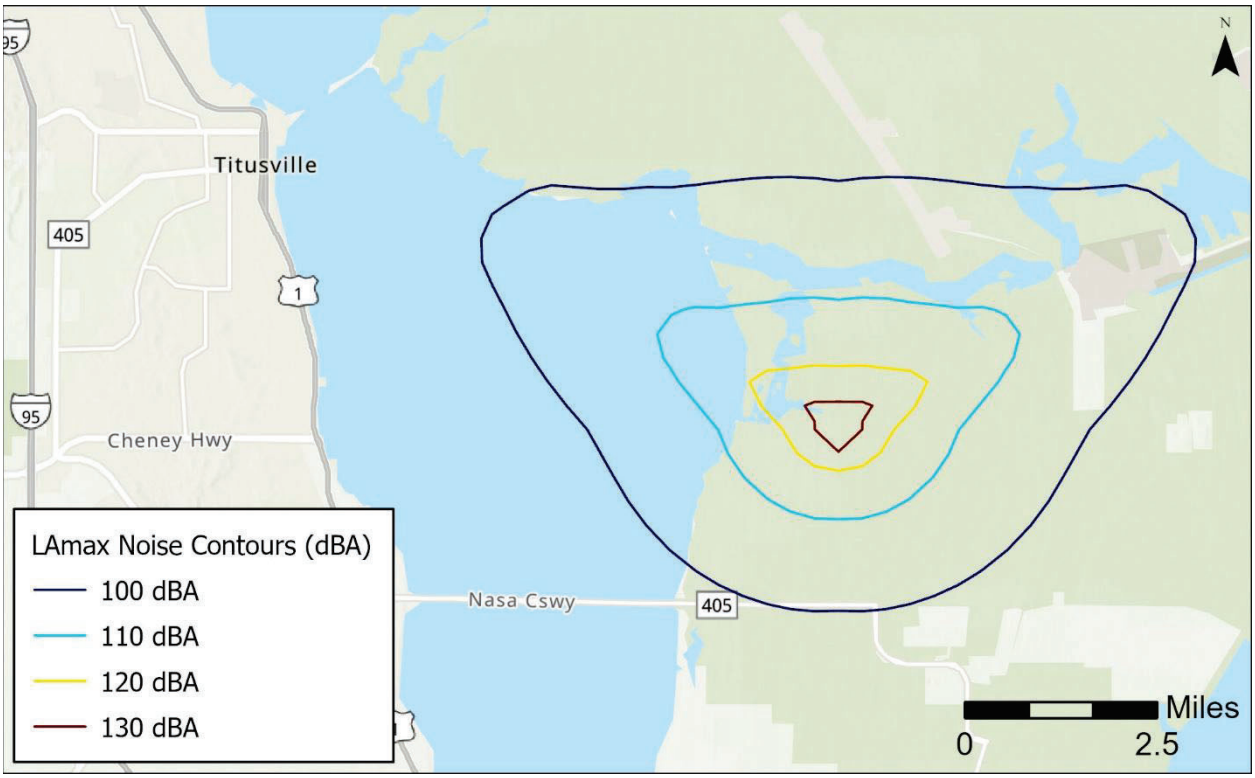
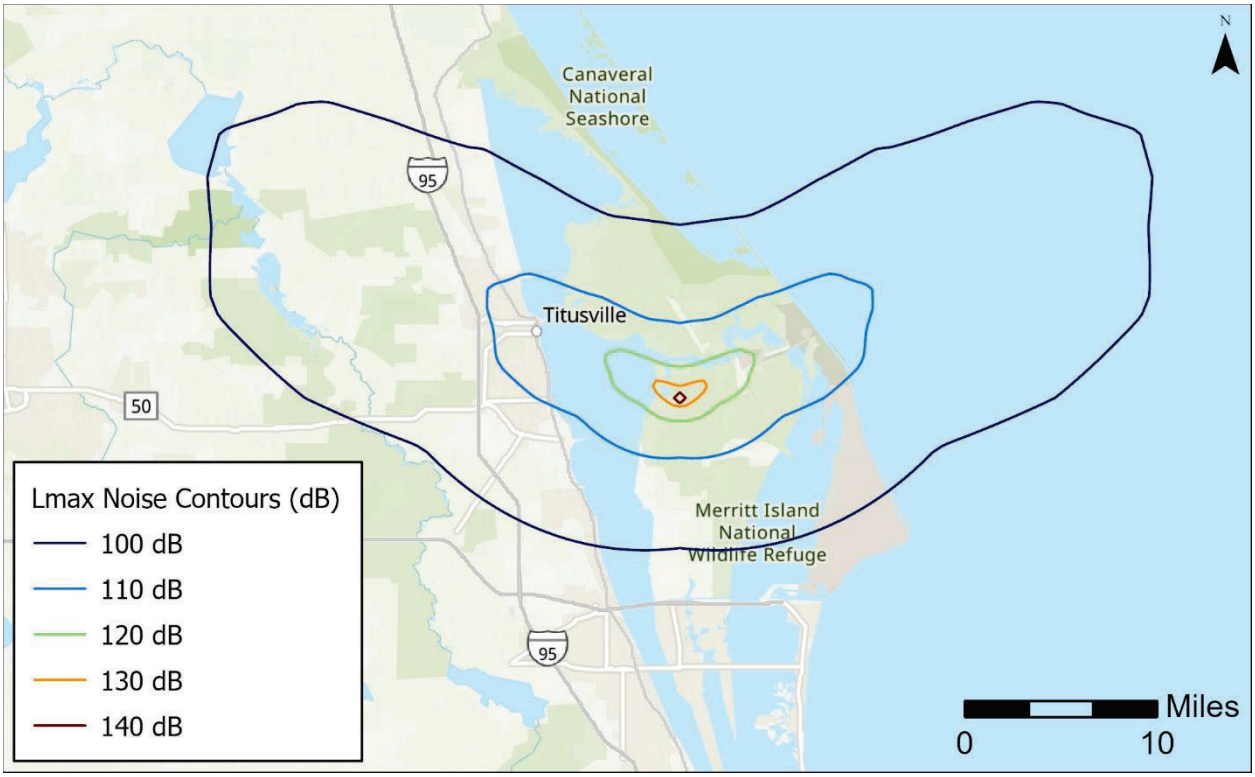


Figure 5-3. Unweighted Maximum Instantaneous Sound Pressure Level Contours



5.1.5 Visual Disturbance

During daylight hours, construction activities within the Action Area that involve large machinery, such as cranes, would be visible at a distance. Dense vegetation and other existing developments would obstruct the visibility of the construction activities. Although construction activities may cause visual obstruction, they are considered temporary and would not have a long-term effect on species. Vertical structures up to 400 feet in height may be constructed within the proposed development area These vertical structures would likely require lighting and, therefore, could have a long-term effect on species such as nesting sea turtles. Construction activities may continue into non-daylight hours and could require artificial lighting. The lighting required for construction would be temporary and limited to the immediate vicinity of the expanded lease area. Additional permanent lighting would be needed for operations at the facilities. Night lighting may disrupt hatchling emergence from sea turtle nests. Hatchlings drawn toward artificial light sources are responding to the same instinctive cues that typically orient them seaward.

Artificial lighting may also result in abandonment of nesting and roosting areas by terrestrial birds. Inappropriate lighting would not be expected to result in adverse effects to mammal species. USFWS-approved sea turtle lighting would be utilized within the expanded SpaceX Campus.

5.2 Cumulative Effects

"Cumulative effects" under the ESA are those effects of future non-Federal activities within the Action Area, i.e., cumulative effects. "Cumulative effects are those effects of

future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include but are not limited to: existing plans for the activity; and any remaining economic, administrative, and legal requirements.

The area affected by construction is located entirely within federal lands. A review of publicly available databases and planning documents was made of the Action Area to identify future state and private activities that, when combined with the Proposed Action, may result in cumulative effects to listed species and critical habitat listed in this PBA with Likely to Adversely Affect determinations. No projects were identified that meet the criteria of being both reasonably foreseeable and exclusively a state or private activity that did not require any type of federal permit. Therefore, according to the definition of cumulative effects in 50 CFR § 402.02, there would be no cumulative effects to the Florida scrub-jay or eastern indigo snake within the Action Area beyond those analyzed in this BCA.

5.3 Southeastern Beach Mouse

5.3.1 Biology and Habitat

The Southeastern beach mouse (*Peromyscus polionotus niveiventris;* SEBM) is distributed along the Florida Atlantic coast from Volusia County to Martin County (USFWS 2019b). SEBM occupy primary and secondary habitats within their range. Primary habitat is characterized by foredunes, transitional dunes, and coastal scrub dunes typically vegetated by sea oats and other salt-tolerant vine and grass species. Secondary habitats are interior scrub and other natural and human-altered landscapes landward of dunes that provide refugia habitat and may support species resource needs, movement corridors, and/or population extensions (Johnson and Barbour 1990). The SEBM utilizes the scrub adjacent to these dunes for digging burrows, which are generally found on the sloping side of a dune at the base of vegetation and are used for refuge, nesting, and food storage (USFWS 2019b).

Overall, little is currently known about the behavior of SEBM (FWC 2026a). Studies have established that SEBM feed primarily on plant seeds and insects associated with coastal dune habitats (FWC 2026a). Breeding by the SEBM generally peaks in the winter season, with gestation lasting 23 days, and typically litters consist of 3 to 4 individuals. The weening period typically lasts 18 days, and the SEBM reaches sexual maturity at 30 days old (FWC 2026a).

5.3.2 Environmental Baseline

The SEBM was listed as threatened on May 12, 1989 (54 FR 20598). Primary threats include habitat loss due to development, hurricanes, and predation by native and non-native species, such as cats (FWC 2026a). The SEBM is known to occur on KSC and CCSFS, where a metapopulation exists with at least four identified subpopulations (FAA 2020). This metapopulation occurs in federally protected lands along the beaches of MINWR and KSC (USFWS 2019b). At KSC, the SEBM typically occupies frontal dunes, and the nearby

scrub habitat is not deemed suitable for the SEBM without intensive coastal dune management (USFWS 2019b). SEBM were documented approximately five (5) miles east of the Study Area July 2018 (Integrated Mission Support Services 2019). No studies have been conducted on SEBM abundance within the Study Area. SEBM faces many threats, which include habitat loss due to development, hurricanes, and predation by native and non-native species, such as cats (FWC 2026a).

5.3.3 Effects of the Action

Suitable habitat for the species, in the form of traditional dunes and coastal scrub dunes, has not been identified in the Study Area. The Study Area is located approximately five (5) miles west of the beach frontal dune and would not affect primary habitat at the beach frontal dune. Additionally, various features of existing and proposed development, including roadways, launchpad infrastructure, and large bodies of water between the Study Area and the nearest beach frontal dunes, would dissuade the species from traveling from the coastline to the construction within the Study Area. Construction within the Study Area would not create any degradation or loss to suitable habitat known to be used by this species.

SEBM may occur elsewhere in the Action Area, potentially occupying suitable coastal dune and scrub habitat. Therefore, the introduction of static test firing activities within the Study Area has the potential to result in an increase in exposure of SEBM to such events, which could, in turn, disturb (e.g., elicit a stress response) individuals that may be present within range of static test firing noise disturbances near the Study Area. Similar launch- and test-related disturbances currently occur throughout portions of KSC and CCSFS, and SEBM occurring in the Action Area during static test fire are expected to respond similarly as they do under current operations.

Oddy et al. (1999) observed no direct impacts to SEBM as a result of normal launch operations of the Titan, Atlas, or Delta launch complexes. Direct impacts to SEBM habitat as a result of the explosion of the Delta rocket in January 1997 were documented and the alteration of habitat resulted in a shift in use with SEBM moving to newly burned areas (Oddy et al. 1999). These studies were conducted when launch and static test fire frequency were lower.

Short duration, episodic, high-intensity sound exposure studies are largely lacking, particularly with field studies that evaluated behavioral responses in rodents. In one study, rats exposed to 104 dB showed evidence of change in the area of the brain where much of the processing of auditory information occurs (Szczepaniak & Møller, 1996). Stimulation of this part of the brain is associated with tinnitus (i.e., ringing sound). Tinnitus could potentially cause an increased susceptibility to predation, as hearing is generally important for small mammal predator avoidance. In another study, rats exposed to noise at 104 dB showed evidence of altered response in a certain type of neuron (Goble et al., 2009). Mice exposed to noise of 123 dB in a laboratory setting experienced hearing loss and impaired spatial learning and memory (Liu et al., 2016). As shown in Section 5.1.4, the maximum sound pressure level within occupied SEBM habitat is expected to be between 100 and 110 dB. Given these levels and the existing body of literature on , in concert with ongoing launch activity closer to occupied habitat considered in the

Environmental Baseline, the noise from the Proposed Action would result in insignificant impacts to SEBM.

There are currently no existing studies on the effects of substrate vibration and burrow collapse for the southeastern beach mouse specifically. One vibration study for the San Bernardino kangaroo rat (*Dipodomys merriami parvus*) involved constructing artificial burrows 5 to 10 feet from haul roads and measuring sand and soil collapse into the burrows. The study found that vibrations induced by truck haul traffic do not pose risks to the stability of San Bernardino kangaroo rat burrows at distances of 5 to 10 feet from the edge of the road (Barneich, 2004). Given the distance of suitable habitat from the static fire stand (over 6 miles) and noise levels received at that distance, burrow collapse is discountable.

There is no known suitable habitat for the SEBM within the Study Area; therefore, disturbances in and directly adjacent to the Study Area during construction and operation, such as noise, lighting, and vibrations, are unlikely to affect SEBM. The proposed introduction of static test firings would create more frequent occurrences of related activity, noise, lighting, and vibrations within the Action Area; however, this species is known to be tolerant to such activities, and effects of these increases are unlikely to affect populations of SEBM that may occur in Atlantic coastal dunes and scrub within the Action Area. Due to the distance of suitable and occupied habitats for SEBM from the static test fire location and the Study Area; the Proposed Action "***may affect, but is not likely to adversely affect***" the SEBM.

5.3.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.3.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the southeastern beach mouse. Therefore, no population-level biological consequences would occur.

5.4 Tricolored Bat

5.4.1 Biology and Habitat

The tricolored bat roosts singly or in small groups in caves, tree foliage, and cavities, and occasionally buildings and other human-made structures (e.g., culverts, bridges) (FWC 2026b) (USFWS 2021b). In Florida, female tricolored bats give birth to 2 pups in May or June (FWC 2026b).

Tricolored bats prefer wooded riparian areas for foraging, often flying along streams or ponds and may prefer landscapes with a mosaic of relatively open and closed canopy areas, with forest edges and tree lines used for foraging and closed canopy woodland used for travel (USFWS 2021b). Tricolored bats are known to use small forest patches and linear tree lines, with no known minimum patch size threshold (USFWS 2024b). During winter, tricolored bats hibernate in caves and mines; however, in the southern U.S., where caves are sparse, the species often hibernate in road-associated culverts and sometimes in tree cavities and abandoned water wells (USFWS 2021b).

The year-round active range for tricolored bats includes the entire state of Florida (USFWS 2024b). The range of the tricolored bat in the United States is organized into three Representation Units (RPU): Northern, Eastern, and Southern (USFWS 2021b). Tricolored bats found within the Southern RPU, which includes all of Florida, exhibit shorter hibernation lengths, increased winter activity, and utilization of culverts as hibernacula (USFWS 2021b). Tricolored bats summer in a variety of landscapes, but they prefer areas along waterways, within open woodlands, or along forest edges (Amelon 2006). These bats roost in live and dead leaf clusters of deciduous hardwood trees and hibernate during the winter in caves and mines (USFWS 2023a). This species exhibits high site fidelity, with many individuals returning year after year to the same hibernaculum (USFWS 2023a). At the southern end of their range, caves are sparse, so they hibernate in human-made structures such as culverts instead (USFWS 2023a). Migration from winter hibernacula to summer foraging grounds in the spring is not well studied, but the maximum migration distance recorded was 151 miles (Samoray et al. 2019).

5.4.2 Environmental Baseline

The tricolored bat was proposed endangered by USFWS on September 14, 2022 (87 FR 177). The species is known to occur in most areas of Florida, including Brevard County. However, since they are rarely encountered within the state, tricolored bats are considered uncommon in Florida (Evans et al. 2017). Main threats to the species include white-nose syndrome, wind energy development-related mortality, climate change, and habitat loss (USFWS 2021b).

According to iNaturalist (2026) and FNAI (2026), there are no known records of the species in the Action Area. A recent study on tricolored bats by Smith et al. (2022) found evidence that suggests tricolored bats at the southern edge of its range (i.e., south Florida) may move north to find cooler hibernacula to support torpor and reproductive success. Tricolored bats have been identified during acoustic surveys on KSC, but were not identified within the Study Area. The species may utilize culverts or tree cavities in the Action Area as winter hibernacula. It is anticipated that some culverts may require replacement or upgrade to accommodate the roadway construction and development.

5.4.3 Effects of the Action

The Proposed Action would impact approximately 155 acres of herbaceous/shrub uplands and approximately 15 acres of upland hardwood or mixed canopy forests within the Study Area. This removal is considered a direct effect through potential habitat loss. Localized and short-term changes in hydrologic conditions could occur during construction, maintenance, or modifications of existing stormwater infrastructure. Short-term and localized reductions of habitat function and quality may occur on upland roosting habitats within the Action Area through an increase in wetland seasonal high-water levels in-turn impacting the availability of upland roosting habitats. However, the Proposed Action would include stormwater management intended to maintain post-construction conditions and protect wetland functions. Additionally, wetland mitigation would be provided where necessary to offset wetland impacts due to the Proposed Action. Therefore, these effects are extremely unlikely and are considered discountable.

During and after construction there would be both an increase in traffic volume and change in traffic patterns. The expected increase in traffic by approximately 7,500 vehicles trips per day could potentially increase the likelihood of bats being killed by vehicular collision and/or deter them from utilizing available foraging habitats within and near the Action Area. Additionally, the increase could also result in indirect effects by altering habitat conditions adjacent to roadways by introducing localized disturbance near transportation corridors. Such changes may reduce the suitability of habitats immediately adjacent to roadways and limit their use by wildlife relative to baseline conditions. Any indirect effects would be localized to areas near roadways and would not be expected to substantially alter overall habitat availability or function within the Action Area. Therefore, these effects would be unlikely to reach the scale of take and are considered insignificant.

Studies of noise impacts to bats have detected changes in the behavior of some species in how they use habitat adjacent to highways with traffic noise, suggesting that bats may not use noisy environments as often as quiet environments (Bednarz 2021; Shannon et al. 2016). However, while research on noise impacts to wildlife indicate that even relatively low-level noise can elicit a change in wildlife behavior or habitat use (Shannon et al. 2016), this does not predict with reasonable certainty how individual species will respond to specific kinds of noise in specific environmental settings. Researchers have noted that the effects of anthropogenic noise on wildlife is often conflated with other elements of the activity causing the noise, like visual disturbances or physical habitat modification, and do not often indicate a clear or discrete chain of causation between particular environmental consequences and observed changes (if any) in wildlife populations (Ortega 2012; Shannon et al. 2016). Therefore, effects from an increase in noise are considered insignificant.

Roosting and foraging habitat for tricolored bats is not a limiting factor for the species across the landscape, particularly in the context of dramatically reduced bat abundance following the introduction of white-nose syndrome. Therefore, mobile individuals, if disturbed by construction, are expected to move to adjacent or nearby suitable habitats. Nonvolant individuals may be exposed to the increase in short-lived, intermittent disturbances related to the Proposed Action.

The Proposed Action would remove approximately 15 acres of the 250 acres of upland hardwood or mixed canopy forest within the Study Area. This equates to a removal of approximately 4.6% of the available roosting habitat within the Study Area. For conference purposes under ESA Section 7(a)(4), NASA anticipates that the Proposed Action is not likely to jeopardize the continued existence of the proposed tricolored bat.

5.4.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.4.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the tricolored bat. Therefore, no population-level biological consequences would occur.

5.5 West Indian Manatee

5.5.1 Biology and Habitat

The West Indian manatee (*Trichechus manatus*) inhabits rivers, bays, canals, estuaries, and coastal areas where it moves between fresh, saline, and brackish waters. Florida's estuaries, freshwater lakes, springs, and rivers provide seagrass and freshwater aquatic vegetation, which are the species' primary food sources (FWC 2026c).

Manatees require warm water for survival and cannot survive prolonged exposure to very cold water (FWC 2026c).

5.5.2 Environmental Baseline

The USFWS lists the West Indian manatee as threatened (32 FR 4001). Main threats to the species are collisions with boats and loss of warm water habitat (FWC 2026c). Due to the lack of marine habitats the species does not occur in the Study Area but occurs within suitable habitat within the Action Area. Surveys funded through NASA have been conducted regularly within the Action Area since 1984, and surveys are also conducted regularly by the State of Florida (Edwards and Ackerman 2016, NASA 1989, FWC 2025). Results of these surveys contain multiple records of the West Indian manatees within waters immediately adjacent to the Action Area, as recent as Summer 2025. These manatees were located in Indian River, Banana River, and Pintail Creek (FWC 2025).

5.5.3 Effects of the Action

The Study Area does not contain suitable habitat for the West Indian manatee. Direct or indirect effects from development of the Proposed Action are not anticipated. The Proposed Action will, however, generate vibration and noise associated with engine testing that may affect the West Indian manatee. Acoustic energy from in-air noise does not effectively cross the air-water interface, and the majority of noise is reflected off the water surface. In addition, underwater sound pressure levels from in-air noise are not expected to reach or exceed threshold levels for injury to any marine species. Noise impact from operations is expected to be minimal, based on previous testing programs, and its effects are expected to be insignificant (USFWS 2020b).

West Indian manatees that surface to breathe at the same time test firing occurs may be temporarily exposed to related noise, lighting, or vibration. This exposure will be intermittent, occasional, and short-lived. Therefore, related effects (e.g., startling resulting in returning underwater prematurely) are expected to be minimal and insignificant. The Proposed Action "***may affect, but is not likely to adversely affect***" the West Indian manatee.

5.5.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.5.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the manatee. Therefore, no population-level biological consequences would occur.

5.6 Audubon's Crested Caracara

5.6.1 Biology and Habitat

Audubon's crested caracaras are found throughout south-central Florida in wet prairies associated with cabbage palms, mixed upland hardwoods associated with palmetto, cypress, scrub oaks, improved pastures, dry prairies interspersed with marshes, shrub-swamp, grasslands, and pinelands. They prefer open areas with thin ground cover to allow them to get a running start before flight (Cornell Lab of Ornithology 2024a). In Florida, Audubon's crested caracaras typically build nests in cabbage palms, the tallest available vegetation, or tree-like structures with a wide view in generally open prairie or pasture with low density scattered brush (Morrison and Dwyer 2023). The species' global distribution includes Texas, Arkansas, Mexico, Cuba, and Panama (FWC 2026d).

The Audubon's crested caracara is a non-migratory resident across its range. In Florida, breeding has been observed from September to April and appears to peak from January to March. Clutch size is typically 2-3 eggs and rarely 4. The incubation period is 30-33 days, nestling period is 42-56 days, and young may remain with parents for several weeks after fledging. The species keeps a strict territory, are monogamous for several years, and returns to its initial nesting site for several breeding cycles (Morrison and Dwyer 2023).

5.6.2 Environmental Baseline

Audubon's crested caracara is synonymous with the northern crested caracara (*Caracara cheriway*). Although *Caracara plancus audubonii* is not currently recognized as a valid subspecies, the species name (i.e., Audubon's crested caracara) is retained in the Federal Register and Florida Statutes for the Florida population because it was the name at the time of that population's federal listing as threatened (52 FR 25229; July 6, 1987). Main threats to the species include habitat loss due to urban development and agriculture, vehicle strikes, and illegal take (FWC 2026d).

Historically, Audubon's crested caracara was a common resident from northern Brevard County, south to Fort Pierce, Lake Okeechobee, and Hendry County (USFWS 1999) conforming closely to original major prairie ecosystems in southcentral Florida (Morrison 1996). The population and distribution of the species decreased because of habitat conversion to agriculture, residential, and commercial uses in the early to mid-20th century (Layne 1996; Humphrey and Morrison 1997; Morrison 1999; USFWS 1999; Barnes 2007, Dwyer 2010). By the time Audubon's crested caracara was listed in 1987 its range was reduced to a core of five counties (Glades, Desoto, Highlands, Okeechobee, and Osceola) with isolated records in three other counties (Charlotte, Hardee, and Polk) (USFWS 1987). However, between its listing in 1987 and 1999, records of Audubon's crested caracara grew to include 15 counties (Charlotte, Collier, Desoto, Glades, Hardee, Hendry, Highlands, Indian River, Martin, Monroe, Okeechobee, Osceola, Palm Beach, Polk, and St. Lucie; USFWS 1999). Presently, there have been breeding season occurrences of the species throughout the state.

In Florida, up to 80% of nesting pairs of Audubon's crested caracaras are found on private cattle ranches, likely due to the presence of shorter grasses that provide increased visibility, thus reducing vulnerability to predators (Rose and Boughton 2019). The Action

Area does not contain any rural pastureland or grassland preferred by Audubon's crested caracara; however, there is available foraging or nesting habitat. According to eBird, there has been one documented observation of Audubon's crested caracara within 1 mile of the Action Area (eBird 2026). There are no records of Audubon's crested caracaras nesting or occupying habitat within the Action Area, and no formal surveys have been conducted within the Action Area.

5.6.3 Effects of the Action

The Proposed Action would impact approximately 20 acres of wetlands within the Study Area which have a presence of cabbage palms suitable for nesting. The Proposed Action would also impact approximately 75 acres of marsh, prairie, and shrub wetland systems suitable for foraging within the Study Area. Indirect effects to Audubon's crested caracara could include habitat degradation from localized and short-term changes in hydrologic conditions, movement and spread of invasive plant species during implementation of the Proposed Action, altered habitat conditions from the increase in traffic, short-term noise events associated with construction and operations, or visual disturbances from artificial lighting. However, there are no known caracaras documented within the construction footprint. Therefore, these indirect effects are considered discountable.

If individual Audubon's crested caracaras were to enter the Study Area during construction, they could experience short-term behavioral disturbance (e.g., temporary avoidance). Such disturbance would be limited in duration and extent and would not be expected to interfere with breeding behavior or the establishment of nesting territories. Any disturbance to Audubon's crested caracaras during construction would be temporary, localized, and minor in nature. Accordingly, these effects are considered insignificant.

Individuals present at the time of static fire tests could be disturbed by noise depending on their proximity to the activity, but any temporary alterations in feeding or sheltering would not significantly disrupt normal caracara behavioral patterns. Given the rarity of caracaras within the Action Area and the low probability of an individual to be present at the time of a static fire event, effects to caracaras from the Proposed Action are extremely unlikely to occur and are considered discountable.

Thus, the Proposed Action "***may affect, but is not likely to adversely affect***" Audubon's crested caracara.

5.6.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.6.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the Audubon's crested caracara. Therefore, no population-level biological consequences would occur.

5.7 Eastern Black Rail

5.7.1 Biology and Habitat

Eastern black rails live in marshes of all kinds, including riparian, coastal, saltmarshes, and impounded wetlands. Plant structure, vegetation height, and vegetation density (versus plant species composition) may most accurately predict habitat suitability, and potentially, species presence, as the species requires dense vegetative cover for movement below the canopy (USFWS 2024d).

Eastern black rails tolerate a few shrubs but are absent from woody or shrub dominated areas. Eastern black rails often occur in the ecotone between deeper marsh and higher ground or in a matrix of wetlands across the broader landscape. In central Florida, typical habitat is wet prairies and ephemeral marshes with mixed grasses and herbaceous species. In and around Lake Okeechobee they use sand cordgrass (*Spartina bakeri*), while in the Everglades they appear to prefer sawgrass (*Cladium jamaicense*) and possibly muhly grass (*Muhlenbergia capillaris*). Eastern black rails forage on seeds and various small (<1 centimeter (cm)) aquatic and terrestrial invertebrates, especially insects. They breed in tidal wetlands or freshwater wetlands with suitable hydrology. They occur in areas with sheet flow or moving water and avoid stagnant water. Eastern black rails prefer areas with micro topographical variation, and adults prefer moist soil to 6 cm deep, whereas chicks use areas with moist soil to 2 cm deep. Eastern black rails also require adjacent areas of higher elevation (i.e., the wetland-upland transition zone) with dense cover to survive high water events due to the propensity of juvenile and adults to walk and run rather than fly. Flooding is a frequent cause of nest failure. For nests to be successful, water levels must be below the nests during egg laying and incubation, which occurs from approximately May through the end of August. After hatching, the chick stage lasts approximately 42 days, after which eastern black rails have obtained juvenile plumage and are capable of flight (USFWS 2021c).

Eastern black rails prefer habitat along the Atlantic Ocean and Gulf of Mexico coastlines, where they defend up to 10 acres of territory. During the breeding and wintering seasons, eastern black rails fly very little. They will typically flush for only a short distance when pursued but mostly remain on the ground and run quickly through dense vegetation (USFWS 2019c).

Due to their relatively small size, habitat preferences, and secretive nature, little is known about the species' breeding behavior. However, the species is known to build nests on taller vegetation a few inches off the ground, avoiding water inundation. Clutch size may be anywhere from 4-13 eggs, with females laying 1-2 clutches per year (Cornell Lab of Ornithology 2024b).

5.7.2 Environmental Baseline

The USFWS listed the eastern black rail as threatened on November 9, 2020 (85 FR 63764). Main stressors impacting the species include habitat degradation, loss, and fragmentation due to climate change; ground- and surface water withdrawals; incompatible land management techniques (e.g., poorly timed prescribed burns,

intense grazing or haying); and natural events such as floods and hurricanes (USFWS 2019c).

The USFWS has no recent records of confirmed eastern black rail breeding in Brevard County, which encompasses the entire Action Area, but the species may occur in the Action Area year-round (USFWS 2019c). During 2022 breeding surveys, black rails were detected within the Action Area but approximately 3.7 miles southeast and 9.5 miles northwest of the Study Area. During the black rail playback surveys, only three (3) encounters of eastern black rail were documented throughout the KSC/MINWR survey area (NASA Environmental and Medical Contract [NEMCOM] 2023). There are no eBird (2026) reports of black rails near the Action Area. Additional records within the region include one record of a single individual documented in MINWR in May 2014 and known records of the species from St. Johns National Wildlife Refuge in 2000 (Center for Conservation Biology 2016). Suitable eastern black rail habitat is present within the Action Area and Study Area in the form of marsh wetlands. Black rails are permanent residents of central coastal Florida, so they may potentially use suitable habitat throughout the year (Cornell Lab of Ornithology 2024b).

The Study Area contains approximately 1,100 acres of potential habitat for eastern black rails in the form of marsh, prairie, and shrub wetland systems. Approximately 75 acres would be impacted by the Proposed Action.

5.7.3 Effects of the Action

The Proposed Action would impact approximately 75 acres of marsh, prairie, and shrub wetland systems within the Study Area of which only four (4) wetland systems (totaling approximately 25 acres) are contiguously greater than five (5) acres in size. Filling in these wetland systems is considered a direct effect through potential habitat loss. Localized and short-term changes in hydrologic conditions could occur during construction, maintenance, or modifications of existing stormwater infrastructure. Short-term and localized reductions of habitat function could occur and could affect habitat quality on the 1,100 acres of marsh, prairie, and shrub wetland systems within the Study Area through a decrease in wetland seasonal high-water levels in turn reducing the area of suitable wetland habitats. However, the Proposed Action would include stormwater management facilities intended to maintain post-construction conditions and protect wetland functions. Additionally, wetland mitigation would be provided where necessary to offset wetland impacts due to the Proposed Action. Therefore, these effects are extremely unlikely and are considered discountable.

Invasive species including Brazilian peppertree, Old World climbing fern (*Lygodium microphyllum*), and cogongrass (*Imperata cylindrica*) are already present within portions of the Study Area. The Proposed Action is not expected to introduce new invasive species; however, these species may be spread through construction activities, including ground disturbance, movement of equipment, or shipment of materials and supplies to the proposed facilities. Increase and spread of invasive species can degrade habitat for eastern black rails by displacing native vegetation, reducing plant community diversity, and diminishing the availability of native food resources and suitable nesting or cover habitat. Specifically, since eastern black rails rely so heavily on dense herbaceous

vegetation for cover, the spread of Brazilian peppertree would have a significant effect on habitat. According to Florida Department of Agriculture and Consumer Services (FDACS), Brazilian peppertree is a Category I invasive plant ("species which are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives". Brazilian peppertree outcompetes native plants because of its tolerance to conditions of extreme moisture (Ewe and Sternberg 2002, 2003). When introduced or spread, Brazilian peppertree can take over herbaceous wetlands and convert them into a monoculture of the shrub-dominant species. Ultimately, this effect could result in a degradation of habitat by displacing native species and food availability or breeding habitat for black rails. However, because these invasive species are already present within the Study Area and are actively being treated throughout the Action Area and MINWR, these effects are extremely unlikely and are considered discountable.

Eastern black rails are highly territorial and typically exhibit limited movement during breeding and wintering seasons. While individuals could occur within the Study Area, they are unlikely to make frequent or long-distance movements across roadways. Consequently, the likelihood of vehicle collisions is low. Therefore, direct effects from an increase in traffic and vehicular collisions are considered insignificant.

Noise events associated with construction and operations may result in short-term behavioral responses by eastern black rails, such as temporary avoidance of active work areas. However, eastern black rails are highly secretive and rely on dense vegetative cover, which would substantially attenuate noise and limit exposure. As a result, construction-related and long-term traffic noise would not be expected to interfere with breeding behavior, territory defense, or nest attendance. Similarly, dense vegetative cover would limit both short-term and long-term exposure to artificial lighting. Therefore, these effects are considered insignificant.

The Proposed Action would result in the loss of approximately 75 acres of marsh, prairie, and shrub wetland systems within the Study Area of which 25 acres is considered contiguous herbaceous wetlands greater than five (5) acres in size. During future project construction, wetland impacts would be mitigated for by the purchase of wetland mitigation credits which provide habitat availability in perpetuity. Additionally, there are no known records of the eastern black rail within three (3) miles of the Study Area. As such, the Proposed Action "***may affect, but is not likely to adversely affect***" the eastern black rail.

5.7.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.7.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the eastern black rail. Therefore, no population-level biological consequences would occur.

5.8 Everglade Snail Kite

5.8.1 Biology and Habitat

The Everglade snail kite ranges from southern Mexico to northern Argentina and resides in the United States only in peninsular Florida (Reichert et al. 2020). Everglade snail kites may use nearly any wetland within south Florida under some conditions and during some portions of their life history. The majority of nesting is concentrated within the large marsh and lake systems of the Greater Everglades and Upper St. John's marshes (Martin et al. 2007).

Snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lakes (natural and man-made) where native and non-native apple snails can be found. Suitable foraging habitat is typically a combination of low profile (less than 3 meters) marsh with an interdigitated matrix of shallow (0.2 to 1.3-meter-deep) open water, which is relatively clear and calm. Snail kites feed visually in open water with a range of water depths. Snail kites are nomadic in response to water depths, hydroperiod, food availability, and other habitat changes. Shifts in distribution can be short term, seasonal, or long term, and can take place between areas from year to year, between areas within a given nesting season, within areas in a given nesting season, and within or between areas for several days to a few weeks. Shallow wetlands with emergent vegetation such as spike rush, bulrush, and other native emergent wetland plant species provide good snail kite foraging habitat as long as the vegetation is not so dense that kites would have difficulty locating apple snails. The specific conditions and vegetation that provide good snail kite foraging habitat vary depending on the specific conditions of each wetland (lake or marsh, variability in water depths, soil characteristics, etc.). Not all areas where there are abundant apple snails support snail kite nesting, but most of these areas provide foraging habitat for snail kites at some time.

Nesting almost always occurs over water, which deters predation (Sykes 1987). Nesting substrates include small trees (usually < 10 m in height), including Carolina willow, cypress (*Taxodium* spp.), melaleuca (*Melaleuca quinquenervia*), swamp bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), pond apple (*Annona glabra*) and dahoon holly. Shrubs used for nesting include wax myrtle, cocoplum (*Chrysobalanus icaco*), buttonbush (*Cephalanthus occidentalis*), sesbania (*Sesbania* spp.), elderberry (*Sambucus nigra*), and Brazilian peppertree. Nesting also can occur in herbaceous vegetation, such as sawgrass, cattail (*Typha* spp.), bulrush (*Scirpus* pp.), and reeds (Sykes et al. 1995).

5.8.2 Environmental Baseline

USFWS listed the Everglade snail kite as endangered on March 11, 1967 (32 FR 4001). Formerly, snail kites occurred in freshwater throughout peninsular Florida; however, depending on water conditions and food availability these locations have been restricted. The current distribution of the Everglade snail kite in Florida is limited to six large freshwater ecosystems (Upper St. Johns marshes, Kissimmee River Basin, Lake Okeechobee, Loxahatchee Slough, the Everglades [i.e., areas south of Lake Okeechobee], and the Big Cypress basin) within the central and southern portions of the state (USFWS 2019d); however, the species has been observed at KSC as recently as 2023 (eBird 2023). The Upper St. Johns River and adjoining marshes do not include the Indian

River Lagoon and Banana River [St. Johns River Water Management District (SJRWMD) 2024], which include the marsh systems surrounding the Action Area.

Main stressors to snail kites include: Factor A: the present or threatened destruction, modification, or curtailment of its habitat or range; Factor B: overutilization of habitat for commercial, recreational, scientific, or educational purposes; Factor C: disease or predation; Factor D: the inadequacy of existing regulatory mechanisms for mitigating impacts; and Factor E: other natural or manmade factors affecting its continued existence. Threats to the snail kites' native food resources, Florida apple snails, include water levels, hydroperiods, vegetation structure, non-native apple snails, and the presence of contaminants in Florida waters. These threats also affect the snail kite through impacts to their habitat (Factor A) and food sources (Factor E) (USFWS 2023b). Nearly continuous flooding of wetlands for more than 1 year is needed to support apple snail populations that, in turn, sustain foraging by the snail kite (Sykes, 1979; Beissinger et al, 1988).

Although marginal, the Study Area provides suboptimal nesting habitat in the form of overgrown, thick vegetative forested cover. There are no large open-water lakes within the Study Area which may restrict use of the Study Area versus nearby optimal habitat. Foraging habitats within the Study Area include freshwater marshes and wet prairies totaling approximately 653 acres. It would be unlikely for Everglade snail kites to use the onsite habitat in preference to nearby higher quality open water systems for foraging or nesting. There is suitable nesting and foraging habitat throughout the Action Area.

5.8.3 Effects of the Action

The Proposed Action would impact approximately 170 acres of wetland habitats within the Study Area. Filling in these wetland systems is considered a direct effect through potential habitat loss. Localized and short-term changes in hydrologic conditions could occur during construction, maintenance, or modifications of existing stormwater infrastructure. Short-term and localized reductions of habitat function could occur and could affect habitat quality on the 2,020 acres of available wetland habitats within the Study Area through a decrease in wetland seasonal high-water levels in turn reducing the area of suitable wetland habitats for foraging. However, the Proposed Action would include stormwater management intended to maintain post-construction conditions and protect wetland functions. Additionally, wetland mitigation would be provided where necessary to offset wetland impacts due to the Proposed Action. Therefore, these effects are extremely unlikely and are considered discountable.

Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Therefore, dense growth of herbaceous or woody vegetation is not conducive to efficient foraging (USFWS 2019d). Removal of wetland habitat would also have a direct impact on the availability of apple snails within the Study Area.

As mentioned in **Section 5.7.3** , invasive species including Brazilian peppertree, Old World climbing fern, and cogongrass are already present within portions of the Study Area. The Proposed Action is not expected to introduce new invasive species; however, these species may be spread through construction activities, including ground disturbance,

movement of equipment, or shipment of materials and supplies to the proposed facilities. Increase and spread of invasive species can degrade habitat for Everglade snail kites by displacing native vegetation, reducing plant community diversity, and diminishing the availability of native food resources, such as apple snails, and suitable nesting or cover habitat. However, because these invasive species are already present within the Study Area and are actively being treated throughout the Action Area and MINWR, these effects are extremely unlikely and are considered discountable.

Given that the Study Area is generally outside of the species' normal range, it is unlikely to be transiting the area during the time of a static fire test. The effort required for a disturbed bird to fly to another area to forage or rest would be minimal, and any effects associated with dispersing are expected to be insignificant.

Other indirect effects to Everglade snail kite could include altered habitat conditions from the increase in traffic, short-term noise events associated with construction and operations, or visual disturbances from artificial lighting and short-term visual disturbances during implementation of the Proposed Action. Visual disturbances could also limit visual sight lines for snail kites foraging for apple snails. However, there are no known occurrences of Everglade snail kite utilizing available foraging or nesting habitat within the Study Area. Therefore, these indirect effects are considered discountable.

The Proposed Action would result in the loss of approximately 170 acres of available wetland habitats within the Study Area. The impact on wetlands would directly impact the availability of apple snails within the Study Area. Wetland habitats within the Study Area are considered suboptimal due to thick vegetative cover which could preclude snail kites effectively locating and foraging for apple snails. Although there is wetland habitats within the Study Area, there are no known records of the Everglade snail kite within the Study Area. For these reasons, the Proposed Action "***may affect, but is not likely to adversely affect***" the Everglade snail kite.

5.8.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.8.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the Everglade snail kite. Therefore, no population-level biological consequences would occur.

5.9 Florida Scrub-Jay

5.9.1 Biology and Habitat

The Florida scrub-jay (FSJ) lives only in the scrub and scrubby flatwoods habitats of Florida. This type of habitat grows only on nearly pure, excessively well-drained sandy soils, and occurs along present coastlines in Florida, on paleodunes of the high central ridges and other ancient shorelines of the Florida Peninsula, and inland on scattered alluvial deposits bordering several major rivers. This species' habitat is dominated by a layer of evergreen oaks [myrtle oak (*Q. myrtifolia*) and/or Archbold oak (*Q. inopina*), sand live oak (*Q. geminata*), Chapman oak (*Q. chapmanii*), and runner oak (*Q. minima*)], rusty lyonia, and

Florida rosemary (*Ceratiola ericoides*). This layer is rarely greater than two meters in height, except where fire has been suppressed. Ground cover is sparse, dominated by saw palmetto and sand palmetto (*Sabal etonia*). Bare sand patches are essential for foraging and acorn-caching. Slash pines and sand pines (*P. clausa*) are widely scattered with usually less than 15 percent cover (Woolfenden and Fitzpatrick 1996).

Scrub-jays are omnivorous, eating almost anything they can catch. Insects comprise the majority of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Acorns are by far the most important plant food (Fitzpatrick et al. 1991) and surplus acorns are frequently cached in the ground (DeGange et al. 1989).

Florida scrub-jays have a social structure that involves cooperative breeding, a trait that the western North American species of scrub-jays do not exhibit (Woolfenden and Fitzpatrick 1984). Florida scrub-jays live in groups ranging from two (a single mated pair) up to large extended families of eight adults and one to four juveniles. Fledgling scrub-jays remain with the breeding pair in their natal territory as "helpers," forming a closely-knit cooperative family group. Pre-breeding numbers are generally reduced to either a pair with no helpers or families of three or four individuals (a pair plus one or two helpers). To become a breeder, a scrub-jay must acquire a territory and mate. Evidence presented by Woolfenden and Fitzpatrick (1984) suggests that Florida scrub-jays are permanently monogamous. The pair retains ownership and sole breeding privileges in their particular territory year after year. Courtship to form the pair is lengthy and ritualized, and involves posturing and vocalizations made by the male to the female (Woolfenden and Fitzpatrick 1996). Age at first breeding varies from 1 to 7 years, although most individuals become breeders between 2 and 4 years of age (Fitzpatrick and Woolfenden 1988). Persistent breeding populations of Florida scrub-jays exist only where there are scrub oaks in sufficient quantity to provide an ample winter acorn supply, cover from predators, and nest sites during the spring (Woolfenden and Fitzpatrick 1996). They typically nest at the edge of an oak thicket, near an open area. During the breeding season, which runs from March through June, average production of young is two fledglings per pair, per year (Woolfenden and Fitzpatrick 1990; Fitzpatrick et al. 1994), and the presence of helpers improves fledgling success (Mumme 1992). Annual productivity must average at least two young fledged per pair for a population of scrub-jays to maintain long-term stability (Fitzpatrick et al. 1991).

5.9.2 Environmental Baseline

The FSJ was listed by the USFWS as threatened on June 3, 1987 (52 FR 20719). Primary threats to the species include range-wide population declines attributed to habitat loss and habitat degradation. KSC supports one of the largest remaining populations of FSJ. Scrub-jay habitat is intensively managed on KSC and CCSFS property, primarily by controlled burning and mechanical treatment (FAA 2020).

The estimated population is between 7,000 to 11,000 individuals (Breininger 1989; Fitzpatrick et al. 1991; Fitzpatrick et al. 1994). Scrub has been significantly reduced by development activity and now typically occurs only in scattered and often small patches in peninsular Florida (Fitzpatrick et al. 1991). Florida scrub-jay populations formerly inhabited 39 of 40 peninsular Florida counties, from Levy, Gilchrist, Alachua, Clay, and

Duval Counties southward. Its range currently occurs from Flagler, Marion, and Citrus counties south to Collier, Glades, and Palm Beach Counties, with the largest remaining populations in Brevard County (especially coastal scrubs of MINWR and KSC), Highlands County (near Sebring, Lake Placid, and Venus, and on Avon Park Air Force Range), and in Marion County (at Ocala National Forest).

In the 2014 *Final Kennedy Space Center Scrub-Jay Compensation Plan* it is noted that at the time, there were about 300 Florida scrub-jay families on MINWR. As of the August 2025 USFWS 5-Year Review, it is reported that there are 225 family groups in MINWR (USFWS 2025). The Merritt Island/Cape Canaveral genetic unit is of primary importance in maintaining the species' viability (NASA 2014). Mapped within the 2014 *Final Kennedy Space Center Scrub-Jay Compensation Plan*, Florida scrub-jay habitat is classified as core, auxiliary, and support habitat and this classification categorizes their importance and roles of different landscapes for maintaining the scrub-jay population. Most core habitat is essential for achieving recovery and the Refuge's Comprehensive Conservation Plan objectives that represent habitat of greatest importance to the Florida scrub-Jay population. Support habitat has lesser importance although some of it is necessary for connecting population cores and providing a population with high persistence probabilities. The Action Area contains core, auxiliary, and support habitat. Auxiliary areas are mostly tertiary territories, but include some primary and secondary territories (about 49) generally outside of fire management units. Some of these areas have value for connecting core areas, though connecting cores is less important than making core area populations sustainable. Most potential scrub-jay habitat on KSC occurs in auxiliary habitat (NASA 2014).

Florida scrub-jays occur within the Action Area and within the Study Area, using the available scrub habitat located east of A Avenue. Following the formal consultation for the 100-acre expansion of the SpaceX Operations Area (FWS Log #: 04EF1000-2019-0193 / 2023-0036318), a species-specific survey consisting of call vocalizations was performed within the Action Area along A Avenue and within the 100-acre Operations Area. During these surveys, FSJs were observed using and defending the scrub habitat east of A Avenue. FSJs were not observed using the habitat west of A Avenue.

Approximately 155 acres of scrub-jay habitat within the Study Area would be permanently converted to developed land. As mentioned previously, this area is occupied.

5.9.3 Effects of the Action

The Proposed Action would result in the development or conversion of approximately 400 acres, with 155 acres of auxiliary or support habitat loss. Support habitat areas emphasize smaller clusters of primary and secondary territories outside of important fire management units. Auxiliary habitat is of lower quality regardless of management history. The scrub habitat east of A Avenue is occupied; therefore, project construction could result in direct take. It is unknown the current number of family groups that would be displaced by construction. The permanent loss of habitat would result in a loss of scrub habitat within the Northeastern Coastal Genetic Unit. The habitat modification would reduce Florida scrub-jay survival and recruitment in future years; however, the loss would

be partially mitigated with the proposed compensation following the 2014 *Final Kennedy Space Center Scrub-Jay Compensation Plan*.

Prescribed burns conducted at CCSFS, KSC, and the MINWR are crucial to providing adequate habitat for fire-dependent species, including the FSJ. Prescribed burns currently are conducted in accordance with the *Memorandum of Understanding between Space Launch Delta 45, the United States Fish and Wildlife Service, and John F. Kennedy Space Center for Prescribed Burning on Merritt Island National Wildlife Refuge, John F. Kennedy Space Center, and Cape Canaveral Space Force Station, Florida* (NASA 2025). Research by KSC noted that a sustainable population depends most on increasing the amount of open medium habitat and that population decline would continue until a suitable amount of this habitat is created through prescribed fire and other mechanical treatments (KSC 2024). This study also found that the reduction of MINWR fire crews and reduced burning opportunities due to operational restraints led to fewer fires. Outside of burn restrictions, such as operational smoke buffers or smoke-sensitive activities/payloads conducting the burn is also influenced by the availability of burn crews, agency funding, and day-of weather. No operational smoke buffer is proposed. The Proposed Action is not anticipated to result in impacts to the prescribed burn program at KSC.

During and after construction there would be both an increase in traffic volume and change in traffic patterns. Morgan et al. (2012) tested the potential for roads and traffic to cause physiological stress and reduce reproductive success of FSJ. The authors found that roadside environments (with regular noise and movement disturbances and the presence of modified edge habitat) were not stressful for FSJ and did not reduce FSJ reproductive success compared to environments with non-road habitat edges and natural interior scrub habitat. Furthermore, the primary proposed roadway (NASA Parkway Connector) is outside of occupied scrub habitat. While individuals could enter within range of the proposed roadway, they are unlikely to make frequent or long-distance movements across or to the roadways as they are highly territorial. Consequently, the likelihood of vehicle collisions is low. Therefore, direct effects from an increase in traffic and vehicular collisions are considered insignificant.

As discussed in Section 5.1.4, noise associated with static fire tests may startle birds, potentially resulting in interruption of foraging, breeding, nesting, or roosting (Knight et al. 2012; Ortega 2012). Such disturbances could also cause a Florida scrub-jay to flush from the nest, leaving eggs or young vulnerable to predation or dehydration. Individuals that flush from a protected or concealed area may be more vulnerable to predation. Noise may also cause elevated stress levels. Stress responses may cause effects such as suppression of the immune system (Slabbekoorn et al. 2018).

At Vandenberg Space Force Base where there has been an increase in Falcon 9 launches starting in 2021, a statistical analysis was conducted to investigate the relationship between western snowy plover (*Charadrius nivosus nivosus*) abundance and productivity and the increased launch frequency (USSF, 2025). While the analysis did identify a significant location-specific relationship between *breeding population count* and *modeled engine noise* (p-value < 0.001), suggesting that western snowy plovers may be selecting habitat further from launch activities to reduce exposure to overpressure

and noise associated with launches, the analysis did not find a significant relationship between snowy plover *hatch rate* and launch-related disturbances (p-values = 0.751 and 0.738 for *overpressure exposure* and *modeled engine noise*, respectively), or between *fledge rate* and launch-related disturbances (p-values = 0.148 and 0.815 for *overpressure exposure* and *modeled engine noise*, respectively) (USSF, 2025). To date, this presents the best available science on launch effects to an avian species, particularly with respect to hatch rates and fledge rates. Unlike western snowy plovers, Florida scrub-jays are very territorial, and they require specific habitat conditions, so they are less likely to relocate. It is unknown if this would affect hatch or fledge rates.

Given the permanent loss of approximately 155 acres of auxiliary and support habitat loss and the anticipated indirect effects from fire restriction, and effects from noise, the Proposed Action "***may affect, and is likely to adversely affect***" the Florida scrub-jay. To compensate for impacts from habitat loss, SpaceX shall follow the process outlined in the 2014 *Final Kennedy Space Center Scrub-Jay Compensation Plan*.

5.9.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.9.5 Population-level Biological Consequences

With implementation of mitigation per the 2014 *Final Kennedy Space Center Scrub-Jay Compensation Plan*, it can be reasonably anticipated there would be no population-level effects to Florida scrub-jays.

5.10 Eastern Indigo Snake

5.10.1 Biology and Habitat

The eastern indigo snake is the largest native snake species in North America with a maximum recorded length of 8.5 feet (ft) (2.6 m) (Moler 1992). Relative to other snake species, adult eastern indigo snakes have very large activity ranges and can move considerable distances in short periods of time (USFWS 2008). Home range is variable depending on the ecoclimate and availability of habitat in the region (Breininger et al. 2011; Dodd and Barichivich 2007; Moler 1992; Ceilley et al. 2014; Hyslop 2007; Layne and Steiner 1996; Legare and Breininger 2002; Moler 1985a; Smith 1987; Speake et al. 1978). Male eastern indigos are known to have larger home range sizes than females, likely due to searching for mates in the area or due to their larger size (Dodd and Barichivich 2007; Moler 1985b, Smith 1987). Home range size for the species ranges from 1.6–1,530 hectares (Layne and Steiner 1996).

In southern parts of their range, eastern indigo snakes are habitat generalists. Movements between habitat types in northern areas of their range may relate to the need for thermal refugia. In extreme south Florida (i.e., the Everglades and the Florida Keys), indigo snakes also use tropical hardwood hammocks, pine rocklands, freshwater marshes, abandoned agricultural land, coastal prairie, mangrove swamps, and human-altered habitats. Though eastern indigo snakes have been found in all available habitats of south Florida, it is thought they prefer hammocks and pine forests, since most observations occur there

and use of these areas is disproportionate compared to the relatively small total area of these habitats (Steiner et al. 1983).

Throughout the entire range, eggs are laid from late May through August, and young hatch in approximately three months. Peak hatching activity occurs between August and September, and yearling activity peaks in April and May (Groves 1960, Smith 1987). Limited information on the reproductive cycle in south-central Florida suggests that the breeding and egg-laying season may be extended.

5.10.2 Environmental Baseline

The USFWS listed the eastern indigo snake as a threatened species on March 3, 1978 (43 FR 4026). Main threats to the species include habitat loss, degradation, and/or fragmentation as a result of urban development, pollution, vehicle strikes, captures for domestication, and intentional killings (FWC 2026e).

Suitable habitat for eastern indigo snakes is present in the Study Area and Action Area. A NASA-funded herpetology survey was conducted at KSC within the Action Area. This long-term assessment (1975-2000) documented presence of the species during the 1976 and 1992-2000 studies. In addition, counts for indigo snakes captured by road-collecting was zero during the 1977-1979 period and one during the 1992-2000 period (Seigel, R.A., et al). The eastern indigo snake has been documented at KSC over the past several decades. The most recent documented indigo snake sighting near CCSFS was in 2018: a roadkill on KSC approximately 0.25 miles north of CCSFS. Sightings prior to that date back to the early 1990s (USFWS 2023c). Therefore, NASA assumes the eastern indigo snake may be present in the Action Area, but there is no survey data to confirm presence.

5.10.3 Effects of the Action

The Proposed Action would convert approximately 400 acres of undeveloped wetland and upland habitats within the Study Area. Construction would require large machinery to remove vegetation and debris, grade the lands, and any miscellaneous site work such as excavation. During these activities, indigo snakes, if present, could be harmed due to strikes from heavy machinery, entombment in underground refugia, and/or crushed under vehicles during ingress/egress from project locations within the Action Area.

Removal of habitat could remove more than half of a female eastern indigo snake's home range. This loss of habitat within a home range would be expected to significantly impair the ability of that individual to feed, breed, and shelter (USFWS 2013). An increase in vehicle traffic associated with the Proposed Action could result in a localized increase in the risk of vehicular collisions within the immediate project area. Construction-related noise or vibration may also cause temporary disturbance to eastern indigo snakes occurring in close proximity to active construction areas; however, any such disturbance would be limited in spatial extent and duration and is not expected to result in abandonment of habitat beyond areas immediately adjacent to construction activities.

Prior to the start of clearing, and as described in the USFWS's standard protection measures, a qualified biologist would survey previously discovered gopher tortoise burrows (USFWS 2024e). Snakes inhabiting a burrow would be allowed to vacate the burrow prior to collapsing the burrow. This measure would ensure no eastern indigo

snakes are crushed or buried as a result of burrow collapse during construction activities. Similarly, if artificial refugia (e.g., piles of construction debris) are produced during construction, a qualified biologist would carefully inspect such areas for the presence of eastern indigo snakes prior to the debris being removed or destroyed. Observed snakes would be allowed to vacate the refugia prior to further activity, ensuring no eastern indigo snakes are crushed or buried during removal.

Enge and Wood (2002) found no correlation between traffic volume and snake mortality (on roads) rates during a study involving 1,022 daily searches to document all observed snake mortality on roads in a central Florida study area between June 1998 and December 2001. During this study, searches occurred on 79 percent of available days during the study period and one juvenile eastern indigo snake was found dead on a road. The study also found that eastern indigo snakes were one of four large snake species proportionally trapped three times more frequently within intact habitats on public lands than they were found on roads in fragmented areas (Enge & Wood 2002).

Standard protection measures would be implemented to minimize the likelihood of collisions between construction equipment and vehicles during overland use (USFWS 2024e). These measures include placing posters in the work area alerting construction personnel to the potential presence of eastern indigo snakes and conducting meetings with construction personnel to inform them about the potential presence of the species and processes to follow in the event the species is observed.

The Species Status Assessment for the Eastern Indigo Snake (USFWS 2024) does not identify noise or light as stressors for this species. However, wildlife species, including reptiles, may experience a startle or stress response when exposed to such disturbances. One study found that a lizard species exposed to intermittent, high-amplitude noise (e.g., aircraft flyovers) exhibited a stress response and altered foraging behavior (Kepas et al., 2023) Increases in anthropogenic disturbance, including noise, likely causes elevated stress responses for eastern indigo snakes (Bogan, et al., 2024). The increased stress can result in immunosuppression. Some study results suggest indigo snakes subjected to ongoing anthropogenic disturbance could be more susceptible to disease. During an eastern indigo snake translocation effort, most snakes captured within an area exposed to anthropogenic noise were affected by a protozoan pathogen (USFWS, 2024f). Conversely, in a survey of free-ranging snakes, including eastern indigo snakes, this pathogen was not detected in areas unaffected by intense anthropogenic disturbance, including noise (O'Hanlon et al., 2023). Any such impacts would be short term and intermittent. Any indigo snakes in the vicinity of the Action Area are currently exposed to such effects every few days from current launches at KSC and CCSFS. Elevated stress responses and immunosuppression may result from this increase in anthropogenic disturbance, leading to sickness or death.

Given the permanent loss of approximately 400 acres of potential habitat loss within the Study Area, the Proposed Action "***may affect, and is likely to adversely affect***" eastern indigo snakes.

5.10.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.10.5 Population-level Biological Consequences

With excavation of all gopher tortoise burrows within construction areas to ensure eastern indigo snakes are not trapped or injured, and implementation of the eastern indigo snake standard protection measures, any potential effects to individuals would be avoided or minimized. As a result, any remaining effects would be limited to a small number of individuals, if any, within the Study Area or an extremely localized portion of the Action Area. Given the limited spatial extent and duration of construction activities, the avoidance and minimization measures incorporated into the Proposed Action, and the availability of suitable habitat in the surrounding landscape, the Proposed Action is not expected to result in population-level effects to eastern indigo snakes.

5.11 Sea Turtles

5.11.1 Biology and Habitat

There are four species of sea turtles known to nest on Brevard County beaches within the Action Area: green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. Additionally, the USFWS indicates that hawksbill sea turtle has potential to occur near the Action Area. All these species are highly migratory and travel hundreds to thousands of miles between nesting, breeding, and feeding sites.

The green sea turtle occurs throughout the subtropical and temperate regions of the Atlantic Ocean and the Gulf of Mexico. Important feeding areas in Florida include the Indian River Lagoon, the Florida Keys, Florida Bay, the Dry Tortugas, Homosassa, Crystal River, Cedar Key, and St. Joseph Bay. Green turtles are mostly herbivorous, feeding on algae and seagrasses; however, the species will also consume sponges, invertebrates, and discarded fish. Every 2 to 5 years, green sea turtles will return to their hatchling beach to lay eggs, producing a clutch of around 110 eggs every two weeks in late spring. Eggs incubate for approximately 2 months (NOAA 2024a).

The Kemp's ridley sea turtle occurs in the Gulf of Mexico. Juveniles may occur in the Atlantic Ocean as far north as Nova Scotia and occasionally may occur in the Eastern North Atlantic (NOAA 2024b). The species feeds on small animals and plants. Most nesting occurs on beaches along the western Gulf of Mexico and 95% of worldwide Kemp's ridley nesting occurs in Mexico (NOAA 2024b). Occasional nesting has been documented in Alabama, Georgia, Florida, North Carolina, South Carolina, and Texas. The species nests on KSC and CCSFS (NASA 2023). Nesting occurs during daylight hours from April to July. Females lay an average of 2 to 3 clutches of approximately 100 eggs per season and return to the beach to nest every 1 to 3 years. Average incubation time is 50 to 60 days (NOAA 2024b).

The leatherback sea turtle has the widest global distribution of any sea turtle or reptile, with major U.S. nesting sites in Florida, Puerto Rico, and the Virgin Islands. The species tends to be present in tropical latitudes globally for nesting and feeding on mainly open-ocean species, including jellyfish and salps. However, leatherback sea turtles have occurred as

far north as Nova Scotia, Canada, and the Netherlands. The typical breeding period for the U.S. population is from March to July. Leatherback sea turtles will lay a brood of around 100 eggs at several nesting sites every 2-4 years, returning to the same nesting beaches each time. Average incubation time is around two months (NOAA 2024c).

The loggerhead sea turtle occurs primarily in subtropical and temperate regions of the Atlantic and Pacific oceans. The species is carnivorous, feeding on floating items in open waters and on bottom-dwelling invertebrates in coastal waters. Loggerhead sea turtles rarely consume plant material. Breeding season is from March to September. During this time, the species will lay three to five clutches of around 100 eggs. Incubation time is approximately two months (NOAA 2024d).

The hawksbill sea turtle occurs in tropical and sub-tropical ocean waters across the globe. This species persists on a diet of sea sponges, marine algae, coral, mollusks, crustaceans, sea urchins, small fish, and jellyfish. The species uses healthy coral reefs for feeding grounds, but have been observed in mangrove estuaries, rock formations, high energy shoals, and estuaries that provide good habitat for sponge growth. Hawkbill sea turtles, like many other sea turtles, return to their hatchling beaches to lay clutches of 130 to 160 eggs. Breeding season can vary but is typically between April and November. Eggs will hatch after two months of incubation (NOAA 2024e).

5.11.2 Environmental Baseline

The USFWS listed the hawksbill, leatherback, and Kemp's ridley sea turtles under a precursor to the ESA in 1970 (35 FR 18319) and the green and loggerhead sea turtles in 1978 (43 FR 32800). Main threats to these species include climate change, loss or degradation of nesting habitat, disorientation of hatchlings by beachfront lighting, ocean pollution, direct harvesting, and bycatching in fishing gear (NOAA 2024a-e).

The combined sea turtle nesting season in Florida is March (NOAA 2024c) through October (USFWS 2020b). During the nesting season, sea turtles are very active along the beaches at CCSFS and KSC. From March through October, adult females come on shore at night, dig a hole, and lay a clutch of eggs, ranging from 100-200 eggs (number is dependent upon species). A female may lay multiple clutches in a season, and this frequency is species dependent. After approximately two months, during the night, the hatchlings emerge from the sand and make their way towards the ocean (NOAA 2024a).

Since the SpaceX Campus and the Proposed Action are inland and do not consist of any beach habitat, surveys have not been completed within the Study Area. MINWR, Canaveral National Seashore, and CCSFS conduct yearly sea turtle nesting surveys within the Action Area. During these surveys, thousands of nests are found each year, the majority belonging to loggerhead and green sea turtles, and nests of leatherback, and Kemp's Ridley sea turtle are found as well. The Action Area encompasses portions of MINWR.

5.11.3 Effects of the Action

The Study Area is approximately 5.3 miles from the beach and 2.0 miles inland from the Indian River. Construction activities may continue into non-daylight hours and could require artificial lighting. The lighting required for construction would be temporary and

limited to the immediate vicinity of the expanded lease area. Additional permanent lighting would be needed for operations at the facilities. The Proposed Action is subject to KSC exterior lighting requirements, which require all facilities at KSC to operate under a Lighting Operations Manual.

Artificial light can disorient hatchlings, occasionally luring them away from the ocean, and can cause adult females to make "false crawls" (i.e., when a female comes ashore but returns to the water without digging a nest). Because the Study Area is over five (5) miles from the nearest beach suitable for nesting and SpaceX would comply with KSC exterior lighting requirements, the Proposed Action "***may affect, but is not likely to adversely affect***" sea turtles.

5.11.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.11.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect sea turtles. Therefore, no population-level biological consequences would occur.

5.12 Monarch Butterfly

5.12.1 Biology and Habitat

The monarch butterfly is a predominantly migratory insect with four life stages: egg, larvae, pupae, and adult (Midwest Association of Fish and Wildlife Agencies 2023). The annual migration cycle begins in the fall when individuals from the eastern population migrate south to overwintering areas in central Mexico (USFWS 2020c). Adults live for an extended period in overwintering areas until they break reproductive diapause in the early spring and begin to migrate to their breeding ranges (USFWS 2020c). Four to five generations are produced annually to complete the migration, ending with the last generation migrating back to overwintering areas (Midwest Association of Fish and Wildlife Agencies 2023).

There are three monarch butterfly populations within continental North America. Two migratory populations are located east and west of the Rocky Mountains, and a third population is a non-migratory population located in southern Florida, where the climate supports year-round breeding (USFWS 2020c). Monarch butterflies occurring in the Action Area are part of this non-migratory population.

Breeding habitat is present where milkweed (*Asclepias* spp.) plants are found. Milkweed plants, which regularly grow in disturbed soils, are the sole host plant for monarch eggs and larvae (USFWS 2020c), and the presence of milkweed plants is vital to the species throughout its breeding and migratory range (Thogmartin et al. 2017). Monarch butterflies forage on a variety of blooming nectar resources throughout their range (USFWS 2020c).

5.12.2 Environmental Baseline

The monarch butterfly was proposed for listing as a threatened species on December 12, 2024 (89 Federal Register 100662–100716). Main threats to the species include loss and

degradation of habitat from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, urban development, and drought (85 FR 81813).

Monarch butterflies may occur throughout the Action Area year-round in suitable habitats, including scrub, open fields, and roadsides (USFWS 2020c). The monarch butterfly may use suitable habitat in the Action Area.

5.12.3 Effects of the Action

The Proposed Action would permanently or temporarily modify potentially suitable habitat used by monarch butterflies during flight and foraging. Monarch butterflies often inhabit disturbed areas exposed to human activity (USFWS 2020c), and noise or visual disturbance is not identified by USFWS as a threat to the species (USFWS 2020e). Therefore, noise and visual disturbance associated with construction and operation activities are unlikely to result in measurable effects to monarch butterflies. Monarchs present in the Action Area may continue to use habitat exposed to temporary disturbances or may temporarily utilize adjacent suitable habitat. Given the temporary nature and limited spatial extent of these disturbances, effects from noise and visual disturbance would be insignificant.

Direct mortality of adult monarch butterflies from vehicle collisions is not considered a reasonably foreseeable effect of the Proposed Action due to the species' flight behavior and the limited nature of vehicular activity. Accordingly, the likelihood of vehicle-related mortality is extremely low and such effects are considered discountable. The most recent targeted vegetation survey conducted within the Action Area was documented in 1985 NASA technical memorandum. The species list did not include any milkweed genus (*Asclepias* spp.) plants (NASA 1985). No known targeted monarch species surveys have been conducted in the area likely due to restricted the sites restricted access. Therefore, due to lack of survey data for both the species and host plant species within the area and the species expected ability to avoid lethal collisions, it is anticipated that the Proposed Action is not likely to jeopardize the continued existence of the proposed monarch butterfly.

5.12.4 Cumulative Effects

There are no known future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, no cumulative effects are anticipated.

5.12.5 Population-level Biological Consequences

The Proposed Action is not likely to adversely affect the monarch butterfly. Therefore, no population-level biological consequences would occur.

5.13 Critical Habitat

The Action Area was evaluated for the presence of Critical Habitat as defined by the Endangered Species Act of 1973, as amended and 50 CFR part 424. The USFWS is the authority, as a federal agency, to protect from destruction or adverse modification the biological or physical constituent elements essential to the conservation of listed species. Critical Habitat is defined as the specific areas within the geographical area occupied

by a species on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection.

Review of the USFWS database identified Proposed Critical Habitat for the West Indian manatee, green sea turtle, and rufa red knot and Designated Critical Habitat for the loggerhead sea turtle within the Action Area. However, the terrestrial critical habitat occurs more than five (5) miles from the Study Area and would not be subject to habitat modification, lighting effects, or other direct or indirect effects associated with construction, operation, or static fire testing. Lighting from the Proposed Action would likely not be visible at the critical habitat(s) located on the KSC beach. For any elevated lighting on structures that could be visible, the light would be indiscernible from other lighting at KSC, including lighting at the launch complexes immediately adjacent to the critical habitat. The Proposed Critical Habitat for the West Indian manatee is fully aquatic and thus would not be direct or indirectly affected by the Proposed Action. Accordingly, the Proposed Action is not anticipated to affect any physical or biological features essential to the conservation of these species. Therefore, the Proposed Action would have "***no effect***" on Designated or Proposed Critical Habitat.

6.0 CONSERVATION MEASURES

The following conservation measures would be implemented.

1. Prescribed Burn Coordination – Continued coordination between SpaceX and KSC would occur to avoid or reduce burn day impacts due to operations.
2. Preconstruction Survey – Preconstruction biological surveys would occur prior to the commencement of construction.
    a. The USFWS Survey Protocol for the Eastern Indigo Snake in North and Central Florida would be followed.
3. The USFWS Standard Protection Measures for the Eastern Indigo Snake would be implemented during construction.
4. KSC exterior lighting requirements would be implemented. The existing Lighting Operations Manual would be updated as new facilities are constructed.

7.0 SUMMARY AND CONCLUSIONS

Based on the evaluation presented above, NASA has made the following determination of effects on ESA-listed species from implementation of the Proposed Action within the Action Area (**Table 7-1**). This PBA is intended to support formal consultation between NASA and the USFWS as required by 50 CFR 402.14(c) and Section 7 of the ESA regarding the likelihood of an adverse effect ("take") of any listed species. This PBA would also support informal consultation regarding species that may be affected but are not likely to be adversely affected.

Table 7-1 Summary of Findings for ESA-Listed Species

Species	Designated Status	Effect Determination
MAMMALS		
Florida panther *Puma concolor coryi*	FE	No effect
Southeastern beach mouse *Peromyscus polionotus niveiventris*	FT	May affect, not likely to adversely affect
Tricolored bat *Perimyotis subflavus*	PE	Not likely to jeopardize
West Indian manatee *Trichechus manatus*	FE	May affect, not likely to adversely affect
BIRDS		
Crested caracara *Caracara plancus audubonii*	FT	May affect, not likely to adversely affect
Eastern black rail *Laterallus jamaicensis ssp. jamaicensis*	FT	May affect, not likely to adversely affect
Everglade snail kite *Rostrhamus sociabilis plumbeus*	FE	May affect, not likely to adversely affect
Florida scrub-jay *Aphelocoma coerulescens*	FT	May affect, likely to adversely affect
Piping plover *Charadrius melodus*	FT	No effect
Rufa red knot *Calidris canutus rufa*	FT	No effect
Whooping crane *Grus americana*	FE; EXPN	No effect
REPTILES		
Atlantic salt marsh snake *Nerodia clarkii taeniata*	FT	No effect
Eastern indigo snake *Drymarchon couperi*	FT	May affect, likely to adversely affect
Green sea turtle *Chelonia mydas*	FT	May affect, not likely to adversely affect
Kemp's ridley sea turtle *Lepidochelys kempii*	FE	May affect, not likely to adversely affect
Leatherback sea turtle *Dermochelys coriacea*	FE	May affect, not likely to adversely affect
Loggerhead sea turtle *Caretta caretta*	FT	May affect, not likely to adversely affect
Hawksbill sea turtle *Eretmochelys imbricata*	FE	May affect, not likely to adversely affect
INSECTS		
Monarch butterfly *Danaus plexippus*	PT	Not likely to jeopardize
PLANTS		
Carter's mustard *Warea carteri*	FE	No effect
Lewton's polygala *Polygala lewtonii*	FE	No effect

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APPENDIX D. CULTURAL RESOURCES

FLORIDA DEPARTMENT of STATE

RON DESANTIS
Governor

CORD BYRD
Secretary of State

National Aeronautics and Space Administration
John F. Kennedy Space Center
Kennedy Space Center, FL 32899

August 25, 2026

RE: DHR Project File No.: 2026-0259-B Received by DHR: July 29, 2026
CULTURAL RESOURCES SURVEY FOR THE ROBERTS ROAD CAMPUS EXPANSION PROJECT KENNEDY SPACE CENTER, BREVARD COUNTY, FLORIDA

To Whom It May Concern:

Our office reviewed the referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties*, as well as Chapters 267.061 and 373.414, *Florida Statutes*, and implementing state regulations for possible effects on historic properties listed, or eligible for listing, in the *National Register of Historic Places*. The project is subject to compliance with requirements for an undertaking by the National Aeronautics and Space Administration (NASA).

In April 2026, SEARCH conducted the above referenced Phase I cultural resource assessment survey (CRAS) on behalf of Space Exploration Technologies. SEARCH excavated approximately 2,230.2 acres with 131 shovel tests dug throughout the project area in Brevard County. As a result of the survey, one previously recorded historical resource was identified. The known resource is 8BR4444 (Observation Tower; SHPO Ineligible, 2024). No archaeological sites were identified. Based on the survey results, it is the opinion of SEARCH that "no further cultural resources work is recommended in support of the proposed Project."

Based on the information provided, our office concurs with the survey results and recommendations presented and finds that the proposed project should have no effect on historic properties listed, or eligible for listing, in the NRHP. Further, we find the submitted report complete and sufficient in accordance with Chapter 1A-46, *Florida Administrative Code*.

If you have any questions, please contact Ethan Putman, Archaeologist III, by email at *Ethan.Putman@dos.fl.gov*.

Sincerely,

Alissa Slade Lotane, SHPO

Alissa Slade Lotane
Director, Division of Historical Resources
& State Historic Preservation Officer

National Aeronautics and Space Administration

John F. Kennedy Space Center
Kennedy Space Center, FL 32899

July 28, 2026

Reply to Attn of: SI-E3

Ethan Putnam
Florida Division of Historical Resources
and State Historical Preservation Officer
500 S. Bronough Street
R. A. Gray Building
Tallahassee, FL 32399-0250

Subject: Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center (KSC) and No Historic Properties Affect Finding

Dear Mr. Putnam:

The National Aeronautics and Space Administration's Kennedy Space Center (NASA KSC) intends to lease land to SpaceX for the expansion of its Robert's Road campus. SpaceX is proposing to expand its facilities over approximately 2,230 acres of land adjacent to its current location. Because the property is owned by KSC, the approval of activities for the lease and subsequent construction qualifies as a Federal Undertaking subject to review under Section 106 of the National Historic Preservation Act of 1966. This consultation is being completed in accordance with the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)*.

In April and June 2026, SEARCH, Inc. conducted a Cultural Resources Survey (CRAS) on this parcel of land. The survey was conducted to identify potential historic properties that meet the National Register of Historic Places (NRHP) criteria. The Area of Potential Effects (APE) for the project encompasses approximately 2,230 acres where construction may occur (see Enclosure, Figure 1-2). No archaeological or historic resources were found as a result of the survey.

Center Consulting Tribes are copied on this correspondence and will receive an unredacted version of the CRAS. Center Consulting Parties will receive a redacted version of the CRAS. Center Consulting Tribes and Center Consulting Parties may submit comments via email

within 30 days of distribution.

NASA KSC agrees with SEARCH, Inc. recommendation that the APE does not have the potential to contain significant archaeological or architectural sites and that no further investigation is necessary within the project area. NASA KSC requests your concurrence with its determination that **No Historic Properties Will Be Affected** as a result of this undertaking. If you have any questions or require further assistance, please contact me at 321-867-8454 or Katherine.s.zeringue@nasa.gov.

Sincerely,

Katherine Zeringue Digitally signed by Katherine Zeringue
Date: 2026.07.28 16:23:36 -04'00'

Katherine Zeringue
KSC Cultural Resource Manager
Environmental Management Branch

Enclosures:
Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center, Brevard County, Florida

cc:
HQS FPO/R. Klein
KSC/SI-E3/D. Dankert
KSC/AD/D. Thorpe
KSD/AD/J. Krouchick
KSC/CC/T. Tezel
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Center Consulting Tribes:
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Seminole Nation of Oklahoma/J. Fultz
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Center Consulting Parties:
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FWS/R. Kanaski
NPS/K. Kneifl
CCSFS/T. Penders
Apollo One Memorial Foundation, Inc.
Brevard County Historical Commission
Cape Canaveral Space Force Museum
City of Titusville
Florida Public Archaeological Network – East Central Region
Historical Society of North Brevard
Indian River Anthropological Society
North Brevard Heritage Foundation
South Brevard Historical Society

From:	Zeringue, Katherine S. (KSC-SIE30)
To:	THPO Compliance
Cc:	Danielle Simon
Subject:	Section 106 Consultation: Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center and No Historic Properties Affected Finding
Date:	Wednesday, July 29, 2026 9:09:00 AM
Attachments:	image001.png image002.png SpaceX Campus Expansion CRAS S106 Consult SHPO_07.28.2026_FINAL.pdf Cultural Resources Survey for the Roberts Road Campus Expansion_20260723 Final.pdf

---

Dear Ms. Osceola,

The National Aeronautics and Space Administration's Kennedy Space Center (NASA KSC) intends to lease land to SpaceX for the expansion of its Robert's Road campus. SpaceX is proposing to expand its facilities over approximately 2,230 acres of land adjacent to its current location. Because the property is owned by KSC, the approval of activities for the lease and subsequent construction qualifies as a Federal Undertaking subject to review under Section 106 of the National Historic Preservation Act of 1966. This consultation is being completed in accordance with the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)*.

In April and June 2026, SEARCH, Inc. conducted a Cultural Resources Survey (CRAS) on this parcel of land. The survey was conducted to identify potential historic properties that meet the National Register of Historic Places (NRHP) criteria. The Area of Potential Effects (APE) for the project encompasses approximately 2,230 acres where construction may occur (see Attachment, Figure 1-2). No archaeological or historic resources were found as a result of the survey.

NASA KSC agrees with SEARCH, Inc.'s recommendation that the APE does not have the potential to contain significant archaeological or architectural sites and that no further investigation is necessary within the project area. Given the negative findings of the report, **No Historic Properties Will Be Affected** as a result of this undertaking.

Comments are requested within 30 days. If you have any questions or require further assistance, please contact me.

Sincerely,

Katherine Zeringue
Cultural Resources Manager
Spaceport Integration and Services
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Mail Code: SI-E3
Kennedy Space Center, FL 32899
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To:	thpo@sno-nsn.gov
Subject:	Section 106 Consultation: Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center and No Historic Properties Affected Finding
Date:	Wednesday, July 29, 2026 9:07:00 AM
Attachments:	image001.png image002.png SpaceX Campus Expansion CRAS S106 Consult SHPO_07.28.2026_FINAL.pdf Cultural Resources Survey for the Roberts Road Campus Expansion_20260723 Final.pdf

---

Dear Mr. Fultz,

The National Aeronautics and Space Administration's Kennedy Space Center (NASA KSC) intends to lease land to SpaceX for the expansion of its Robert's Road campus. SpaceX is proposing to expand its facilities over approximately 2,230 acres of land adjacent to its current location. Because the property is owned by KSC, the approval of activities for the lease and subsequent construction qualifies as a Federal Undertaking subject to review under Section 106 of the National Historic Preservation Act of 1966. This consultation is being completed in accordance with the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)*.

In April and June 2026, SEARCH, Inc. conducted a Cultural Resources Survey (CRAS) on this parcel of land. The survey was conducted to identify potential historic properties that meet the National Register of Historic Places (NRHP) criteria. The Area of Potential Effects (APE) for the project encompasses approximately 2,230 acres where construction may occur (see Attachment, Figure 1-2). No archaeological or historic resources were found as a result of the survey.

NASA KSC agrees with SEARCH, Inc.'s recommendation that the APE does not have the potential to contain significant archaeological or architectural sites and that no further investigation is necessary within the project area. Given the negative findings of the report, **No Historic Properties Will Be Affected** as a result of this undertaking.

Comments are requested within 30 days. If you have any questions or require further assistance, please contact me.

Sincerely,

Katherine Zeringue
Cultural Resources Manager
Spaceport Integration and Services
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Subject:	Section 106 Consultation: Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center and No Historic Properties Affected Finding
Date:	Wednesday, July 29, 2026 9:06:00 AM
Attachments:	image001.png image002.png SpaceX Campus Expansion CRAS S106 Consult SHPO_07.28.2026_FINAL.pdf Cultural Resources Survey for the Roberts Road Campus Expansion_20260723 Final.pdf

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Dear Jason,

The National Aeronautics and Space Administration's Kennedy Space Center (NASA KSC) intends to lease land to SpaceX for the expansion of its Robert's Road campus. SpaceX is proposing to expand its facilities over approximately 2,230 acres of land adjacent to its current location. Because the property is owned by KSC, the approval of activities for the lease and subsequent construction qualifies as a Federal Undertaking subject to review under Section 106 of the National Historic Preservation Act of 1966. This consultation is being completed in accordance with the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)*.

In April and June 2026, SEARCH, Inc. conducted a Cultural Resources Survey (CRAS) on this parcel of land. The survey was conducted to identify potential historic properties that meet the National Register of Historic Places (NRHP) criteria. The Area of Potential Effects (APE) for the project encompasses approximately 2,230 acres where construction may occur (see Attachment, Figure 1-2). No archaeological or historic resources were found as a result of the survey.

NASA KSC agrees with SEARCH, Inc.'s recommendation that the APE does not have the potential to contain significant archaeological or architectural sites and that no further investigation is necessary within the project area. Given the negative findings of the report, **No Historic Properties Will Be Affected** as a result of this undertaking.

Comments are requested within 30 days. If you have any questions or require further assistance, please contact me.

Sincerely,

Katherine Zeringue
Cultural Resources Manager
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To:	thpo@tttown.org
Subject:	Section 106 Consultation: Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center and No Historic Properties Affected Finding
Date:	Wednesday, July 29, 2026 9:11:00 AM
Attachments:	image001.png image002.png SpaceX Campus Expansion CRAS S106 Consult SHPO_07.28.2026_FINAL.pdf Cultural Resources Survey for the Roberts Road Campus Expansion_20260723 Final.pdf

---

Dear Mr. Frank,

The National Aeronautics and Space Administration's Kennedy Space Center (NASA KSC) intends to lease land to SpaceX for the expansion of its Robert's Road campus. SpaceX is proposing to expand its facilities over approximately 2,230 acres of land adjacent to its current location. Because the property is owned by KSC, the approval of activities for the lease and subsequent construction qualifies as a Federal Undertaking subject to review under Section 106 of the National Historic Preservation Act of 1966. This consultation is being completed in accordance with the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)*.

In April and June 2026, SEARCH, Inc. conducted a Cultural Resources Survey (CRAS) on this parcel of land. The survey was conducted to identify potential historic properties that meet the National Register of Historic Places (NRHP) criteria. The Area of Potential Effects (APE) for the project encompasses approximately 2,230 acres where construction may occur (see Attachment, Figure 1-2). No archaeological or historic resources were found as a result of the survey.

NASA KSC agrees with SEARCH, Inc.'s recommendation that the APE does not have the potential to contain significant archaeological or architectural sites and that no further investigation is necessary within the project area. Given the negative findings of the report, **No Historic Properties Will Be Affected** as a result of this undertaking.

Comments are requested within 30 days. If you have any questions or require further assistance, please contact me.

Sincerely,

Katherine Zeringue
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Subject:	Section 106 Consultation: Cultural Resources Survey for the Roberts Road Campus Expansion Project at the John F. Kennedy Space Center and No Historic Properties Affected Finding
Date:	Wednesday, July 29, 2026 9:02:00 AM
Attachments:	image001.png image002.png Cultural Resources Survey for the Roberts Road Campus Expansion_20260723 Final_Redacted.pdf SpaceX Campus Expansion CRAS S106 Consult SHPO_07.28.2026_FINAL.pdf

---

Dear Consulting Party,

The National Aeronautics and Space Administration's Kennedy Space Center (NASA KSC) intends to lease land to SpaceX for the expansion of its Robert's Road campus. SpaceX is proposing to expand its facilities over approximately 2,230 acres of land adjacent to its current location. Because the property is owned by KSC, the approval of activities for the lease and subsequent construction qualifies as a Federal Undertaking subject to review under Section 106 of the National Historic Preservation Act of 1966. This consultation is being completed in accordance with the *Programmatic Agreement Among the National Aeronautics and Space Administration, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Management of NASA Centers (NPA)*.

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NASA KSC agrees with SEARCH, Inc.'s recommendation that the APE does not have the potential to contain significant archaeological or architectural sites and that no further investigation is necessary within the project area. Given the negative findings of the report, **No Historic Properties Will Be Affected** as a result of this undertaking.

As a Center Consulting Party, you are receiving a redacted version of the CRAS. You may submit comments via email within 30 days of distribution.

If you have any questions or require further assistance, please contact me at 321-867-8454 or Katherine.s.zeringue@nasa.gov.

Sincerely,

Katherine Zeringue
Cultural Resources Manager
Spaceport Integration and Services

Kennedy Space Center
Mail Code: SI-E3
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CULTURAL RESOURCES SURVEY FOR THE ROBERTS ROAD CAMPUS EXPANSION PROJECT KENNEDY SPACE CENTER BREVARD COUNTY, FLORIDA

JULY 2026

SEARCH

CULTURAL RESOURCES SURVEY FOR THE ROBERTS ROAD CAMPUS EXPANSION PROJECT KENNEDY SPACE CENTER BREVARD COUNTY, FLORIDA

PREPARED FOR:

SPACE EXPLORATION TECHNOLOGIES
CAPE CANAVERAL, FLORIDA

PREPARED BY:

SEARCH
8298 BAYBERRY ROAD
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AUTHORED BY:
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LEEANNE MAHONEY
PRINCIPAL INVESTIGATOR

JULY 2026

SEARCH PROJECT NUMBER: 260027

WWW.SEARCHINC.COM

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EXECUTIVE SUMMARY

Space Exploration Technologies Corp. (SpaceX) contracted Southeastern Archaeological Research, LLC (SEARCH) to conduct a Phase I archaeological survey in support of the Roberts Road Campus Expansion (Project) at the Kennedy Space Center (KSC) in Brevard County, Florida. The Project encompasses approximately 902.5 hectares (ha; 2,230.2 acres [ac]) on the west side of Kennedy Parkway North between Schwartz Road and NASA Parkway adjacent to and north of the KSC visitor complex. The survey was conducted to support the National Aeronautics and Space Administration (NASA) KSC in compliance with federal regulatory requirements, including Section 106 of the National Historic Preservation Act and its implementing regulation, 36 CFR Part 800. NASA is the lead federal agency for this undertaking, and the KSC Cultural Resources Manager (CRM) is coordinating the Section 106 compliance, including consultation with the State Historic Preservation Officer (SHPO). Within the area of potential effects (APE), the archaeological survey identified the presence or absence of archaeological sites that may be eligible for listing in the National Register of Historic Places (NRHP).

For the purposes of this survey, the APE is defined as the approximately 902.5 ha (2,230.2 ac) area that may be subject to ground-disturbing effects during construction.

The Phase I archaeological survey was conducted in April and June 2026. No artifacts or archaeological sites were identified within the APE. One previously recorded resource (8BR04444) was revisited that was previously evaluated by SHPO as ineligible for listing in the NRHP. SEARCH recommends that no further cultural resources work is recommended in support of the proposed Project.

SEARCH PROJECT TEAM

Project Management
William Werner, MA, Director
Leeanne Mahoney, MPS, RPA, Principal Investigator

Field Crew
Jeremy Bowers, BA
Ian King, MA
Juliete Ortegon, BA

Laboratory
Greg Hendryx, MA, RPA

Report Preparation
Leeanne Mahoney, MPS
Drew Kinchen, MA, RPA
Jeremy Bowers, BA
Ian King, MA

Peer Review
Charlotte Pevny, PhD, RPA

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1 INTRODUCTION

Space Exploration Technologies Corp. (SpaceX) contracted Southeastern Archaeological Research, LLC (SEARCH) to conduct a Phase I archaeological survey in support of the Roberts Road Campus Expansion (Project) at the Kennedy Space Center (KSC) in Brevard County, Florida. The Project is confined within three discontinuous areas that encompass a total of approximately 902.5 hectares (ha; 2,230.2 acres [ac]) on the west side of Kennedy Parkway North along the north side of Schwartz Road and extending south to NASA Parkway adjacent to and north of the KSC visitor complex (**Figure 1-1** and **Figure 1-2**).

The purpose of the archaeological survey was to identify the presence or absence of archaeological sites within area of potential effects (APE) and to provide recommendations for listing in the National Register of Historic Places (NRHP). The National Aeronautics and Space Administration (NASA) is the lead federal agency for this undertaking, and the KSC Cultural Resources Manager (CRM) will coordinate the Section 106 compliance including consultation with the State Historic Preservation Officer (SHPO). The survey was conducted to support NASA compliance with federal regulatory requirements including Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulation 36 CFR Part 800, and was in accordance with the Florida Division of Historical Resources' (FDHR) recommendations for such projects, as stipulated in the FDHR's *Cultural Resource Management Standards & Operations Manual, Module Three: Guidelines for Use by Historic Preservation Professionals*. The survey also complies with Chapter 267 of the Florida Statutes and Rule Chapter 1A-46, Florida Administrative Code. The principal investigator is a professional archaeologist who meets the qualifications established in the Secretary of the Interior's Standards and Guidelines (48 FR 44716, 29 September 1983).

1.1 AREA OF POTENTIAL EFFECTS

For the purposes of this survey, the APE corresponds to the 902.5 ha (2,230.2 ac) area that may be subject to ground-disturbing activities.

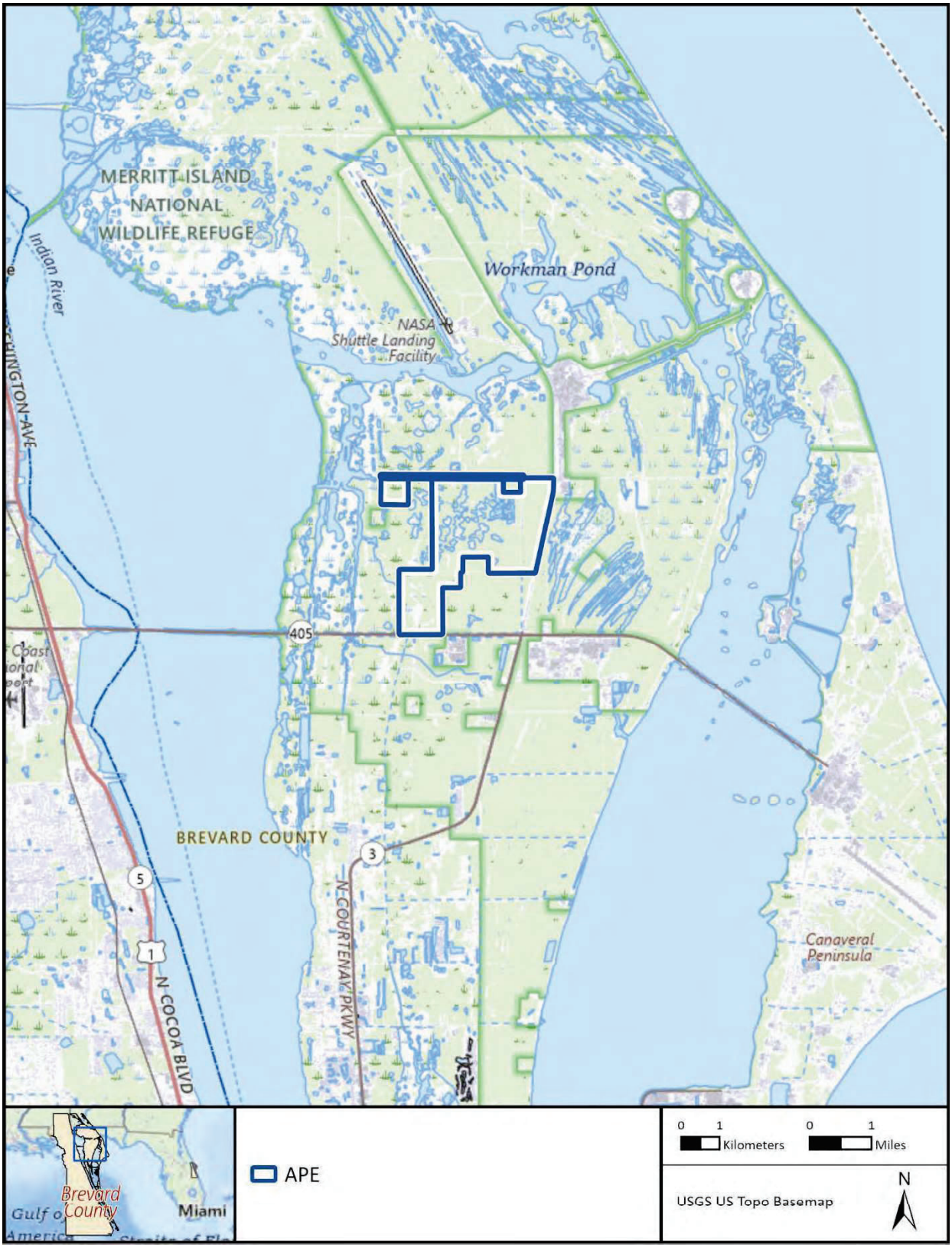

Figure 1-1. Project location on a topographic map.

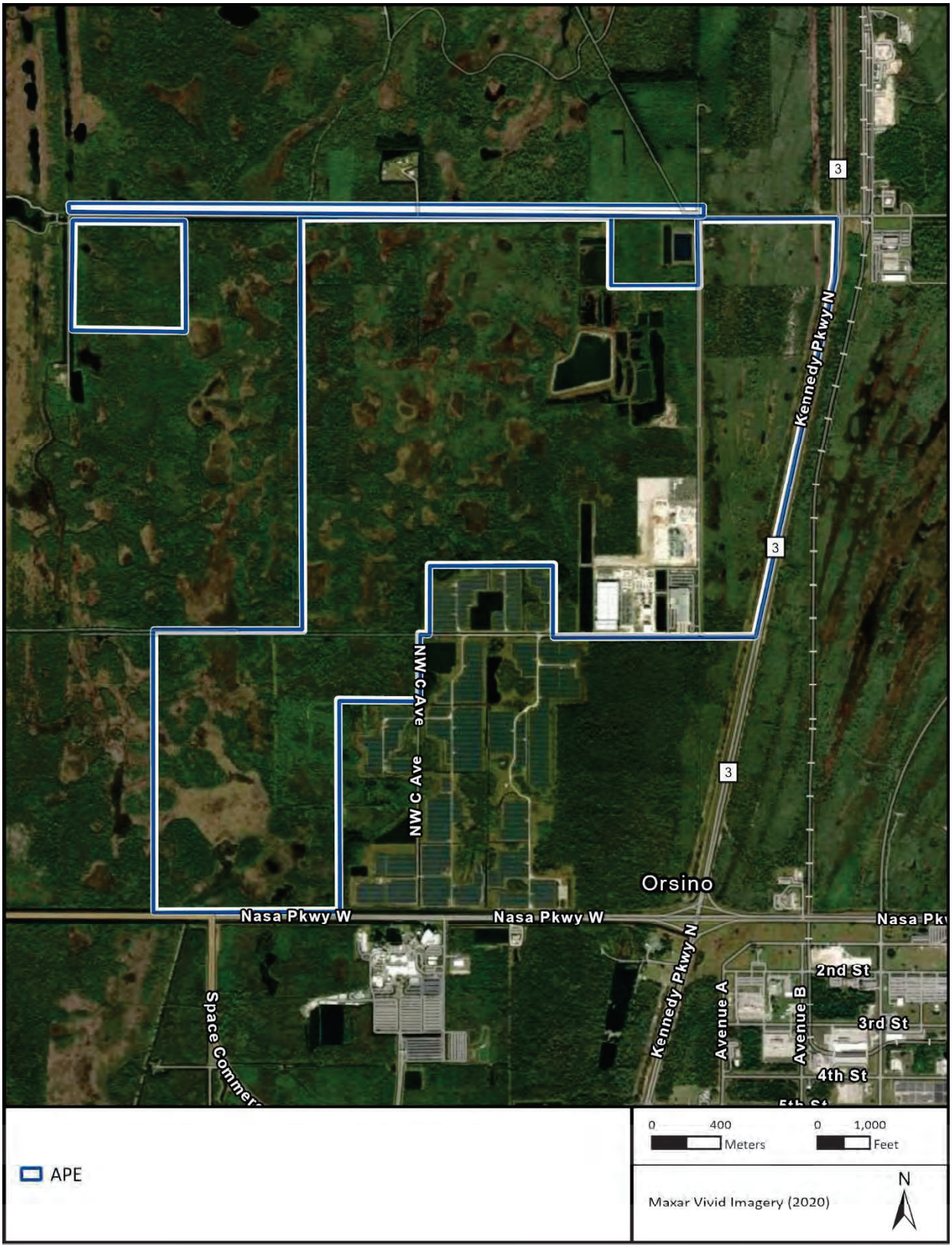

Figure 1-2. Project location on an aerial photograph.

2 ENVIRONMENT

2.1 PHYSIOGRAPHY AND GEOLOGY

The APE is within the KSC on Merritt Island within the Cape Canaveral physiographic province and the larger Eastern Flatwoods District, as defined by Brooks (1981). Brooks (1981) mapped the area as the Cape Canaveral section of the Central Atlantic Coast Strip within the Eastern Flatwoods District. Florida has a complex geologic history with repeated periods of deposition when the Florida Plateau was submerged followed by periods of erosion when the ocean recessed. The earliest underlying formation within the APE is the Avon Park Limestone. The Hawthorn formation is nearest to the surface, and it is overlain by unconsolidated beds of fine sand, shells, clay, calcareous clay of late Miocene or Pliocene age, and then Pleistocene quartz sands (Schmalzer and Hinkle 1990). Merritt Island consists of an accreted series of coastal ridges over Middle and Late Pleistocene coquina, shell, and quartz sand separated by low tidal marshes and swamps and freshwater marsh and swamps. The APE is on the western side of the peninsula and it is characterized by isolated freshwater swamps, low sandy flatwoods with little relief and densely vegetated with saw palmetto, ferns, scrub trees, and hardwoods (**Figure 2-2**). Elevations within the APE range 0.0–1.5 m (0.0–5.0 ft) above mean sea level.

Figure 2-1. Typical environment in the APE.

2.2 SOIL

Soil within the APE are mostly Immokalee sand on the low ridges that follow Kennedy Parkway North, Wabasso sand on the slightly elevated portions of the marine terrace, and Riviera and Winder soils in the terrace depressions (United States Geological Survey Natural Resources

Conservation Service [USGS NRCS] 2026; **Figure 2-3** and **Table 2-1**). Soil across the APE are primarily classified as somewhat poorly to very poorly drained as most of the area has very low topographic relief typical for flood plains on marine terraces of the coastal plain (**Figure 2-4**). Moderately well drained soil in the APE are isolated to the northeast quadrant and represent an area that has been leveled and constructed artificially for development purposes. Soil on the higher portions of the terrace are formed by sandy and loamy marine deposits and typically loamy alluvium in the depressions.

Table 2-1. Soil Map Units and Drainage Classifications.

Soil Map Unit	Drainage Class	Acres	Hectares	Percentage
Chobee sandy loam, frequently flooded	Very poorly drained	4.69	1.90	0.21
Chobee mucky loamy fine sand, depressional	Very poorly drained	35.41	14.33	1.59
Copeland-Bradenton-Wabasso complex, limestone substratum	Poorly drained	179.83	72.78	8.06
Riviera sand, 0–2% slopes	Poorly drained	73.80	29.87	3.31
Anclote sand, frequently ponded, 0–1% slopes	Very poorly drained	15.53	6.28	0.70
Riviera and Winder soils	Poorly drained	18.26	7.39	0.82
Riviera and Winder soils, depressional	Very poorly drained	475.01	192.23	21.30
Floridana sand, frequently ponded, 0–2% slopes	Very poorly drained	14.07	5.70	0.63
Immokalee sand, 0–2% slopes	Poorly drained	162.21	65.64	7.27
Myakka sand, 0–2% slopes	Poorly drained	99.22	40.15	4.45
Pomello sand, 0–5% slopes	Somewhat poorly drained	18.97	7.68	0.85
Quartzipsamments, smoothed	Moderately well drained	32.77	13.26	1.47
St. Johns sand, 0–2% slopes	Poorly drained	203.81	82.48	9.14
St. Johns sand, depressional	Very poorly drained	16.47	6.67	0.74
Turnbull and Riomar soils, tidal	Very poorly drained	101.12	40.92	4.53
Udorthents, steep	Well drained	0.04	0.02	0.00
Basinger sand, depressional	Very poorly drained	14.29	5.78	0.64
Basinger sand, 0–2% slopes	Poorly drained	30.61	12.39	1.37
Wabasso sand, 0–2% slopes	Poorly drained	549.17	222.24	24.62
Bradenton fine sand, limestone substratum	Poorly drained	179.94	72.82	8.07
Water	Very poorly drained	4.97	2.01	0.22
Total		**2230.16**	**902.5**	**100.0**

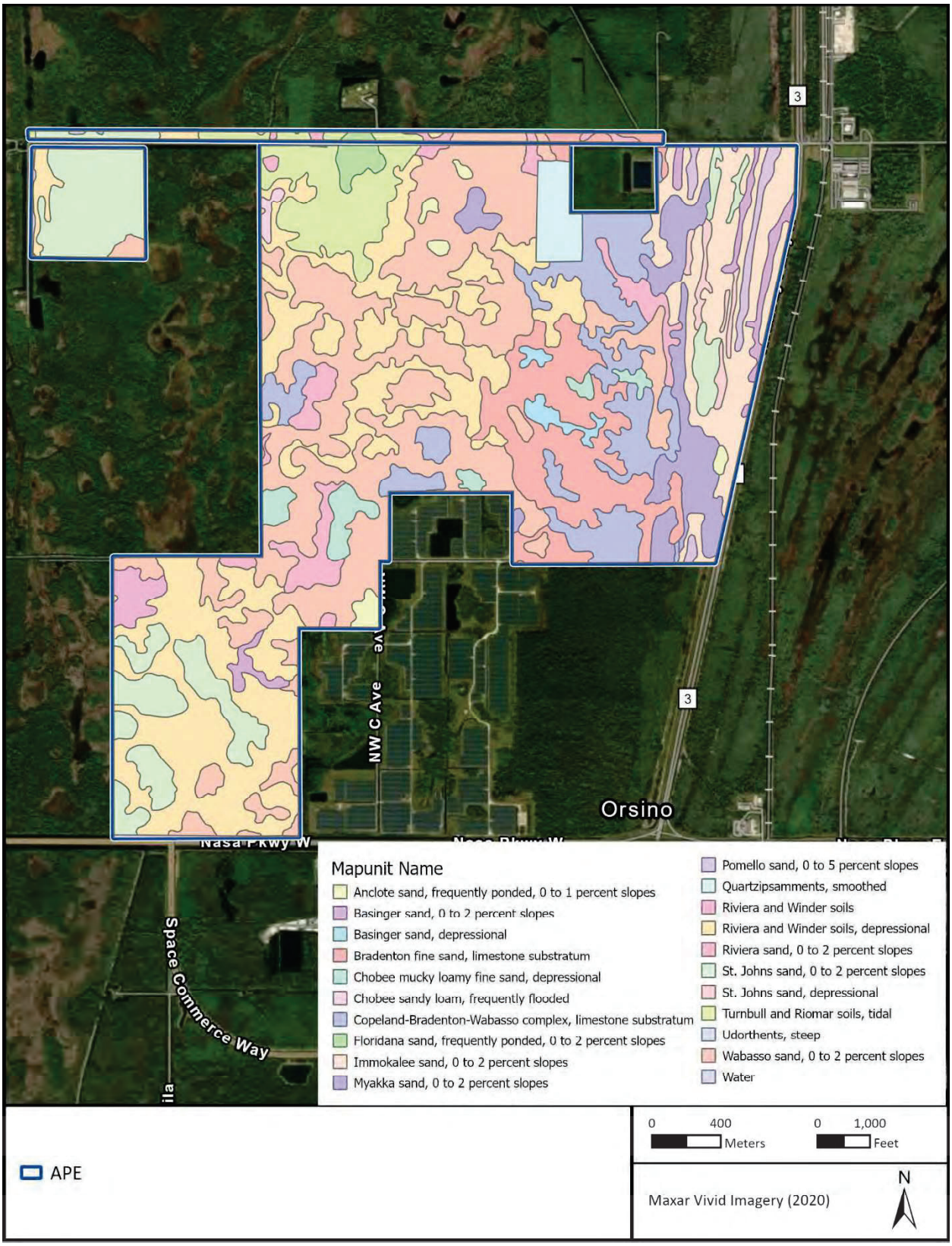

Figure 2-2. Mapped soil units within the APE.

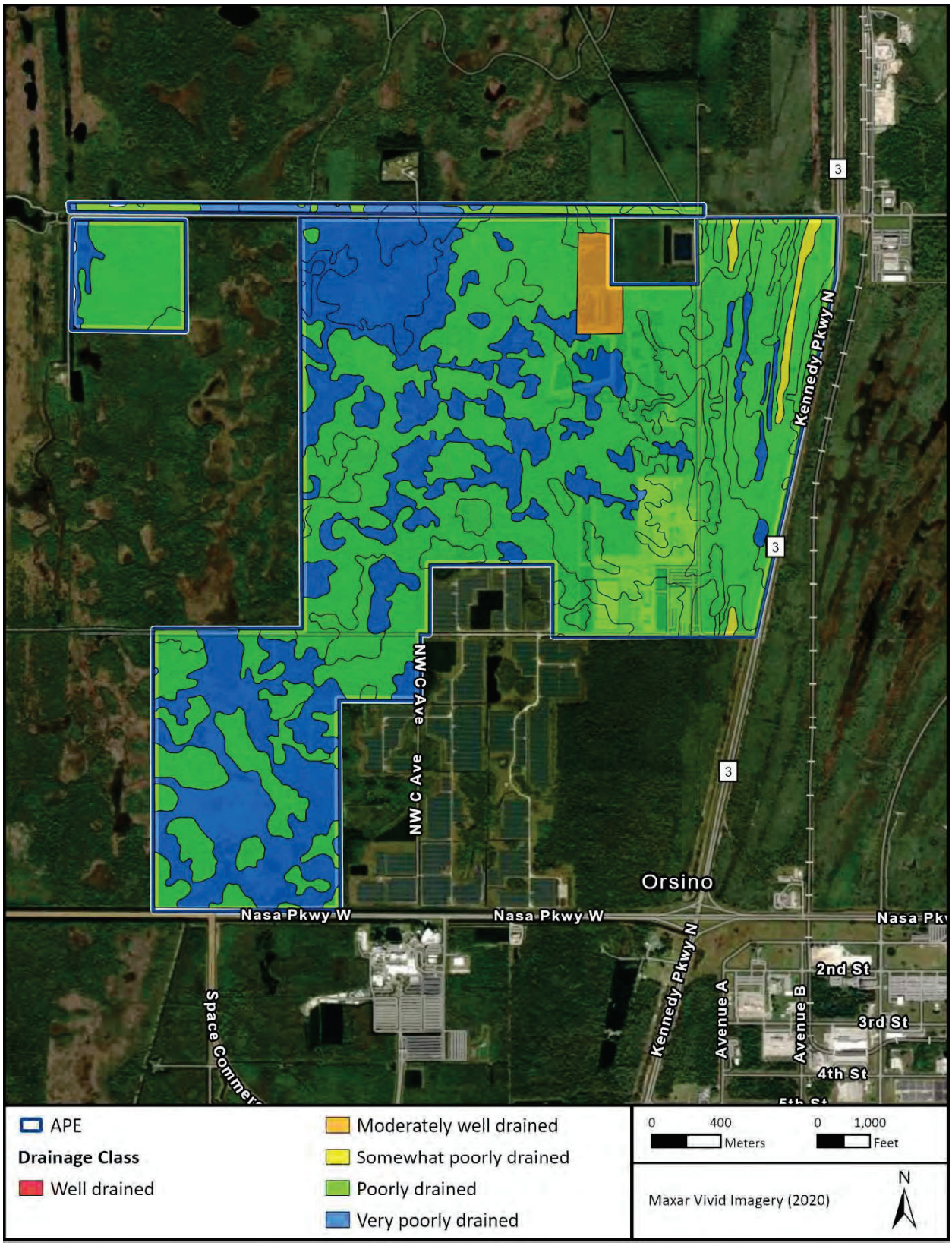

Figure 2-3. Soil drainage class within the APE.

2.3 PALEOENVIRONMENT

Approximately 24,000 to 18,000 years ago, during the Last Glacial Maximum, global ice volumes were greatest and temperatures were about 11 degrees colder than today (Ehlers and Gibbard 2004). However, this period was also characterized by a slow warming trend that melted massive ice sheets resulting in global sea-level rise (Rohling et al. 1998). By 22,000 years ago, Gulf of America sea levels were at a low stand of 125.0 to 130.0 m (410.1 to 426.5 ft) below modern levels (Joy 2019:109), and Pleistocene shorelines extended at least 200 km (124 mi) further south than today's (Balsillie and Donoghue 2004; Gagliano et al. 1982; Saucier 1994:49–50).

After about 17,000 years ago, global melting of the ice sheets (deglaciation) led to sea-level rise and transgression of the continental shelves, particularly Florida's western margins that drain the Floridan aquifer-fed rivers. Even during the Younger Dryas, the last return to glacial conditions about 13,800 years ago, meltwaters slowed, but sea level continued to rise at least 60.0 m (196.9 ft) over the next 2,400 years (Joy 2019). Sea levels, though higher, were still much lower than at present; along the Gulf of America Coast, extensive grasslands probably existed, possibly attracting mammoth, bison, and other large grazing mammals.

The rate of sea-level rise was gradual for 13,000 years to about 4,500 years ago; however, the rate and magnitude of ice melt was punctuated by three "melt-water pulses" that occurred in the late Pleistocene and early Holocene at approximately 14,200, 11,400, and 8000 years ago (Blanchon 2011). Florida's inland wetlands, lakes, and ponds formed mostly after 9000 years ago (Watts and Hansen 1988). By about 6000 years ago, Florida's climate included increased precipitation and surface water flow, as indicated by increased pine and wetland pollens, including abundant cypress, which indicates broad new areas of wetland habitat in the later pollen records (Watts and Hansen 1988; Watts et al. 1992). Higher sea levels and elevated water tables resulted in essentially modern conditions by the late Holocene, approximately 4500 years ago. The climate, water levels, and plant communities of Florida have been relatively stable during the past 4,000 years.

3 CULTURAL OVERVIEW

3.1.1 Paleoindian Period (12,000–10,000 BP)

The most widely accepted model for the peopling of North and South America is that Asian populations migrated to North America over the Beringia land bridge that formerly linked Siberia and Alaska some 12,000 years ago. The timeline of human occupation on the Americas continues to change with new data. There is evidence of human migrations that date before 12,000 years ago (Adovasio et al. 1990; Dillehay et al. 2008) and more recent research supports that previous data could be inaccurate (Surovell et al. 2026). Regardless of the precise timing of the first occupations of North and South America, the current evidence suggests that Florida was inhabited by humans by 12,000 years ago. Claims for an earlier occupation (e.g., Purdy 1981, 2008) are controversial. The best evidence for earlier occupation comes from the Sloth Hole and Page-Ladson sites in Jefferson County, where radiocarbon dates pre-dating 12,000 BP have been obtained from levels containing lithic waste flakes, but no diagnostic tool forms (Dunbar 2002, 2006; Hemmings 1999, 2004). Both sites are inundated river sites, and although the contexts are thought to be intact, there is a possibility of the downward movement of artifacts from the overlying artifact-bearing levels.

The conventional view of Paleoindian existence in Florida has been that people were nomadic hunters and gatherers in an environment quite different from that of the present. Excavations at the Harney Flats site in Hillsborough County (Daniel and Wisenbaker 1987) have altered this view, and many archaeologists now believe that people during the Paleoindian period lived part of the year in seasonally inhabited occupation sites near critical resources, such as fresh water.

3.1.2 Archaic Period (10,000–2500 BP)

During the subsequent Archaic period (10,000–2500 BP), human populations began to expand outward from north-central Florida as the climate became wetter and water sources were more prevalent. After the demise of Pleistocene fauna, human subsistence strategies became more diverse and included new plant, animal, and aquatic species. People began to live in larger groups, use different types of stone tools, and inhabit more of what is now Florida.

The Early Archaic (10,000–7000 BP) represented a continuity of the Paleoindian occupation of Florida and occurred during a time of rising sea levels, a gradual warming trend, and the spread of oak hardwood forests and hammocks. Numerous small Early Archaic special activity and camp sites have been identified throughout the East Central Florida region (Milanich 1994). The Middle Archaic (7000–5000 BP) was a wetter period, with the intrusion of mixed pine and oak into the hardwood forest. As conditions became wetter, large river systems and wetlands developed, and people began to exploit the resources associated with these aquatic habitats. This trend continued into the Late Archaic period (5000–2500 BP); however, there is evidence that the environment became slightly drier during this period and that aquatic habitats were fewer and not as deep (Russo 1986). Precontact populations in Brevard County were likely much smaller than in more populated locales along the lower St. Johns River.

The earliest pottery was tempered with plant fibers. The people who made fiber-tempered pottery practiced a lifestyle of hunting, gathering, and incipient horticulture. One of the centers of early pottery production was along the Atlantic Coast between southern South Carolina and northern Florida. Fiber-tempered pottery was made with naturally occurring clays; plant fibers were added to the clay as a tempering agent to strengthen it. Traditionally, manufacture of this ware was believed to span approximately 1,500 years, with plain and decorated variants (e.g., incised, and punctated types) undergoing periods of stylistic popularity (Bullen 1972). Radiometric analysis, however, suggests that the production of fiber-tempered wares, at least in the Middle St. Johns River Valley, spanned a shorter interval from about 4100–3600 BP (Randall and Sassaman 2005) with stylistic variability attributable to ethnic, sociopolitical, and functional factors more than to temporal trajectory (Sassaman 2003).

3.1.3 Post Archaic Period (2500–500 BP)

By 2500 BP, regional adaptations were well established. Archaeologists subdivided the state into geographic areas that share similar archaeological traits. The APE is within the Indian River region of the East and Central Lake archaeological region. The Indian River region extends from the Indian River–St. Lucie county line northward along the Atlantic coast to Merritt Island in Brevard County (Milanich 1994; Rouse 1951). The western boundary extends about 32 km (20 mi) inland to the St. Johns River drainage and tributaries.

Irving Rouse (1951) first described archaeological cultures in the Indian River area as Malabar. His chronology framed Malabar as a local variant of the St. Johns tradition, which grew out of the Orange pottery of the Late Archaic period. Mostly known from sites in its core area of northeast Florida, the St. Johns tradition is characterized by chalky pottery first produced beginning about 2500 BP. Increased population and settlement numbers, construction of sand burial mounds, continued economic dependence on aquatic resources, and greater emphasis on plant cultivation accompanied the changed ceramic production (Goggin 1952:40; Milanich 1994:243–274). Significant amounts of sand-tempered pottery also characterize Indian River pottery assemblages. This pottery may indicate influence from adjacent culture areas. Some vessels were likely made from the same local clays as the St. Johns wares (Espenshade 1983).

Table 3-1 presents the post-Archaic ceramic chronology of the Indian River region. Cordell's (1985) analysis of pottery from several sites in Brevard County largely informs the sequence. The sequence appears to be applicable to other portions of the Indian River region and the east and central archaeological region of Florida (Milanich 1994). Dates assigned to these periods are estimates extrapolated from Milanich's chronology for the entire East and Central Lakes archaeological region (Milanich 1994:247).

Table 3-1. Post-Archaic Ceramic Chronologies in the Indian River Region.

Years BP	Period	Distinguishing Traits
500–250	Period III	Introduction of European artifacts. St. Johns Check Stamped continues.
1250–500	Period II	St. Johns Check Stamped appears in combination with St. Johns Plain. Sand-tempered plain remains at about 10 percent. Belle Glade Plain remains a minority type.
1500–1250	Late Period I	St. Johns Plain returns to dominance as sand-tempered plain decreases to about 10 percent. Slight increase in Belle Glade Plain (3 percent).

Table 3-1. Post-Archaic Ceramic Chronologies in the Indian River Region.

Years BP	Period	Distinguishing Traits
2000–1500	Middle Period I	St. Johns Plain is still predominant, but sand-tempered plain increases to about 30 to 40 percent of assemblages. Belle Glade Plain present in very small amounts (less than 1 percent).
2500–2000	Early Period I	Decrease in fiber-tempered pottery. St. Johns Plain is the dominant ware. Minor representation of sand-tempered plain.

Sources: Carr et al. 1995; Cordell 1985; Milanich 1994

In the above table, Malabar I corresponds to the Early Period and continues into Period II. Malabar II is characterized by the appearance of St. Johns Check Stamped pottery, beginning in Period II, and continuing through Period III (Milanich 1994:250; Rouse 1951). The Indian River region was not widely influenced by Mississippian culture. Some exotic goods have been identified in Malabar II contexts, but these are sparse and infrequent (Penders 2012). Interaction was more frequent between coastal groups and interior groups of the Indian River region. Most sites recorded at Cape Canaveral are along the Banana River.

Interior sites include small, special-use campsites and larger, multicomponent sites featuring extensive midden deposits that may indicate permanent habitation. Russo's (1986) analysis of faunal remains from interior sites denotes a dependence on aquatic resources, including turtles, waterfowl, fish, and freshwater mussels. Throughout the post-Archaic period, wetland resources expanded. Water sources deepened, providing suitable habitats for more and larger fish, such as bass and pickerel. During the dry months (winter and spring), water sources shrank and provided habitat for fish species, such as bowfin and gar, that favor shallow, muddy-bottomed ponds. Terrestrial animals, including deer, raccoon, and rabbit, also were exploited. Dietary emphasis was definitively on freshwater wetland resource acquisition.

Coastal sites were present in many locations along the Indian River lagoon, the adjacent uplands, and on the barrier islands. Although modern development destroyed many of these sites, a few have been investigated and provided information on coastal adaptations. Evidence suggests that the coast was utilized seasonally during the winter and spring months of the year when interior wetlands were less abundant. The data indicate that some sites were small, extractive sites occupied by only a few individuals, while other larger sites served as habitation sites. People exploited marine fish, shellfish (especially coquina), and some terrestrial animals for food (Milanich 1994:252–253). It is unclear whether the same populations moved back and forth between the coast and the interior, or whether separate populations inhabited these two areas.

Mortuary practices intensified in the Malabar I and II periods. Shell and sand mounds were commonly built in the Indian River region but are not easy to differentiate between Malabar I or Malabar II periods (Rouse 1951; Penders 2012). At Cape Canaveral, mounds are located adjacent or in proximity to habitation areas, unlike other areas of Florida where mounds are positioned away from associated occupation sites (Penders 2012). A review of the Florida Master Site File (FMSF) indicates that there are no mounds within or in the vicinity of the APE. The DeSoto Grove burial mound (8BR00083) is over 9.9 km (6.0 mi) south.

3.2 POSTCONTACT CONTEXT

The following is a historic context of Brevard County from European exploration to the present.

3.2.1 European Exploration and Early Settlement (1513–1821)

The area that is now Brevard County served as an important stage for many early European expeditions in North America. Some historians believe that the Italian captain John Cabot sailed south along the Brevard County coast during his 1498 explorations (Dovell 1952; Eriksen 1994). There is also evidence that Spanish ships raided indigenous coastal villages to capture and enslave people. When Juan Ponce de León came to Florida, he found a local who understood Spanish. Ponce de León left Puerto Rico on March 3, 1513, with three ships. After sailing on a northwesterly course for 30 days, the ships landed either north of Cape Canaveral or in the vicinity of modern-day Melbourne Beach (Eriksen 1994; Gannon 1996; Milanich 1995). Ponce de León sighted land during the Feast of Flowers (Pascua Florida) and called it La Florida (Milanich 1995). Ponce de León remained at this initial landing place for six days before pulling anchor and sailing toward Jupiter Inlet, where he landed to restock firewood and water for the ships. The fleet rode the countercurrents of the Gulf Stream to Biscayne Bay and eventually rounded the southern tip of the peninsula (Gannon 1996; Milanich 1995). The island off the Brevard County coast became known as Canaveral, the Spanish term for canebrake. Many sixteenth-century maps depict Cape Canaveral, which is one of the oldest place names in North America (Eriksen 1994).

The Gulf Stream off the Brevard County coast emerged as an important thoroughfare for the transportation of American raw materials to Europe. Spanish treasure galleons rode this warm current from Havana through the Bahama Channel. Wrecks occurred regularly in the treacherous shoals around Cape Canaveral, and the local Native American tribe, the Ais, often recovered the cargo. Spain realized the importance of this trade route, and when the French established a colony, Fort Caroline, on the St. Johns River near modern-day Jacksonville, they tasked Pedro Menéndez de Avilés, a highly respected officer in the Spanish navy, with eradicating French influence in the area and starting a colony in la Florida (Milanich 1995). The French colony awaited supplies and reinforcements coming from France under the command of Jean Ribault. Menéndez felt it crucial to reach and destroy Fort Caroline before Ribault arrived. In August 1565, Menéndez, with his fleet of 10 ships, sighted Cape Canaveral (Gannon 1996; Milanich 1995). The Spanish force searched for six weeks along the northern Florida coast before they found the French fort. A tropical storm had scattered the French defenses and left the fort an easy target for Menéndez to destroy. During the gale, a ship of French colonists wrecked somewhere near Cape Canaveral. While Menéndez marched south along the coast to meet the wayward French force, he kept a detailed description of the area, including Brevard County. The Spanish constructed the garrison Santa Lucia on the high plateau near Jupiter Inlet as a line of defense for the new colony (Eriksen 1994; Milanich 1995).

In 1605, Spain sent a delegation under the command of Álvaro Mexía to the Brevard County area. Spanish officials charged the diplomat with placating the Ais and mapping the region. His

mission proved successful. Mexía became an honorary chief of the tribe and explored the Indian and Banana Rivers (which the Spanish called Río de Ais and Ulumay Lagoon). Mexía's maps detail many Native American settlements along the shores of Mosquito Lagoon (at the north end of the Indian River). It is possible that his entourage spread orange seeds along the banks of the Indian River (Eriksen 1994).

On July 24, 1715, a flotilla of 11 Spanish ships carrying 14 million pesos in gold, silver, and jewels left Havana for Europe. A few days into the voyage, 10 of the 11 ships wrecked off the East Florida coast between St. Lucie and Mantanzas. Approximately 700 sailors died, and an additional 1,500 washed up on the coast. The Ais aided the Spaniards by providing them with supplies and instructions for gathering food in the dunes. The Spanish government, desperate to recover the lost treasure, established an encampment of salvers in the vicinity of the present-day Sebastian State Park in the far southern portion of Brevard County. Salvers recovered only one-third of the lost cargo (Eriksen 1994).

In the mid-1700s, European colonial powers fought a worldwide war, the Seven Years War, as a means to consolidate their colonial holdings. After Britain prevailed in the Seven Years War in 1763, it traded Havana to Spain for Florida. The British divided the colony along the Apalachicola River into East and West Florida. In 1765, the botanist John Bartram and his son William searched for the St. Johns River headwaters (Eriksen 1994; Tebeau 1980 [1971]). The two were the first Europeans to document the Brevard County region (Eriksen 1994). In 1783, the Treaty of Paris restored Florida to Spain, whose control of the territory would remain tenuous (Tebeau 1980 [1971]). Vicente Manuel de Zéspedes, the Spanish governor, wrote to the king in 1785 that isolated groups of Americans had settled in the area (Eriksen 1994; Tebeau 1980 [1971]). Immigrants from the tribes north of Florida now numbered 5,000 to 6,000 in the colony. The majority of these "Seminoles" remained west of the St. Johns River. The area known as the Mosquito Coast included present-day Brevard County (Eriksen 1994).

The American colonies declared their independence from British rule in 1776. The last naval battle of the American Revolutionary War took place off the coast of Cape Canaveral on March 10, 1783, when the British HMS Sybil gave chase to two Continental Navy Ships that were carrying silver from Cuba to support the Continental Army. The battle resulted in a victory for the American side with the HMS Sybil badly damaged and fleeing from the fight (FDHR 2024). In 1783, the Treaty of Paris ended the American Revolution and returned Florida to Spain.

3.2.2 American Territorial Period through the Civil War (1812–1861)

Florida became a territorial possession of the United States after President James Monroe ratified the Adams-Onís Treaty on February 22, 1821. The United States government appointed General Andrew Jackson governor of the territory later that same year (Eriksen 1994; Tebeau 1980 [1971]). Jackson partitioned Florida into two counties: Escambia to the west and St. Johns to the east. In 1824, the area encompassing most of east-central Florida, including Brevard County, officially became Mosquito County.

In 1835, the Second Seminole War brought conflict to eastern Florida. Along with a severe freeze in 1835, the war decimated Mosquito County's population, as most everyone fled to safe havens outside the county (Shofner 1995:36). The war ended in 1842, and on March 14, 1844, the territorial government created St. Lucie County (present-day Brevard County), from Mosquito County (Carter 1962:994–995; Dunn 1998:34).

On March 3, 1845, Florida became the twenty-seventh state admitted to the Union (Eriksen 1994). Judge Theodore Washington Brevard settled in Tallahassee two years later. He spent 12 years as state comptroller and became the namesake for Brevard County on January 6, 1855, when it was founded. This new county encompassed more than 18,130 square km (7,000 square mi) and had its seat of government in the small town of Susannah, north of Fort Pierce (Eriksen 1994; Fernald and Purdum 1992; Morris 1995). John Houston established Arlington, the first permanent US settlement in southern Brevard County, in 1854 (Eriksen 1994).

On January 10, 1861, Florida seceded from the Union. Brevard County remained far removed from the battlefields to the north but still played an important role in the war. The settlers along the Indian River engaged in salt production for the Confederate Army. Blockade runners frequently utilized the inlets and bays of the Indian River and Mosquito Lagoon during their smuggling ventures (Tebeau 1980 [1971]).

3.2.3 Late Nineteenth Century (1861–1899)

Prior to the 1880s, water transportation, by sea and river, was the dominant mode of long-distance travel for most of Florida's residents. Due to Florida's low population, underdevelopment, and lack of capital, railroads entered the state slowly. By the mid-1800s, Florida had only one successful rail line, and it connected Tallahassee to the Gulf of America at St. Marks (Brown 1991:13–14). Most of Florida's roads were bumpy, waterlogged (during summer months), sand-laden trails that even ox teams had a difficult time traversing. With the arrival of Henry Flagler and Henry Plant in the 1880s, trains began to cross the Florida landscape. Railroads generally brought growth to the communities and regions they touched (Covington 1957:136, 169; Johnson 1966:129).

3.2.4 Twentieth Century to Present (1900–Present)

By the end of the nineteenth century, Florida had concerted an effort in road development across the state. With the proliferation of railroads, farmers, merchants, and others advocated for improved roads to transport goods and people to and from the railroad depots. During the 1910s and 1920s, the number of automobiles in the state and nation increased, exerting more pressure on the government to construct and improve roads. Prior to 1924, only 1,204 km (748 mi) of hard-surfaced road existed in the state. By 1928, this number had grown to 2,556 km (1,588 mi), and 95 km (59 mi) in the process of being paved (Jackson 1992; Kendrick 1964; Tebeau 1980 [1971]). Not surprisingly, as car ownership increased and roads improved, train dominance diminished.

In 1917, Brevard County achieved its modern-day dimensions when the southern portions of the county became St. Lucie and Okeechobee Counties, and the western portion became Osceola County (Fernald and Purdum 1992). The center of population in the county shifted from Titusville in the north to Eau Gallie, Cocoa, and Melbourne in the south. A bridge constructed from Cocoa to Merritt Island opened a link to the many small communities on the coast. By the mid-1920s, four bridges spanned the Banana River, and new towns were established along the beaches as a result of these bridges (Eriksen 1994).

Cape Canaveral and the islands off the coast had been primarily isolated until the construction of bridges connecting them to the mainland (Lethbridge 2021). However, even after the construction of bridges, they remained sparsely settled for several more decades (Hiller 2005). By 1936, only two settlements remained evident near Cape Canaveral: Canaveral and Artesia (Florida State Road Department 1936). At the dawn of World War II, roughly 100 people called Cape Canaveral home (Lethbridge 2021). As war approached in 1939, the military chose land south of Cocoa Beach to build the Banana River Naval Air Station (Eriksen 1994). At war's end, the US government deactivated the Banana River Naval Air Station (Morris 1948; Stone 1988). In 1949, President Harry S. Truman established the Joint Long Range Proving Ground at Cape Canaveral. Banana River Naval Air Station became Patrick Air Force Base in 1950 and hosted experimental launches of hybrid rockets as a supporting base for Cape Canaveral. Following the launch of Soviet satellites into orbit in 1957, American interests turned to space exploration. Originally the new mission belonged to the Department of Defense, but in 1958, President Dwight D. Eisenhower formed the National Aeronautics and Space Administration (NASA 2025).

Settlement in present-day Cape Canaveral boomed with the arrival of the space program. NASA began operations on the Cape in 1958, when the Army Missile Firing Laboratory transferred to NASA. Initially, the agency used several Cape Canaveral Air Force Station facilities, including offices, hangars, and several launch complexes. The US Army Corps of Engineers acted as purchasing agent for NASA, and NASA slowly gained title to 56,656 ha (140,000 ac) on Merritt Island. This new stretch of land included the small towns of Orsino, Wilson, Health, and Audubon, as well as orchards, crop land, and several small fishing villages. The state of Florida provided submerged land and much of the land south of the old Haulover Canal and north of the barge canal. Improvements to the area began, including the widening of several roads, such as sections of State Road A1A (Hiller 2005). As plans and building progressed, NASA and the US Fish and Wildlife Service (USFWS) reached an interagency agreement on August 28, 1963, that the USFWS would retain management of all land not used for NASA operation (USFWS 2015). This land is jointly managed between the Merritt Island National Wildlife Refuge and the National Park Service/Canaveral National Seashore. Currently, the Merritt Island National Wildlife Refuge manages 20,997 ha (51,885 ac) of KSC property, in addition to jointly managing 13,935 ha (34,434 ac) with the Canaveral National Seashore.

The construction of KSC began in 1963 and included a complex of more than 50 buildings on the island and one of the largest single-story buildings in the world: the Vehicle Assembly Building. The facility was named John F. Kennedy Space Center in 1963 following the assassination of

President John F. Kennedy. The space industry had a dramatic effect on the area. Brevard County grew by 371 from 1950 to 1960, and that population had doubled by 1970 (Tebeau 1980 [1971]). This growth continued, and by 1990, Brevard County had nearly 400,000 residents (US Census Bureau 1996).

As the NASA mission changed, the facilities adapted to meet its needs. In recent years, the KSC has begun a new era of space exploration with the closure of the Space Shuttle program and the conversion of facilities to commercial launch sites that could host multiple types of spacecraft. Brevard County continued to benefit from its location along the Space Coast, and its population reached 500,000 by 2010 (US Census Bureau 2010).

4 HISTORIC MAP AND AERIAL PHOTOGRAPHY REVIEW

SEARCH examined historic maps and aerial photographs to identify past land use within and in the vicinity of the APE. The earliest resource studied were Bureau of Land Management (BLM) General Land Office (GLO) survey maps. Government land surveyors created GLO maps during the nineteenth century as part of the surveying, platting, and sale of public lands. In Florida, these maps show landscape features such as vegetation, waterbodies, roads, and Spanish land grants. The level of detail in GLO maps varies—some also depict structures, Native American villages, railroads, and agricultural fields. A GLO map of Florida Township 22 South, Ranges 36 and 37 East, depict no development within the APE, which is shown as water in the northwestern half (GLO 1860a, GLO 1860b).

Aerial photography taken in 1949 depicts the APE as mostly within a cluster of pools and lagoons that form along Banana Creek and Moore Creek (USGS 1949a; **Figure 4-1**). Schwartz Road abuts the north side of the APE, Kennedy Parkway North abuts the eastern side of the APE, NASA Parkway West abuts the APE to the south, and Roberts Road is routed through the central portion of the APE. A Avenue Northeast is routed north-south through the eastern portion of the APE connecting Schwartz Road with Roberts Road. Land disturbing activities are visible outside of the south-central portion of the APE and along NASA Parkway West. A 1949 topographic quadrangle map illustrates the area within the APE as scattered with lagoons and marsh (USGS 1949b; **Figure 4-2**). An unimproved road parts from Roberts Road and meanders over the lagoons in the western portion of the APE. The developments that are visible in the aerial photograph are depicted and a cluster of six structures are illustrated along Roberts Road within the development that is south-central of and outside of the APE. Another development is illustrated within the APE near the intersection of Roberts Road and Kennedy Parkway. Aerial imagery from 1958 depicts a cluster of structures or possible homestead in the west-central portion of the APE at the end of the unimproved road that departs from Roberts Road that is also visible in the 1949 aerial photograph. Additionally, a path or road appears to meander from the south side of Schwartz Road to a possible building and agricultural land in the northwestern portion of the APE (**Figure 4-3**).

A 1970 topographic quadrangle map depicts the APE much like the previous 1949 topographic quadrangle map with the only new activity appearing to be borrowing or other land disturbing activity in the north along Schwartz Road (USGS 1970; **Figure 4-4**). Outside of the APE, developments around Orsino to the southeast have increased significantly. By 1976, the cluster of structures, unimproved roads, and canal depicted in the west-central portion of the APE on the 1958 aerial discussed above are no longer visible in aerial photographs and topographic quadrangle maps and the vegetation appears to have regrown. There is e increased activity around the borrow area in the northeast portion of the APE with several unimproved roads appearing as routed in the direct vicinity of the area (USGS 1976a, 1976b; **Figure 4-5** and **Figure 4-6**). By the mid to late 1990s, aerial imagery shows that the northeast portion of the APE had been subjected to further borrow activity with large, inundated pits (**Figure 4-7**).

No further development is evident within the Project until the 2020s. Modern aerial photographs depict a solar farm abutting the south-central portion of the APE and SpaceX's Roberts Road campus has begun construction in the northwest quadrant of the intersection of Roberts Road and A Avenue.

Figure 4-1. Aerial photograph showing the APE (USGS 1949a).

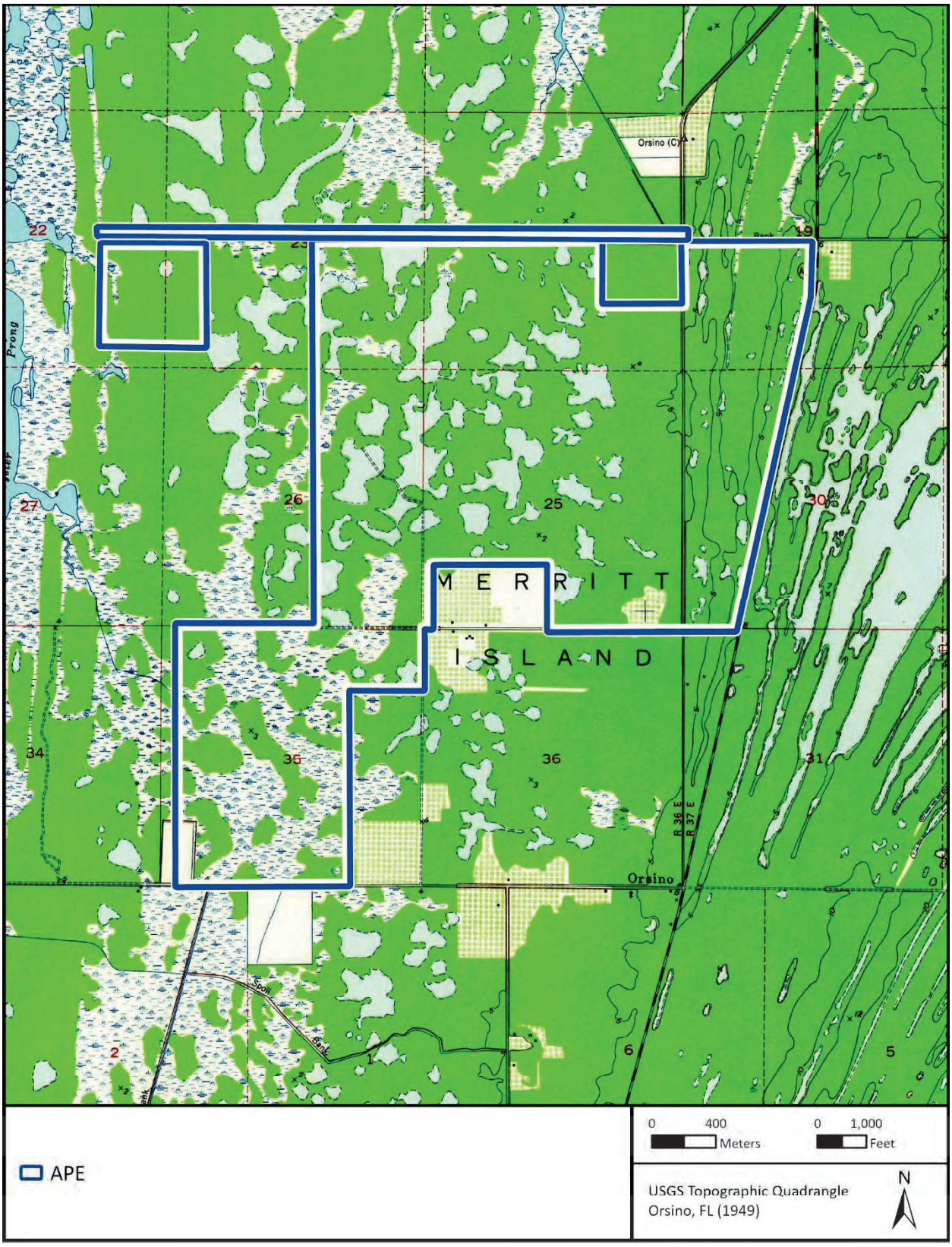

Figure 4-2. USGS topographic map showing the APE (USGS 1949b).

Figure 4-3. Aerial photograph showing the APE (USGS 1958).

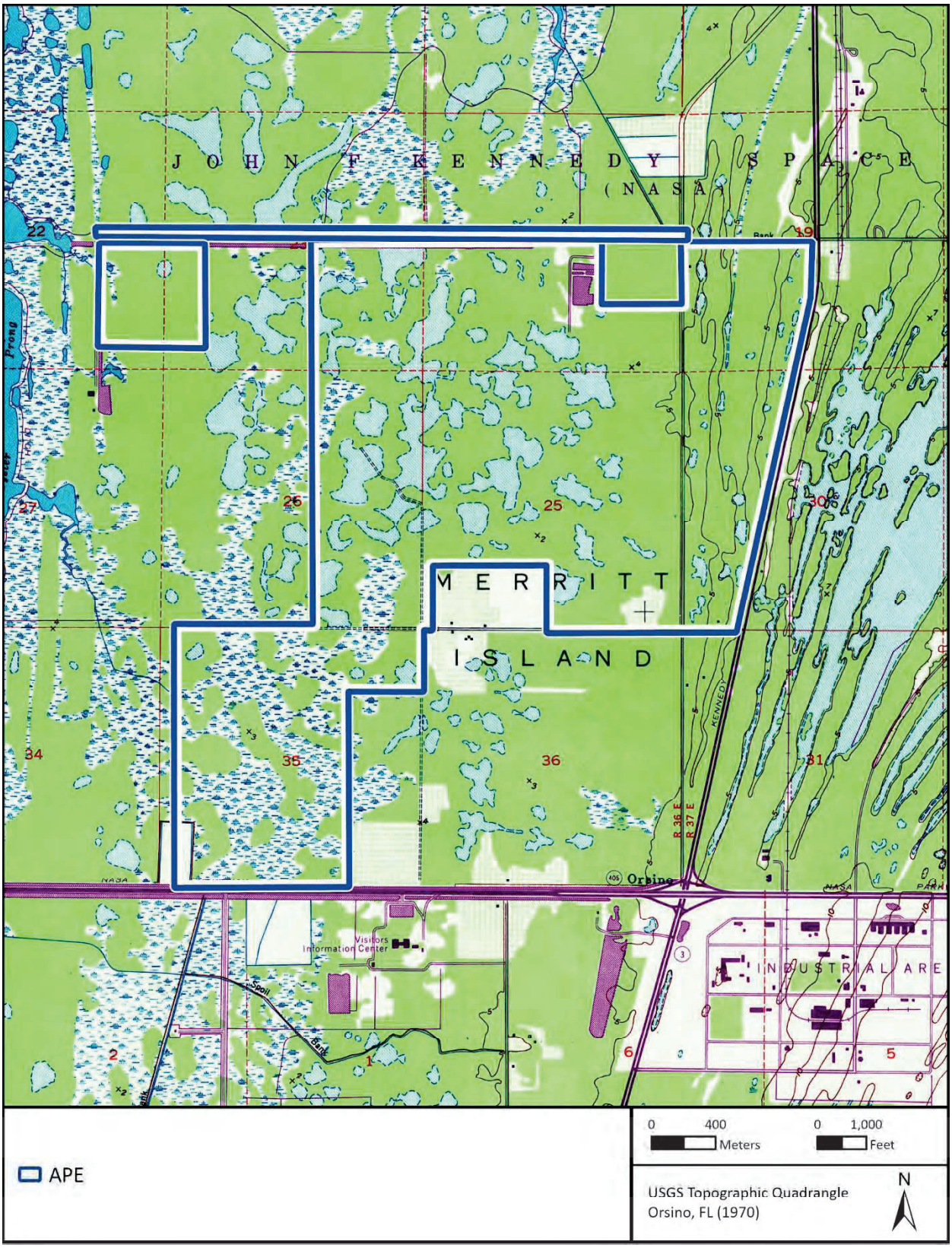

Figure 4-4. USGS topographic map showing the APE (USGS 1970).

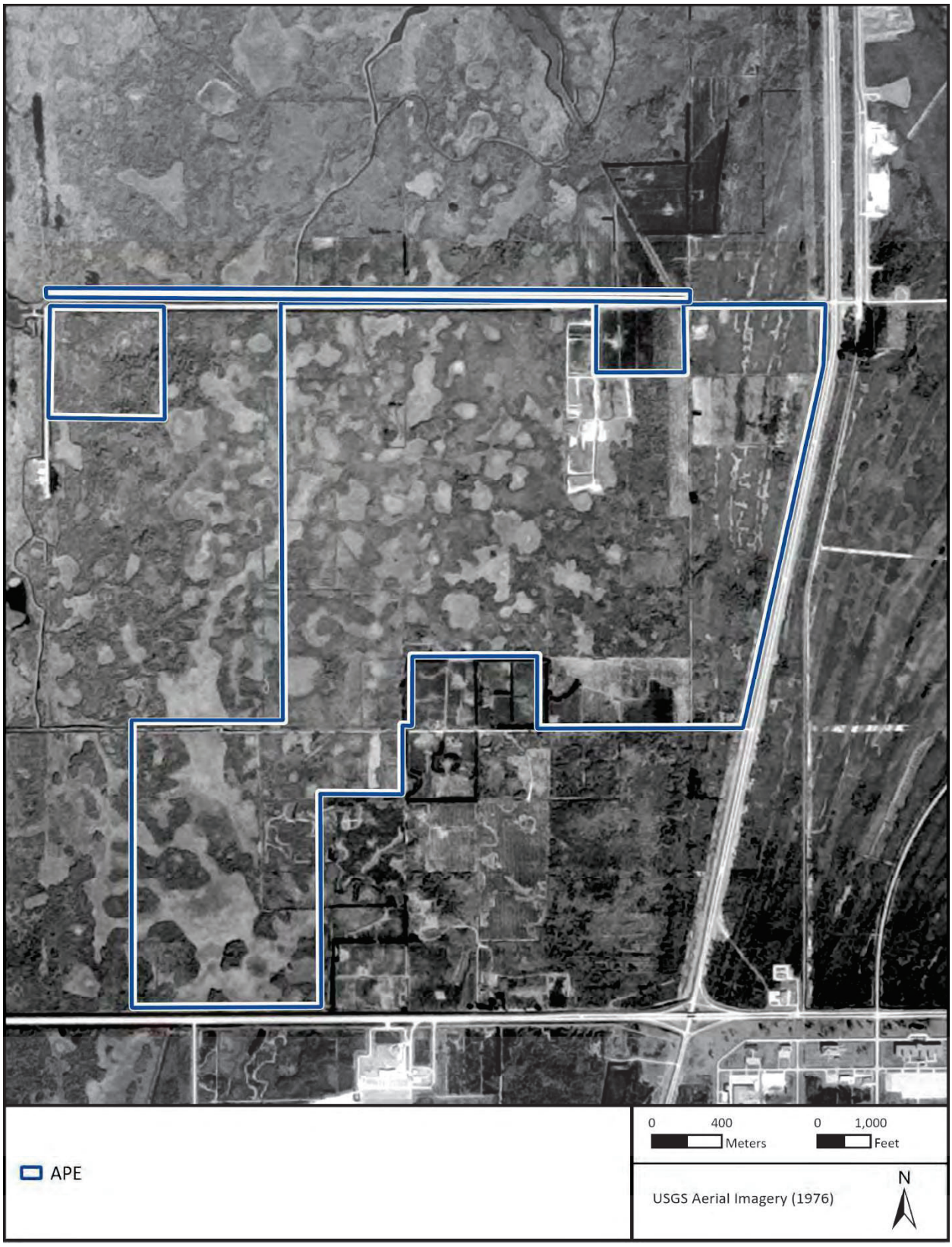

Figure 4-5. Aerial photograph showing the APE (USGS 1976a).

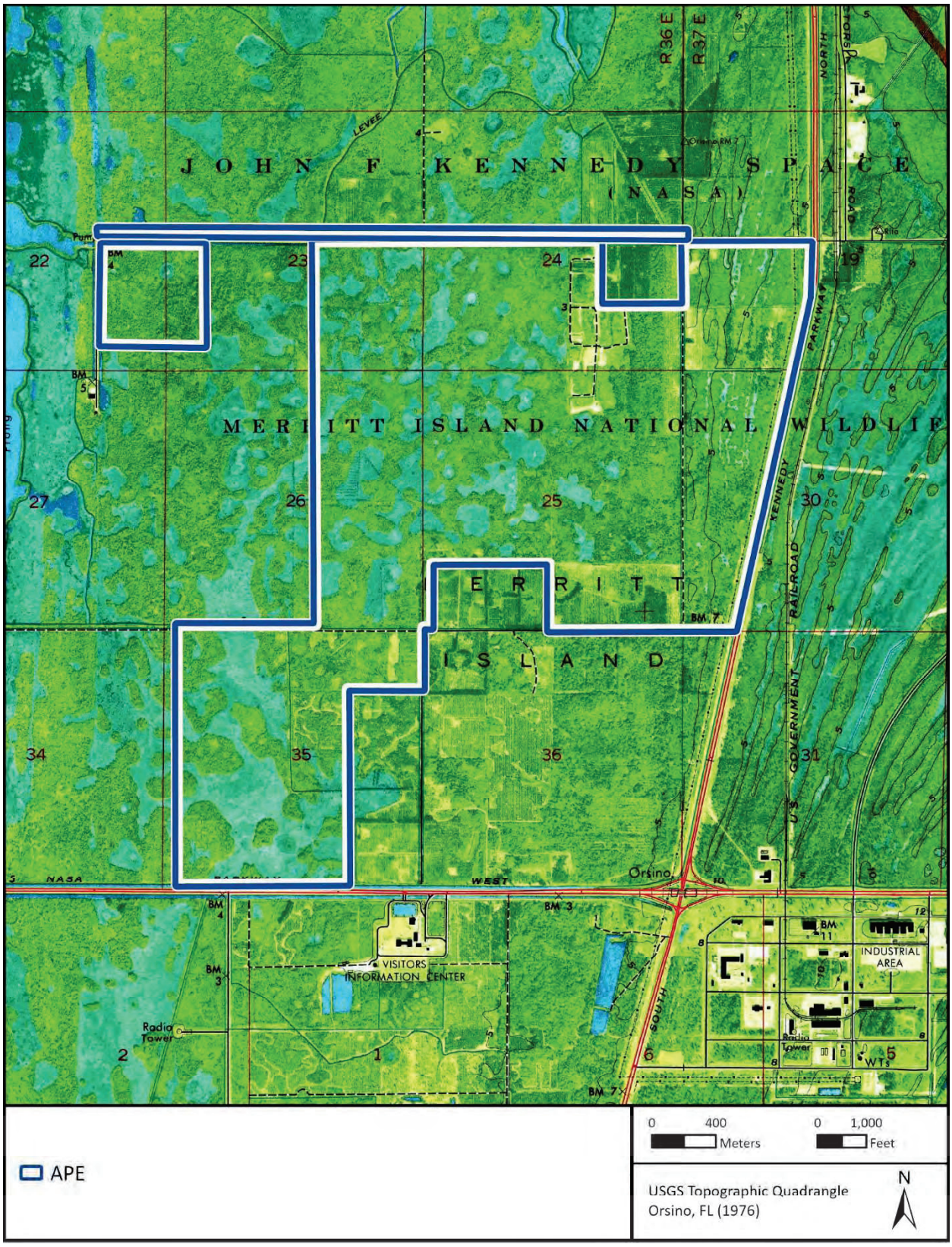

Figure 4-6. USGS topographic map showing the APE (USGS 1976b).

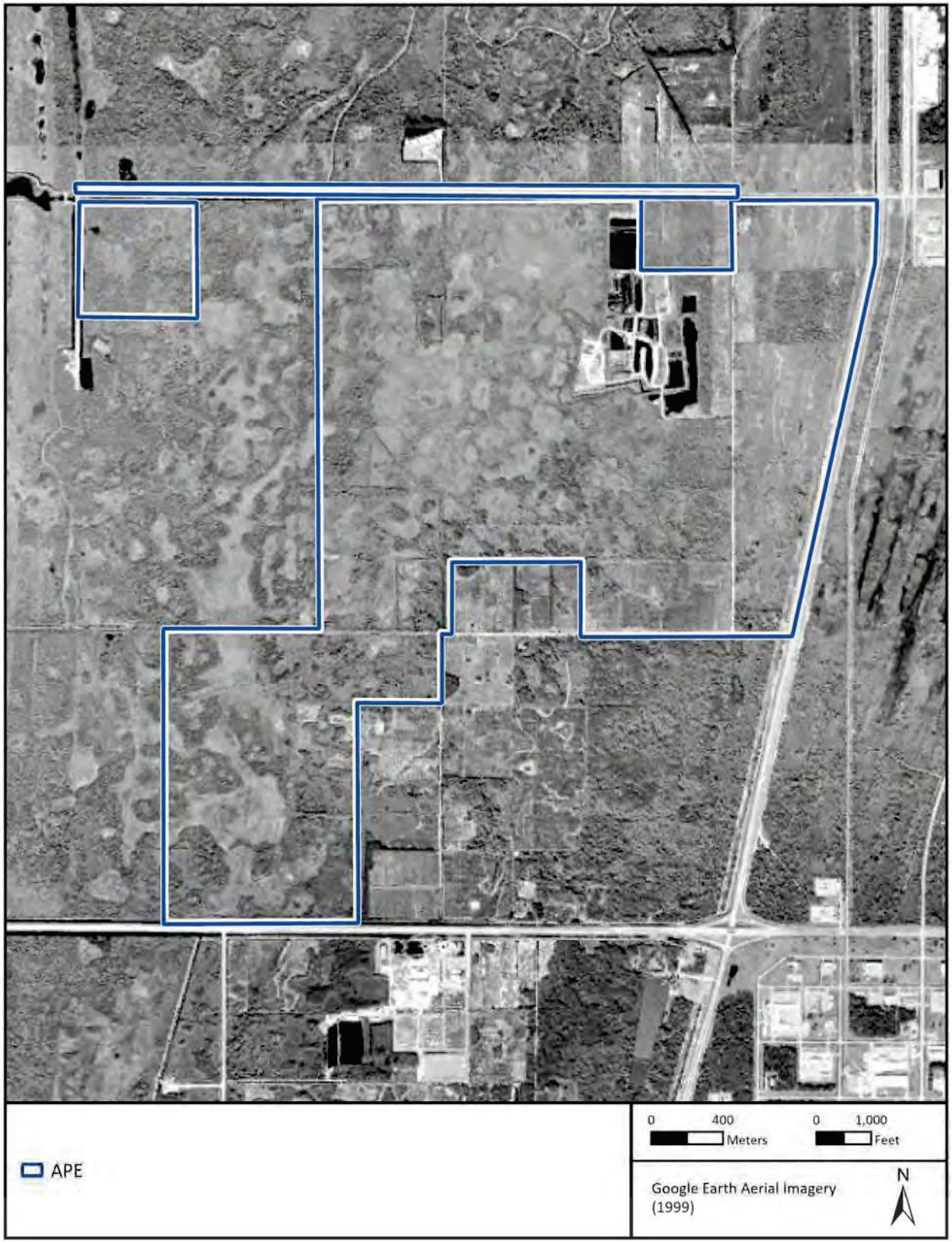

Figure 4-7. Aerial photograph showing the APE (Google Earth 1999).

5 FLORIDA MASTER SITE FILE REVIEW

A review of the FMSF database (updated April 2026) indicates that 23 cultural resource surveys have been conducted within 1.6 km (1.0 mi) of the Project, resulting in the recording of four archaeological sites, 41 previously recorded architectural resources, and 10 linear resources, (**Table 5-1**–**Table 5-4**; **Figure 5-1** and **Figure 5-2**). Of the previous surveys, four archaeological surveys (FMSF Survey Nos. 30141, 29422, 3447, and 260) and one architectural history survey (FMSF Survey No. 20744) fall within the APE. FMSF Survey No. 26810 abuts the southern portion of the APE but did not intersect the current limits. Review of the associated survey reports indicates that most of the APE has not been systematically surveyed for cultural resources. However, portions of the area associated with FMSF Survey No. 29422 are currently under development by SpaceX following previous Section 106 consultation and these will be excluded from the current survey. Further, one additional archaeological survey was completed for 11.5 ha (28.4 ac) at Kennedy Space Center in 2024; however while the report is included in **Table 5-4**, the survey footprint is not yet provided in current FMSF data.

Of the 55 previously recorded resources within 1.6 km (1.0 mi) of the APE, one is located within the APE (structure 8BR04444). Historic resource 8BR04444 is a steel skeleton tower used for communications and measuring meteorological conditions. The structure is located in the north central portion of the APE, and was evaluated as ineligible for listing in the NRHP by SHPO in July of 2024. Additionally, although resources 8BR02907–8BR02930, 8BR03043, and 8BR03044 have been previously recorded within 1.6 km (1.0 mi) of the APE, these resources have since been divested and are no longer physically present in the locations mapped in the FMSF data. Further, resource 8BR02958 was demolished and is no longer extant in its mapped location.

Table 5-1. Previously Recorded Archaeological Sites within 1.6 km (1.0 mi) of the APE.

FMSF No.	Name	Type	SHPO Evaluation
8BR00150	Oyster Prong Creek Mound	Precontact burial mound(s)	Not evaluated
8BR00161	Cocoa Beach Mound	Precontact mound(s)	Not evaluated
8BR00582	Dune and Swale	Lithic scatter	Ineligible
8BR04364	The Granite Rock Homestead	Building remains	Ineligible

Table 5-2. Previously Recorded Architectural Resources within 1.6 km (1.0 mi) of the APE.

FMSF No.	Name	Year Built	SHPO Evaluation
8BR00172	Launch Complex 39	1968	Eligible (NRHP listed in 1973)
8BR01998	SRB ARF Manufacturing Building	1986	Eligible
8BR02907	NLAX 40; NLAX 41	ca. 1952 (Not extant)	Ineligible
8BR02908	NLAX 170	ca. 1985 (Not extant)	Eligible
8BR02909	NLAX 120; NLAX 121	ca. 1961 (Not extant)	Ineligible
8BR02910	NLAX 190	ca. 1982 (Not extant)	Ineligible
8BR02911	NLAX 191; NLAX 197; NLAX 198; NLAX 890	1970 (Not extant)	Ineligible
8BR02912	NLAX 107-112, 117-119, and 180	1973 (Not extant)	Ineligible
8BR02913	NLAX 153; NLAX 154	ca. 1960 (Not extant)	Ineligible
8BR02914	NLAX 125; NLAX 126; NLAX 127	ca. 1968 (Not extant)	Ineligible

Table 5-2. Previously Recorded Architectural Resources within 1.6 km (1.0 mi) of the APE.

FMSF No.	Name	Year Built	SHPO Evaluation
8BR02915	NLAX 141; NLAX 142	1968- (Not extant)	Ineligible
8BR02916	NLAX 42-51, 35815, 35819, 35851, 35856	ca. 1950 (Not extant)	Ineligible
8BR02917	NLAX 175; NLAX 176	ca. 1966 (Not extant)	Ineligible
8BR02918	NLAX 4005	ca. 1970 (Not extant)	Ineligible
8BR02919	NASA KSC Railroad Helium Cars (13)	ca. 1961 (Not extant)	Ineligible
8BR02920	NLAX 201; NLAX 202	ca. 1965 (Not extant)	Ineligible
8BR02921	NLAX 130; NLAX 131	ca. 1965 (Not extant)	Ineligible
8BR02922	NLAX 100, "Blue Ox"	ca. 1976 (Not extant)	Ineligible
8BR02923	Locomotive 1	1968+ (Not extant)	Eligible
8BR02924	NLAX 122; NLAX 123	ca. 1961 (Not extant)	Ineligible
8BR02925	NLAX 160; NLAX 161	ca. 1967 (Not extant)	Ineligible
8BR02926	NLAX 162, NLAX 163	1973- (Not extant)	Ineligible
8BR02927	NLAX 914	ca. 1964 (Not extant)	Ineligible
8BR02928	NLAX 124	ca. 1967 (Not extant)	Ineligible
8BR02929	NLAX 177; NLAX 178; NLAX 179	1966+ (Not extant)	Ineligible
8BR02930	NLAX 194	ca. 1982 (Not extant)	Ineligible
8BR02958	Environmental Health Building	1965 (Not extant)	Ineligible
8BR02998	Spaceport Central	ca. 1976	Ineligible
8BR03035	Locomotive Maintenance Facility	ca. 1978	Ineligible
8BR03042	NLAX 171	ca. 1985	Eligible
8BR03043	Locomotive 2	1970+ (Not extant)	Eligible
8BR03044	Locomotive 3	1970+ (Not extant)	Eligible
8BR04444*	Observation Tower	ca. 1965	Ineligible
8BR04575	Cafeteria	ca. 1976	Ineligible
8BR04576	Kennel	ca. 1976	Ineligible
8BR04577	First Aid Station	ca. 1980	Ineligible
8BR04578	Food Services	ca. 1972	Ineligible
8BR04597	Survey Marker T22SR37 S17/18/19/20	ca. 1953	Ineligible
8BR04598	Universal Camera Pad #18	ca. 1965	Ineligible
8BR04443	Roberts Road Footbridge	1943	Ineligible
8BR04635	KSC Pond Historic Landscape	Before 1969	Ineligible

*Within the APE.

Table 5-3. Previously Recorded Linear Resources within 1.6 km (1.0 mi) of the APE.

FMSF No.	Name	Date	SHPO Evaluation
8BR02931	NASA Railroad at Kennedy Space Center	ca. 1950	Eligible
8BR02932	NASA KSC Railroad System HD	ca. 1978	Eligible
8BR04367	Howe Grove Road	c1821	Ineligible
8BR04572	DNC West Canal	ca. 1941	Ineligible
8BR04573	DNC East Canal	ca. 1941	Ineligible
8BR04628	Drainage Ditch	Before 1969	Ineligible
8BR04629	Access Road	Post 1950	Ineligible
8BR04631	Spoil Bank Ditch	ca. 1943	Ineligible
8BR04632	KSC Ditch 1	ca. 1951	Ineligible
8BR04633	KSC Ditch 2	ca. 1951	Ineligible
8BR04634	KSC Ditch 3	ca. 1969	Ineligible

Table 5-4. Previous Cultural Resources Surveys Conducted within 1.6 km (1.0 mi) of the APE.

FMSF Survey No.	Survey Report Title	Year	Main Author
260*	*Cultural Resource Reconnaissance of Merritt Island National Wildlife Refuge*	1978	Griffin, John W.
421	*Cultural Resource Assessment of Chemical Waste Disposal Facilities, Kennedy Space Center*	1977	Martinez, Carlos A.
961	*Archaeological survey report: NASA Space Shuttle solid rocket booster facility site on Merritt Island, Florida*	1974	Smith, Richard L.
2471	*Archaeological survey to establish zones of archaeological potential (ZAPs) in the VAB and industrial areas of the Kennedy Space Center.*	1990	Archaeological Consultants, In
2992	*Archaeological Survey for Established Zones of Archaeological Potential (ZAPs) in the Launch Complex Area (Option 1), of the Kennedy Space Center*	1991	Deming, Joan G.
3447*	*Archaeological Survey to Establish Zones of Archaeological Potential (ZAPS) in the Shuttle Landing and KSC South Area (Option 2) of the Kennedy Space Center*	1991	Archaeological Consultants, In
3664	*Cultural Resource Assessment Survey of a Proposed Landfill Site, Kennedy Space Center, Brevard County, Florida*	1993	Deming, Joan G.
5474	*Survey and Evaluation of the Historic Facilities within the Industrial, Launch Complex 39 (LC-39), Vehicle Assembly Building (VAB), and Shuttle Landing Facility (SLF) areas of the John F. Kennedy Space Center (KSC), Brevard County, Florida*	1998	Delahaye, Daniel
11239	*Multiple Property Submission for Historic Cultural Resources of the John F. Kennedy Space Center, Florida*	1991	Delahaye, Daniel
19482	*Historical Survey and Evaluation of the Jay Jay Bridge, Railroad System, and Locomotives, John F. Kennedy Space Center, Brevard County, Florida*	2012	ACI
20744*	*Architectural Survey and Evaluation of 45 Facilities that have reached the age of 45-50 years, John F. Kennedy Space Center, Brevard County, Florida*	2013	Price, David L.
20760	*Architectural Survey and Evaluation of NASA- owned Facilities at Cape Canaveral Air Force Station*	2013	Price, David L.
26810	*Cultural Resource Assessment Survey of the Discovery Solar Energy Center Property, Brevard County, Florida*	2019	Archaeological Consultants Inc
28010	*Cultural Resource Assessment Survey for Space Commerce Way from NASA Parkway West to Kennedy Parkway, Brevard County, Florida*	2022	Janus Research
28108	*Phase I Cultural Resources Assessment Survey of Exploration Park North Expansion EA Brevard County, Florida*	2020	Lombardi, Kathryn
28952	*A Cultural Resources Assessment Survey of Five Improvement Locations on the NASA Causeway, Brevard County, Florida*	2020	Mark F. Martinkovic
28954	*Cultural Resource Assessment Survey of the Proposed International Space Research Park at the John F. Kennedy Space Center, Brevard County, Florida*	2004	Archaeological Consultants, Inc.
29098	*Phase I Cultural Resources Assessment Survey of the DNC Retail Warehouse Pre-Con Site, Brevard County, Florida*	2023	Elizabeth Zieschang
29422*	*Cultural Resources Assessment Survey for the Roberts Road North Expansion Area and NASA Parkway Connector at Kennedy Space Center, Brevard County, Florida*	2022	Newton, Jason
30031	*Phase I Cultural Resource Assessment Survey of the Schwartz Road Property at the John F. Kennedy Space Center, Brevard County, Florida*	2024	Altes, Kristina
30141*	*An Archaeological Survey of the Kennedy Space Center Spaceport Growth Boundaries Districts 1, 2, 3, and 4*	2024	Handley, Brent
30428	*Phase I Cultural Resources Assessment Survey of the Visitor Complex PEA Boundary Site, Merritt Island, Brevard County, Florida*	2024	Zieschang, Elizabeth
--	Phase I Archaeological Survey of 28.4 Acres at Kennedy Space Center, Brevard County, Florida Technical Report	2024	Brockington and Associates, Inc.

*Within the APE / -- Not yet depicted in FMSF data.

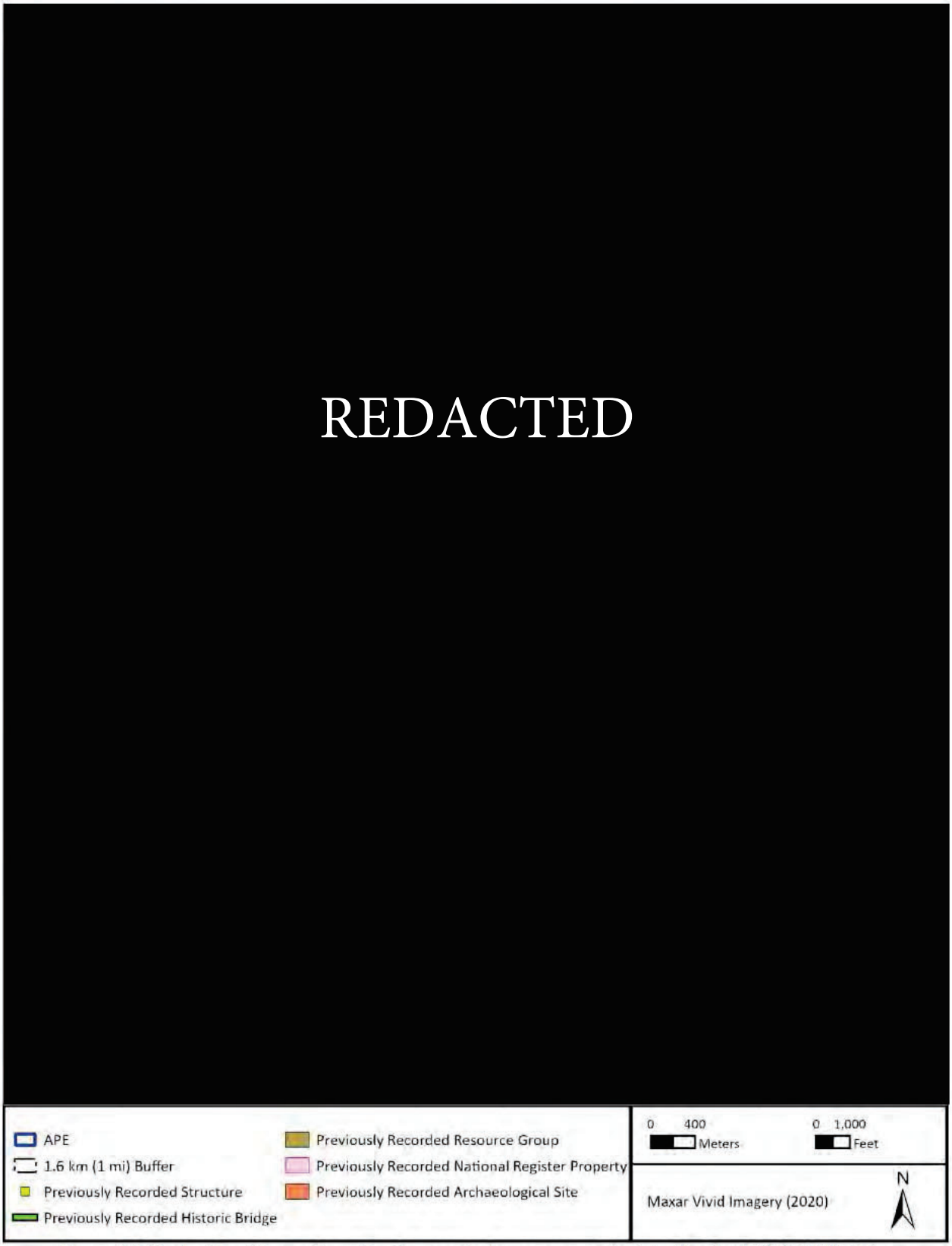

Figure 5-1. Project location and previously recorded resources as depicted by April 2026 FMSF data.

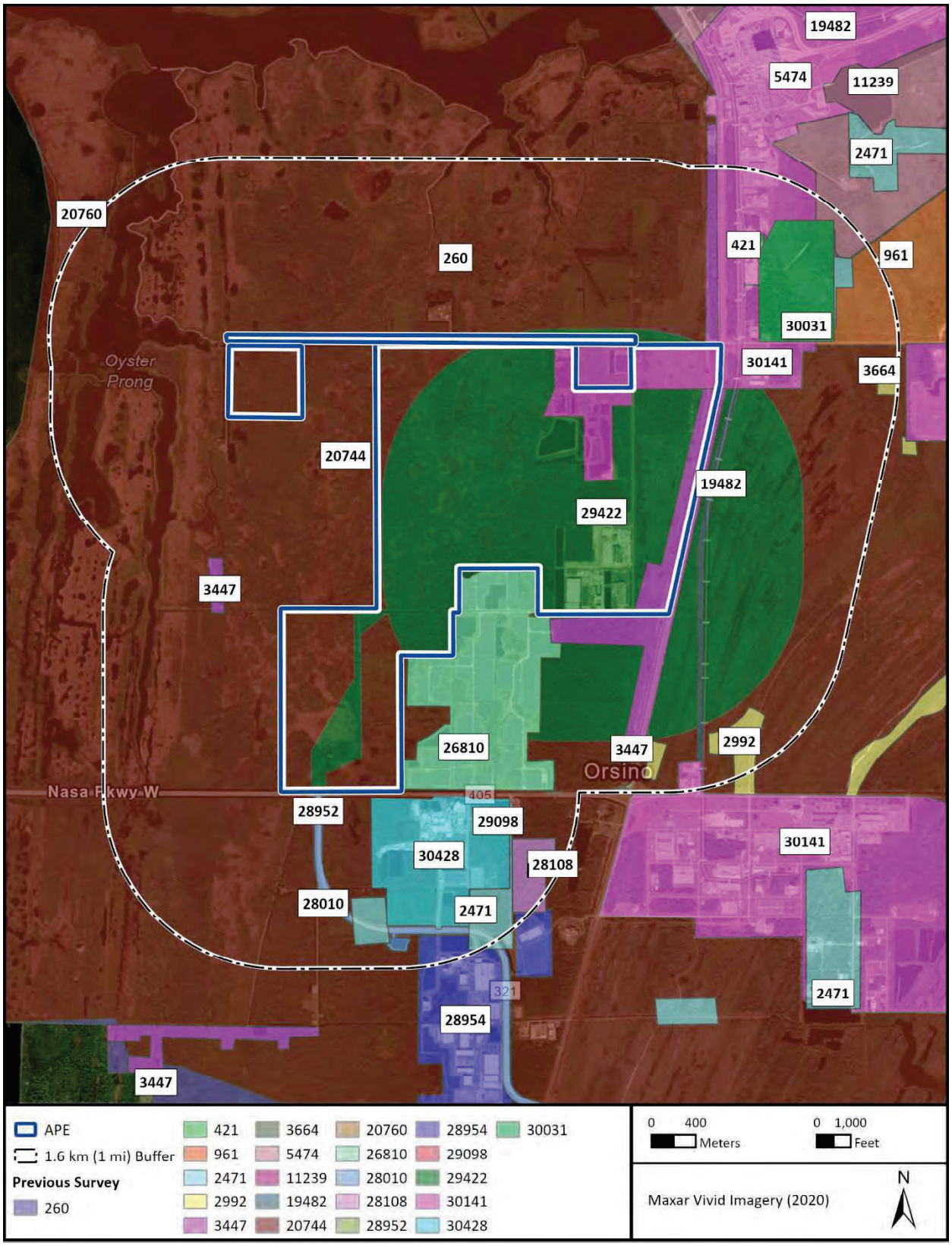

Figure 5-2. Project location and previously conducted cultural resource surveys as depicted by April 2026 FMSF data.

6 RESEARCH DESIGN

The goal of this cultural resources survey was to identify cultural resources within the APE. The research design included background research and a field survey. The background research involved a review of relevant archaeological and historical literature, environmental data, and previous cultural resource surveys conducted near the Project. This information was used to determine zones of archaeological probability within the APE to guide the fieldwork sampling strategy. The background research also confirmed the likely absence of previously recorded aboveground or historic architectural features within the APE. The research design and methods followed FDHR's *Cultural Resource Management Standards & Operations Manual, Module Three: Guidelines for Use by Historic Preservation Professionals*. Prior to fieldwork, SEARCH prepared a work plan (Werner and Mahoney 2025) that outlined the specific methods proposed for the survey of the APE, which was reviewed and approved by the KSC CRM.

6.1 ARCHAEOLOGICAL SITE AND ARCHAEOLOGICAL OCCURRENCE DEFINITIONS

An archaeological site is defined as three or more artifacts, "not known to be distant from their original context, which fit into a hypothetical cylinder of 30 m diameter, regardless of depth below surface" (FDHR 2003:19). An archaeological occurrence (AO) is defined as "the presence of one or two non-diagnostic artifacts, not known to be distant from their original context, which fit into a hypothetical cylinder of 30.0 m (98.4 ft) diameter, regardless of depth below surface" (FDHR 2003:19).

6.2 ARCHAEOLOGICAL PROBABILITY

SEARCH developed a sensitivity model for cultural resources within the APE. The model considered distance to water, elevation, landform type, soil classification, and level of drainage as primary factors to establish high-, moderate-, and low-probability zones, as described in the SHPO's guidelines for cultural resource assessment surveys in *Module 3: Guidelines for Use by Historic Preservation Professionals* (FDHR 2003). KSC's Zones of Archaeological Potential (ZAP) model categorizes the entire APE as Low ZAP due to the freshwater marsh and swamp environment with low ridges, and wet hammocks.

The APE has low topographic relief and is poorly to very poorly drained throughout (see **Section 2.2**). SEARCH's sensitivity model considers areas equal to or greater than 2.0 m (6.6 ft) elevation, regardless of soil drainage classification, as moderate probability and areas of lower elevation as low probability. This approach comprises an effort to target subtle variations in elevation to test them for the presence of archaeological sites. Areas of low probability often correspond with permanently inundated wetland in the National Wetland Inventory. The natural ridges in the eastern portion of the APE along Kennedy Parkway North and sparsely scattered and isolated areas in the west-southwest are considered to have moderate archaeological probability, since these areas are greater than 2.0 m (6.6 ft) in elevation.

SEARCH conducted a preliminary review of historic maps and aerial photographs to determine the sensitivity level for historic-period resources; this review identified areas of historic farming activity within the APE; however, these areas are topographically low and subject to inundation. Additionally, an observation tower was constructed in the north-central portion of the APE along Schwartz Road in the mid-1960s.

6.3 METHODS

6.3.1 Field Methods

The archaeological survey is designed to support compliance with Section 106 of the NHPA of 1966, as amended, the National Environmental Policy Act of 1969, and the Archaeological Resources Protection Act of 1979. The survey was conducted in accordance with the FDHR's *Module Three: Guidelines for Historic Preservation Professionals*. The work was overseen by SEARCH personnel who meet the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716).

The APE is mostly undeveloped, densely vegetated, and scattered with areas of inundation. To facilitate the survey, access routes were cleared of vegetation prior to the fieldwork. The access routes favor higher ground to provide access to the most elevated landforms and avoid inundated and untraversable areas. The low topographic features in the APE and visible in LiDAR data provided by SpaceX, although the data excludes the far western portion (**Figure 6-1**). Shovel test (ST) locations were accessed from the cleared paths within most of the APE. Additionally, SEARCH did not revisit previously surveyed portions of the APE.

The archaeological survey included the inspection of exposed ground surfaces and excavation of STs as appropriate throughout the 902.5 ha (2,230.2 ac) APE, excluding areas currently under development following previous Section 106 consultations (101.32 ha [250.38 ac]). In accordance with FDHR and KSC guidelines, and following SEARCH's model focused on elevation, areas equal to or greater than 2.0 m (6.6 ft) elevation (primarily the eastern portion of the APE) were shovel tested at 50 m (164 ft) intervals for moderate probability zones. The remaining area within the APE was tested judgmentally, favoring areas in proximity to the access routes that are characterized by higher elevation and drier ground with greater potential to contain intact archaeological deposits.

Shovel tests containing artifacts were delineated with the placement of STs at reduced intervals (typically 12.5 m [41.0 ft]). STs measured 50.0 centimeters (cm; 19.6 inches [in]) in diameter and were excavated to a depth of 100.0 cm (39.4 in) below surface (bs), unless prevented by groundwater inundation or impenetrable zones, such as rubble/fill, limestone, or clay. Soil was screened through 0.60 cm (0.25 in) hardware mesh and backfilled upon completion of documentation. Archaeological site boundaries were documented using handheld GPS devices and in accordance with the FDHR and KSC recording guidelines. Areas where shovel testing was infeasible, unsafe, or impractical due to the presence of disturbed deposits, standing water,

roads, buried utilities, or other obstructions were photo-documented. All documented justifications for not shovel testing during the field visit are provided in this report.

Field crews were equipped with mobile devices paired to a global positioning device capable of sub-meter accuracy for data collection. Using ESRI software, digital maps were maintained through ArcGIS Online depicting the surveyed area. Cultural materials, soil strata, Munsell color, soil texture, depth, and environmental setting of each ST was recorded using the ESRI Maps application. The Universal Transverse Mercator coordinates of all STs were recorded with global positioning system devices based on the 1983 North American Datum.

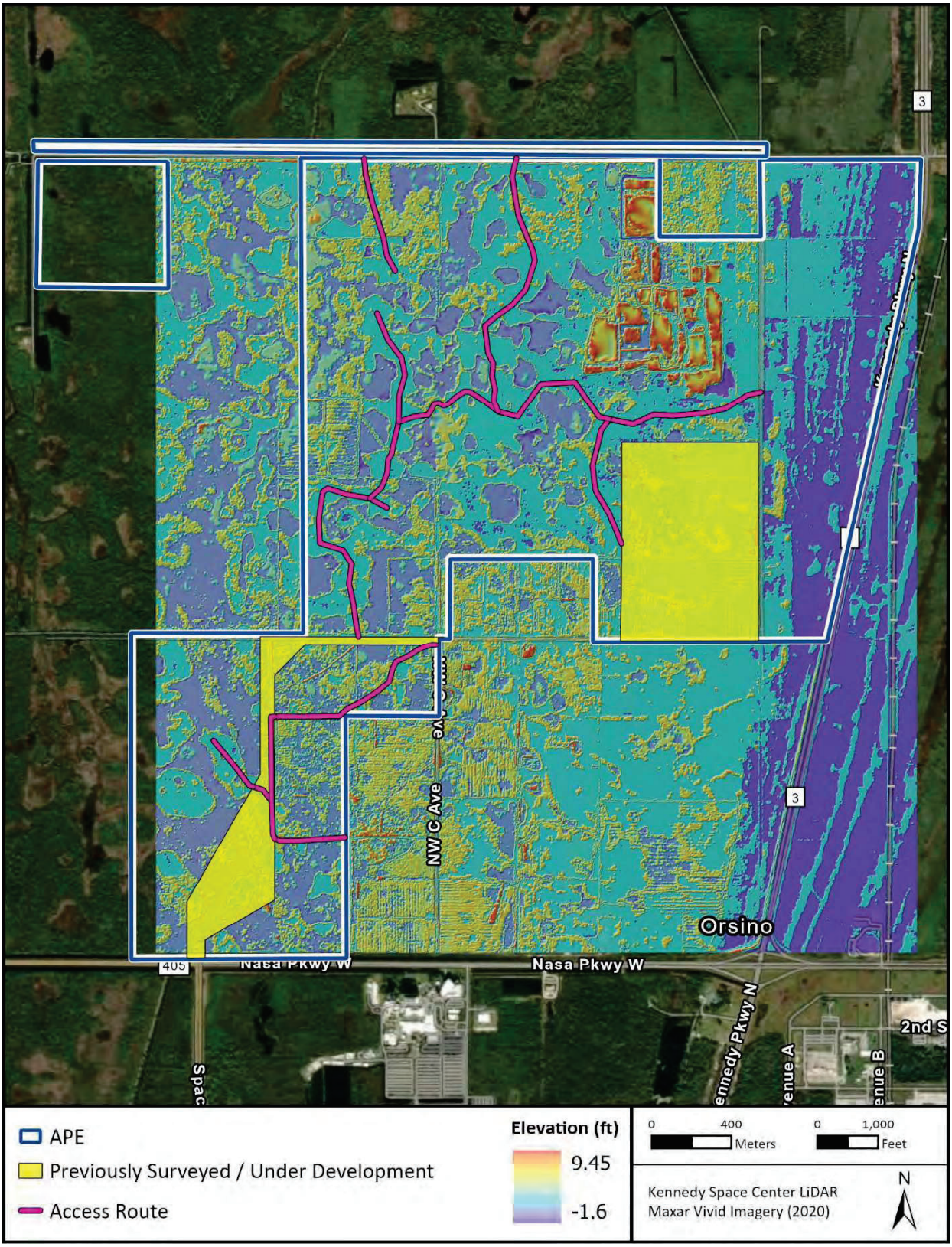

Figure 6-1. APE depicted on SpaceX provided LiDAR imagery showing access routes.

6.3.2 Laboratory Methods

In accordance with the work plan approved by the KSC CRM prior to the survey, temporally diagnostic artifacts from intact contexts with the potential to yield further information through laboratory analysis were to be collected and analyzed. One potential artifact was collected in the field and analyzed in the SEARCH Jacksonville office. The piece was determined to be non-cultural and will be discarded.

6.3.3 NRHP Criteria

Cultural resources identified within the APE were evaluated according to the criteria for listing in the NRHP. As defined by the National Park Service (NPS), the quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. that are associated with events or activities that have made a significant contribution to the broad patterns of our history; or
B. that are associated with the lives of persons significant in our past; or
C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. that have yielded, or may be likely to yield, information important in prehistory or history.

NRHP-eligible districts must possess a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development (NPS 1997). NRHP-eligible districts and buildings must also possess historic significance, historic integrity, and historical context.

6.3.4 Procedures to Address Unexpected Discoveries

The following procedures were in place in the event of the unanticipated discovery of human remains in alignment with KSC-PLN-1733, the KSC's *Integrated Cultural Resource Management Plan* (NASA KSC 2024). If human remains are encountered during the archaeological survey, the stipulations of Florida State Law Chapter 872.05 (Offenses Concerning Dead Bodies and Graves) should be followed. All work in the near vicinity of the human remains should cease and reasonable efforts should be made to avoid and protect the remains from additional impact. SEARCH will immediately notify the KSC CRM and SpaceX of the discovery and SpaceX will notify the KSC Protective Services. The KSC CRM will handle all consultation with SHPO, Tribes and compliance with NAGPRA, if required.

7 SURVEY RESULTS

SEARCH completed the archaeological survey between April 15 and 19, 2026, and June 24 and 25, 2026, which included systematic pedestrian survey and the excavation of 131 STs within the APE. No new archaeological resources were identified (**Figure 7-1**; **Appendix A: FDHR Survey Log Form**). One AO (AO-1) was identified in the field, however later analysis determined that the object is not an archaeological artifact. The APE is characterized by a low and flat landform with interspersed wetlands surrounded by vegetation that increases in density towards the western extent of the APE. In the eastern portion of the Project, the APE is bound by Kennedy Parkway North. The landform is vegetated with scrubby pine flatwoods and is slightly elevated along Kennedy Parkway North where there is a series of low, nearly parallel, ridges with elevations up to 2 m (7 ft) above mean sea level (**Figure 7-2** and **Figure 7-3**). The landform drops to approximately 1 m (3 ft) above mean sea level toward the central portion of the APE, which is densely vegetated with saw palmetto, ferns, scrub trees, and wetland vegetation in the lower-lying areas (**Figure 7-4** and **Figure 7-5**). A series of trails were cut through the dense vegetation following the highest portion of the landform to facilitate the survey (**Figure 7-6** and **Figure 7-7**). The northwestern portion of the APE is densely vegetated mixed hardwood forest bound to the north and west by a man-made canal. The majority of the northwest corner of the APE near East Oyster Prong Trail is comprised of low-lying wetlands with standing water that increases in depth towards the canal to the west (**Figure 7-8** and **Figure 7-9**). There is a significant area of disturbance in the east-central portion of the APE including mechanical excavation adjacent to an area scattered with borrowing or other land disturbing activity in the north along Schwartz Road expanding from the activity first identified in a 1970 topographic map (see **Figure 4-4** and **Figure 7-10**). The southwestern portion of the APE is characterized by low-lying, mixed hardwood forest with stagnant standing water (**Figure 7-11** and **Figure 7-12**). The two locations that historical topographic maps and aerial photographs depicted farming activity and structures up to the 1970s were inundated and no features evidence of the unimproved roads or historic farming activities were observed.

One previously recorded resource (8BR04444) was revisited in the north-central portion of the APE (**Figure 7-13**). Resource 8BR04444 is a ca. 1965 steel skeleton observation tower that was evaluated by SHPO as ineligible for listing in the NRHP in July of 2024.

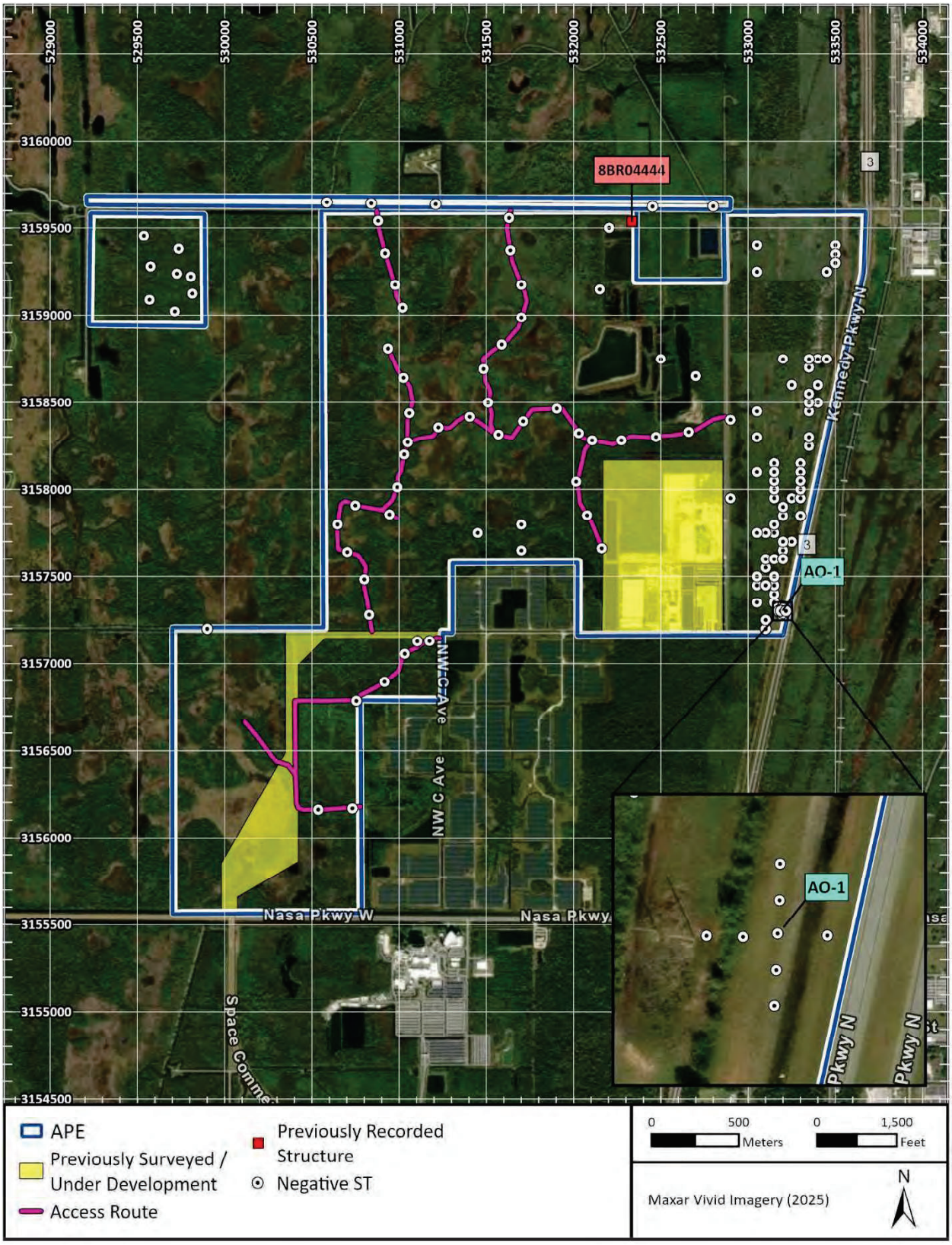

Figure 7-1. Results of the archaeological survey.

Figure 7-2. Overview of scrubby pine flatwoods in eastern portion of the APE, facing north.

Figure 7-3. Overview of the eastern boundary of APE along Kennedy Parkway North, facing north.

Figure 7-4. Overview of the central portion of the APE showing dense vegetation, facing north.

Figure 7-5. Wetland vegetation in the central portion of the APE, facing west.

Figure 7-6. Overview of cut trails through the APE, facing north.

Figure 7-7. Overview of cut trails through the APE, facing north.

Figure 7-8. Inundated wetland in northwestern corner of APE, facing north.

Figure 7-9. Northwest portion of APE with dry seasonal wetland, facing south.

Figure 7-10. Overview of disturbance in the east-central portion of the APE, facing southwest.

Figure 7-11. Southwest portion of the APE, showing wetland vegetation, facing north.

Figure 7-12. Stagnant water in southwest portion of the APE, facing west.

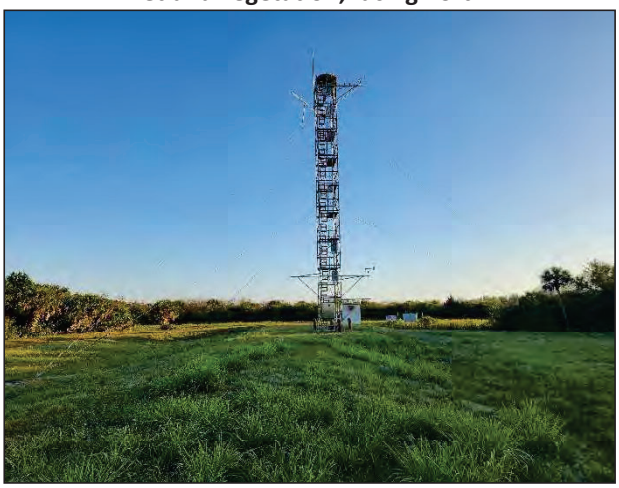

Figure 7-13. Previously recorded resource 8BR04444, facing north.

7.1 GENERAL STRATIGRAPHY

ST excavation in the APE identified soils consistent with poorly drained to very poorly drained conditions that are typical for flatwoods, low broad flats, sloughs, depressions, and flood plains. Much of the western portion of the APE is classified as wetland in the National Wetland Inventory and the APE is slightly higher and drier to the east. Surface conditions in the far western portion of the APE are often wet but due to unseasonably dry conditions, STs were excavated in higher areas between areas of inundation, but were often terminated at the water table (see **Appendix B**: **Shovel Test Log**).

In the moderate probability zones and the eastern portion of the APE, ST soil profiles were consistent with the Immokalee series. Typically, Stratum I is an approximately 20.0–30.0 cm (7.8–11.8 in) thick very dark brown (10YR 2/2) loamy sand with organic material over a 30.0–40.0 cm (11.8–15.7 in) thick Stratum II of dark gray (10YR 4/1) sand followed by light gray (10YR

7/2) sand that was excavated to a depth of up to 90.0 cm (35.4 in) below surface (bs) and often terminated at the water table (**Figure 7-14**).

AO-1 was identified in ST N7300 E3200 along the eastern boundary of the APE near Kennedy Parkway North. ST excavation in the vicinity identified unconsolidated gravel and sediments within the upper horizons, which indicate disturbance from past land modification, such as road construction. The excavation of ST N7300 E3200 identified six strata. Stratum I is 20.0 cm (7.8 in) thick dark grayish brown (10YR 4/2) loamy sand. Statum II is a 15.0 cm (5.9 in) thick very dark brown (10YR 2/2) loamy sand. Stratum III is light gray (10YR 7/1) sand to a depth of 45.0 cm (17.7 in) bs. Stratum IV is black (10YR 2/1) loamy sand to a depth of 55.0 (21.6 in) bs. Stratum V is 15.0 cm (5.9 in) thick gray (10YR 5/1) sand. Stratum VI is white (10YR 8/1) sand, which was excavated to a depth of 100.0 cm (39.3 in) bs (**Figure 7-15**).

Few STs were excavated in the interspersed wetlands in the western portion of the APE due to saturated ground or standing water. In slightly higher elevated and drier areas in the west-central portion of the APE along the access routes, soil profiles are representative of the poorly drained Wabasso series which is typical for low broad flats, sloughs, and depressions. Stratum I was identified as grayish brown to light grayish brown (10YR 5/2 or 10YR 6/2) sand to a depth of 35.0 cm (13.8 in) bs, over Stratum II (if identified) organic gray or dark grayish brown (10YR 6/1 or 10YR 4/2) sand to a depth of 50.0 cm (19.7 in) bs, over grayish brown (2.5Y 5/2) sandy clay to a depth of 93.0 cm (36.7 in) bs. Excavations were typically terminated at clay with redoximorphic features (**Figure 7-16**) or at the water table. In the northwestern corner of the APE, the water table appeared as shallow as 35.0 cm (13.8 in) bs.

ST excavation in the southernmost portion of the APE identified soil profiles typical for the very poorly drained Riviera series. Soil stratigraphy is generally an approximately 45.0 cm (17.7 in) thick Stratum I of dark grayish brown or very dark brown (10YR 4/2 or 10YR 2/2) loamy sand over Stratum II gray or brown (10YR 5/1 or 10YR 5/3) loamy sand that was excavated up to 60.0 cm (23.6 in) bs and excavation terminated at either the water table (**Figure 7-17**) or white (10YR 8/1) deteriorated limestone bedrock.

Figure 7-14. Typical soil profile in the eastern portion of APE (ST N7600 E3100).

Figure 7-15. Typical soil profile in the southeastern portion of APE (ST N7300 E3200).

Figure 7-16. Typical soil profile in the west-central portion of APE (ST N8690 E3350).

Figure 7-17. Typical soil profile in the southwestern portion of APE (ST N7129 E1175).

7.2 ARCHAEOLOGICAL OCCURRENCE

SEARCH identified one archaeological occurrence (AO-1), which was later determined to be noncultural, in ST N7300 E3200 between 20.0–30.0 cm (7.9–11.8 in; see **Figure 7-1**) bs. AO-1 is a triangular-shaped piece of chert that measures 3.71 × 3.31 cm and is 0.62 cm thick. Given the uncertainty regarding evidence of cultural modification, the object was collected for further analysis. Radial STs excavated in the cardinal directions from ST N7300 E3200 were negative for cultural material.

Laboratory analysis of AO-1 determined that the recovered object is not culturally modified. Further supporting the laboratory analysis results of the non-cultural chert; there is no raw material quarry source nearby and the material has a sizeable quartz inclusion that would make it less desirable for stone tool manufacturing. This material is typical of modern road gravels. As AO-1 is located less than 30 m (98 ft) from Kennedy Parkway North and road-fill gravels were present in eastern delineation ST N7300 E3217, SEARCH asserts that the object is the result of nearby road-fill gravel activities and is not an archaeological artifact.

Figure 7-18. Non-cultural piece of chert, AO-1.

8 SUMMARY AND CONCLUSIONS

Between April 15 and 19, 2026, and June 24 and 25, 2026, SEARCH conducted a Phase I archaeological survey on behalf of SpaceX in support of the Roberts Road Campus Expansion at the KSC in Brevard County, Florida. The undertaking encompasses approximately 902.5 ha (2,230.2 ac) on the west side of Kennedy Parkway North between Schwartz Road and NASA Parkway adjacent to and north of the KSC visitor complex.

The Phase I archaeological survey did not identify any artifacts or archaeological sites within the APE. One previously recorded NRHP-ineligible resource (8BR04444) was revisited during survey. SEARCH recommends that no further cultural resources work is recommended in support of the proposed Project.

9 REFERENCES CITED

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APPENDIX A

SURVEY LOG SHEET

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Ent D (FMSF only) _____

Survey Log Sheet

Florida Master Site File
Version 5.0 3/19

Survey # (FMSF only) _____

Consult *Guide to the Survey Log Sheet* for detailed instructions.

Manuscript Information

Survey Project (name and project phase)
Roberts Road Campus Expansion Phase I Cultural Resources Survey

Report Title (exactly as on title page)
CULTURAL RESOURCES SURVEY FOR THE ROBERTS ROAD CAMPUS EXPANSION PROJECT KENNEDY SPACE CENTER BREVARD COUNTY, FLORIDA

Report Authors (as on title page)
1. Mahoney, Leeanne
2. Bowers, Jeremy
3. King, Ian
4. _____

Publication Year 2026 **Number of Pages in Report** (do not include site forms) 65

Publication Information (Give series, number in series, publisher and city. For article or chapter, cite page numbers. Use the style of *American Antiquity*.)
On file at SEARCH New Orleans, LA. SEARCH project no. 260027.

Supervisors of Fieldwork (even if same as author) Names LEEANNE MAHONEY

Affiliation of Fieldworkers: Organization Southeastern Archaeological Research City Jacksonville

Key Words/Phrases (Don't use county name, or common words like *archaeology, structure, survey, architecture, etc.*)
1. SpaceX
2. Kennedy Parkway
3. Roberts Road
4. _____
5. _____
6. _____
7. _____
8. _____

Survey Sponsors (corporation, government unit, organization, or person funding fieldwork)
Name Space Exploration Technologies Organization _____
Address/Phone/E-mail Cape Canaveral, Florida

Recorder of Log Sheet Ian King **Date Log Sheet Completed** 7-7-2026

Is this survey or project a continuation of a previous project? ☒ No ☐ Yes: Previous survey #s (FMSF only) _____

Project Area Mapping

Counties (select every county in which field survey was done; attach additional sheet if necessary)
1. Brevard
2. _____
3. _____
4. _____
5. _____
6. _____

USGS 1:24,000 Map Names/Year of Latest Revision (attach additional sheet if necessary)
1. Name ORSINO Year 2015
2. Name _____ Year _____
3. Name _____ Year _____
4. Name _____ Year _____
5. Name _____ Year _____
6. Name _____ Year _____

Field Dates and Project Area Description

Fieldwork Dates: Start 4/13/26 End 6-25-2026 **Total Area Surveyed** (fill in one) 903.00 hectares _____ acres

Number of Distinct Tracts or Areas Surveyed 3

If Corridor (fill in one for each) **Width:** _____ meters _____ feet **Length:** _____ kilometers _____ miles

Florida Master Site File / Div. of Historical Resources / R.A. Gray Bldg / 500 S Bronough St., Tallahassee, Florida 32399-0250
Phone 850.245.6440, Fax 850.245.6439, Email: SiteFile@dos.myflorida.com

Survey Log Sheet

Survey #_____

Research and Field Methods

Types of Survey (select all that apply): ☒archaeological ☐architectural ☐historical/archival ☐underwater ☐damage assessment ☐monitoring report ☐other(describe): _____

Scope/Intensity/Procedures

Pedestrian survey and systematic shovel testing at intervals according to high, moderate and low probability for archaeological sites

Preliminary Methods (select as many as apply to the project as a whole)

☐Florida Archives (Gray Building) ☐library research- *local public* ☒local property or tax records ☒other historic maps ☒LIDAR
☐Florida Photo Archives (Gray Building) ☐library-special collection ☐newspaper files ☒soils maps or data ☐other remote sensing
☒Site File property search ☐Public Lands Survey (maps at DEP) ☐literature search ☒windshield survey
☒Site File survey search ☐local informant(s) ☐Sanborn Insurance maps ☒aerial photography

☐other (describe): _____

Archaeological Methods (select as many as apply to the project as a whole)

☐Check here if **NO** archaeological methods were used.

☐surface collection, controlled ☐shovel test-other screen size ☐block excavation (at least 2x2 m) ☐metal detector
☐surface collection, uncontrolled ☐water screen ☐soil resistivity ☐other remote sensing
☒shovel test-1/4"screen ☐posthole tests ☐magnetometer ☒pedestrian survey
☐shovel test-1/8" screen ☐auger tests ☐side scan sonar ☐unknown
☐shovel test 1/16"screen ☐coring ☐ground penetrating radar (GPR)
☐shovel test-unscreened ☐test excavation (at least 1x2 m) ☐LIDAR

☐other (describe): _____

Historical/Architectural Methods (select as many as apply to the project as a whole)

☐Check here if **NO** historical/architectural methods were used.

☐building permits ☐demolition permits ☐neighbor interview ☐subdivision maps
☐commercial permits ☒windshield survey ☐occupant interview ☐tax records
☐interior documentation ☒local property records ☐occupation permits ☐unknown

☐other (describe): _____

Survey Results

Resource Significance Evaluated? ☐Yes ☒No

Count of Previously Recorded Resources 0 **Count of Newly Recorded Resources** 0

List Previously Recorded Site ID#s with Site File Forms Completed (attach additional pages if necessary)

List Newly Recorded Site ID#s (attach additional pages if necessary)

Site Forms Used: ☐Site File Paper Forms ☐Site File PDF Forms

REQUIRED: Attach Map of Survey or Project Area Boundary

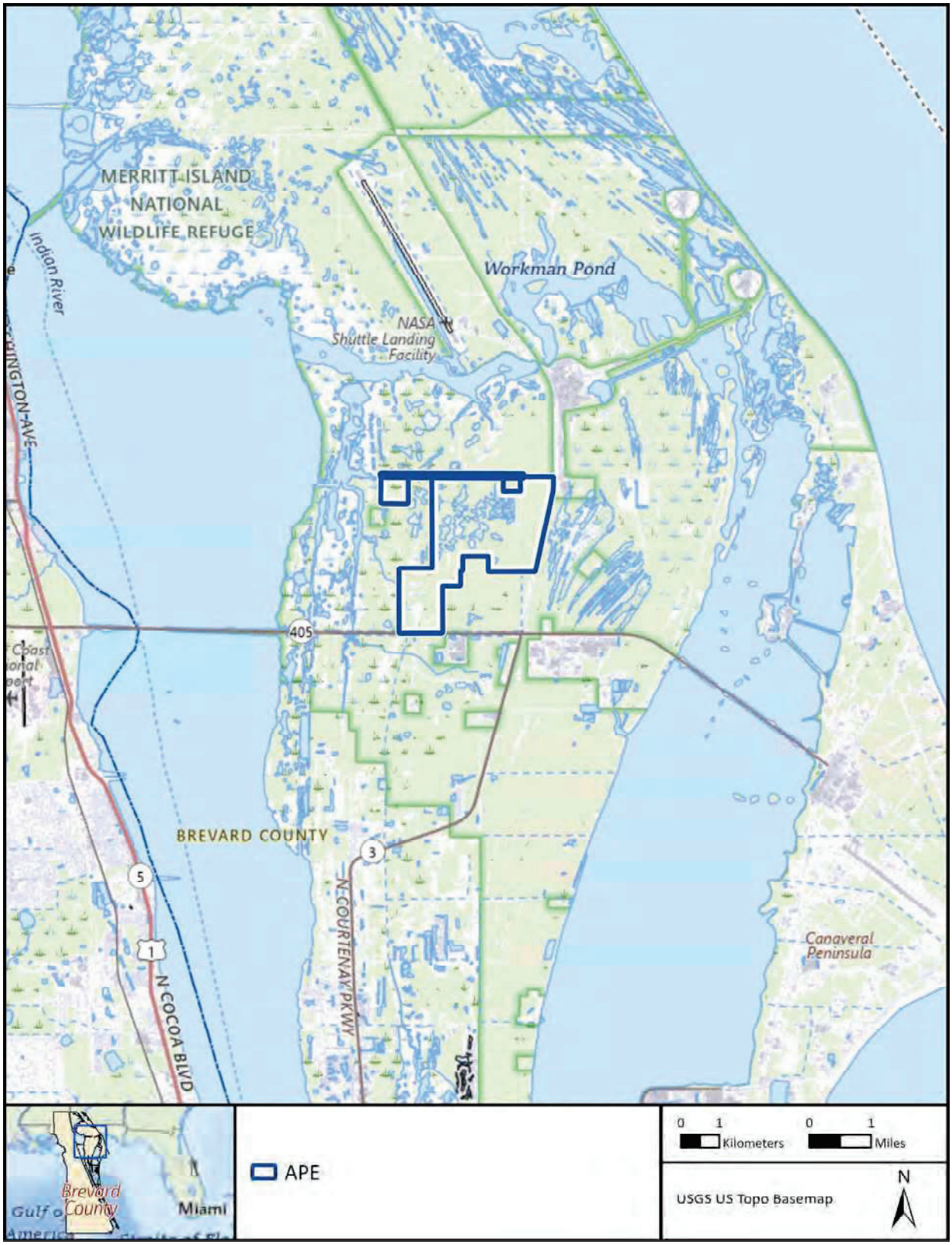
SHPO USE ONLY **SHPO USE ONLY** **SHPO USE ONLY**

Origin of Report: ☐872 ☐Public Lands ☐UW ☐1A32 # _____ ☐Academic ☐Contract ☐Avocational
☐Grant Project # _____ ☐Compliance Review: CRAT # _____

Type of Document: ☐Archaeological Survey ☐Historical/Architectural Survey ☐Marine Survey ☐Cell Tower CRAS ☐Monitoring Report
☐Overview ☐Excavation Report ☐Multi-Site Excavation Report ☐Structure Detailed Report ☐Library, Hist. or Archival Doc
☐Desktop Analysis ☐MPS ☐MRA ☐TG ☐Other: _____

Document Destination: Plottable Projects **Plotability:** _____

Florida Master Site File / Div. of Historical Resources / R.A. Gray Bldg / 500 S Bronough St., Tallahassee, Florida 32399-0250
Phone 850.245.6440, Fax 850.245.6439, Email: SiteFile@dos.myflorida.com


MERRITT ISLAND
NATIONAL
WILDLIFE REFUGE
Indian River
Workman Pond
NASA
Shuttle Landing
Facility
405
BREVARD COUNTY
3
5
1
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N COURTENAY PKWY
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Brevard
County
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0 1 Miles
USGS US Topo Basemap
N

APPENDIX B

SHOVEL TEST LOG

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Project Name	Project Number	Project Phase	Excavation ID	Type	Excavation Date	Northing	Easting	Termination	Level	Depth	Munsell	Texture	Inclusions	Comments
Roberts_Rd	260027	1	N7200 E3100	Negative ST	2026-04-15 12:33:07	3157200	533100	Max Depth	1	0-29	10YR 4/1	Sand		
Roberts_Rd	260027	1	N7200 E3100	Negative ST	2026-04-15 12:33:07	3157200	533100	Max Depth	2	29-100	10YR 7/1	Sand		
Roberts_Rd	260027	1	N7300 E3200	Precontact ST	2026-04-15 12:32:03	3157300	533200	Max Depth	1	0-20	10YR 4/2	Loamy Sand		
Roberts_Rd	260027	1	N7300 E3200	Precontact ST	2026-04-15 12:32:03	3157300	533200	Max Depth	2	20-35	10YR 2/2	Loamy Sand		
Roberts_Rd	260027	1	N7300 E3200	Precontact ST	2026-04-15 12:32:03	3157300	533200	Max Depth	3	35-45	10YR 7/1	Sand		
Roberts_Rd	260027	1	N7300 E3200	Precontact ST	2026-04-15 12:32:03	3157300	533200	Max Depth	4	45-55	10YR 2/1	Loamy Sand		
Roberts_Rd	260027	1	N7300 E3200	Precontact ST	2026-04-15 12:32:03	3157300	533200	Max Depth	5	55-70	10YR 5/1	Sand		
Roberts_Rd	260027	1	N7300 E3200	Precontact ST	2026-04-15 12:32:03	3157300	533200	Max Depth	6	70-100	10YR 8/1	Sand		
Roberts_Rd	260027	1	N7350 E3150	Negative ST	2026-04-15 12:52:03	3157350	533150	Max Depth	1	0-24	10YR 6/1	Loamy Sand		Coarse sand. Saturated at base
Roberts_Rd	260027	1	N7350 E3150	Negative ST	2026-04-15 12:52:03	3157350	533150	Max Depth	2	24-100	10YR 7/2	Sand		
Roberts_Rd	260027	1	N7350 E3050	Negative ST	2026-04-15 13:10:16	3157350	533050	Max Depth	1	0-17	10YR 6/1	Loamy Sand		
Roberts_Rd	260027	1	N7350 E3050	Negative ST	2026-04-15 13:10:16	3157350	533050	Max Depth	2	17-100	7.5YR 7/3	Sand		
Roberts_Rd	260027	1	N7450 E3050	Negative ST	2026-04-15 13:27:35	3157450	533050	Max Depth	1	0-23	10YR 6/1	Loamy Sand		
Roberts_Rd	260027	1	N7450 E3050	Negative ST	2026-04-15 13:27:35	3157450	533050	Max Depth	2	23-100	7.5YR 7/3	Sand		
Roberts_Rd	260027	1	N7500 E3050	Negative ST	2026-04-15 13:48:18	3157500	533050	Max Depth	1	0-21	10YR 6/1	Loamy Sand		
Roberts_Rd	260027	1	N7500 E3050	Negative ST	2026-04-15 13:48:18	3157500	533050	Max Depth	2	21-100	7.5YR 7/3	Sand		
Roberts_Rd	260027	1	N7550 E3100	Negative ST	2026-04-15 13:58:02	3157550	533100	Root Impasse	1	0-32	10YR 6/1	Loamy Sand		
Roberts_Rd	260027	1	N7550 E3100	Negative ST	2026-04-15 13:58:02	3157550	533100	Root Impasse	2	32-47	7.5YR 7/3	Sand		
Roberts_Rd	260027	1	N7600 E3100	Negative ST	2026-04-15 14:10:01	3157600	533100	Inundated	1	0-23	10YR 2/2	Loamy Sand		

			N7600	Negative								
Roberts_Rd	260027	1	E3100	ST	2026-04-15 14:10:01	3157600	533100	Inundated	2	23-60	10YR 4/1	Sand
			N7600	Negative								
Roberts_Rd	260027	1	E3100	ST	2026-04-15 14:10:01	3157600	533100	Inundated	3	60-73	10YR 7/2	Sand
			N7600	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 14:23:01	3157600	533150	Inundated	1	0-24	10YR 2/2	Loamy Sand
			N7600	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 14:23:01	3157600	533150	Inundated	2	24-80	10YR 4/1	Sand
			N7650	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 14:39:01	3157650	533200	Inundated	1	0-20	10YR 6/1	Loamy Sand
			N7650	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 14:39:01	3157650	533200	Inundated	2	20-73	7.5YR 5/3	Sand
			N7650	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 14:39:01	3157650	533200	Inundated	3	73-85	10YR 8/1	Sand
			N7600	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 15:03:03	3157600	533200	Max Depth	1	0-26	10YR 4/2	Loamy Sand
			N7600	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 15:03:03	3157600	533200	Max Depth	2	26-51	10YR 6/1	Sand
			N7600	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 15:03:03	3157600	533200	Max Depth	3	51-100	10YR 7/2	Sand
			N7700	Negative								
Roberts_Rd	260027	1	E3250	ST	2026-04-15 15:29:03	3157700	533250	Inundated	1	0-27	10YR 5/1	Loamy Sand
			N7700	Negative								
Roberts_Rd	260027	1	E3250	ST	2026-04-15 15:29:03	3157700	533250	Inundated	2	27-64	7.5YR 5/3	Sand
			N7700	Negative								Compact sand
Roberts_Rd	260027	1	E3250	ST	2026-04-15 15:29:03	3157700	533250	Inundated	3	64-74	10YR 2/1	Sand
			N7700	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 15:43:00	3157700	533200	Root Impasse	1	0-24	10YR 6/1	Loamy Sand
			N7700	Negative								
Roberts_Rd	260027	1	E3200	ST	2026-04-15 15:43:00	3157700	533200	Root Impasse	2	24-39	7.5YR 7/3	Sand
			N7750	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 16:48:06	3157750	533150	Inundated	1	0-19	10YR 4/2	Loamy Sand
			N7750	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 16:48:06	3157750	533150	Inundated	2	19-42	7.5YR 5/3	Sand
			N7750	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 16:48:06	3157750	533150	Inundated	3	42-70	10YR 7/1	Sand
			N7800	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 17:01:02	3157800	533150	Inundated	1	0-20	10YR 5/2	Loamy Sand
			N7800	Negative								
Roberts_Rd	260027	1	E3150	ST	2026-04-15 17:01:02	3157800	533150	Inundated	2	20-77	10YR 6/2	Sand

Roberts_Rd	260027	1	N7850 E3200	Negative ST	2026-04-15 17:18:02	3157850	533200	Inundated	1	0-18	10YR 5/2	Loamy Sand	
Roberts_Rd	260027	1	N7850 E3200	Negative ST	2026-04-15 17:18:02	3157850	533200	Inundated	2	18-80	10YR 6/2	Sand	
Roberts_Rd	260027	1	N7900 E3200	Negative ST	2026-04-15 17:35:02	3157900	533200	Inundated	1	0-35	10YR 6/1	Loamy Sand	
Roberts_Rd	260027	1	N7900 E3200	Negative ST	2026-04-15 17:35:02	3157900	533200	Inundated	2	35-90	7.5YR 5/3	Sand	
Roberts_Rd	260027	1	N7950 E3150	Negative ST	2026-04-15 17:54:15	3157950	533150	Inundated	1	0-41	10YR 6/1	Loamy Sand	
Roberts_Rd	260027	1	N7950 E3150	Negative ST	2026-04-15 17:54:15	3157950	533150	Inundated	2	41-90	10YR 7/3	Sand	
Roberts_Rd	260027	1	N8000 E3150	Negative ST	2026-04-15 18:14:03	3158000	533150	Max Depth	1	0-28	10YR 6/1	Loamy Sand	
Roberts_Rd	260027	1	N8000 E3150	Negative ST	2026-04-15 18:14:03	3158000	533150	Max Depth	2	28-74	10YR 7/3	Sand	
Roberts_Rd	260027	1	N8000 E3150	Negative ST	2026-04-15 18:14:03	3158000	533150	Max Depth	3	74-100	10YR 8/1	Sand	
Roberts_Rd	260027	1	N8050 E3150	Negative ST	2026-04-15 18:25:02	3158050	533150	Max Depth	1	0-23	10YR 6/1	Loamy Sand	
Roberts_Rd	260027	1	N8050 E3150	Negative ST	2026-04-15 18:25:02	3158050	533150	Max Depth	2	23-68	10YR 7/3	Sand	
Roberts_Rd	260027	1	N8050 E3150	Negative ST	2026-04-15 18:25:02	3158050	533150	Max Depth	3	68-100	10YR 8/1	Sand	
Roberts_Rd	260027	1	N7250 E3100	Negative ST	2026-04-15 13:00:02	3157250	533100	Max Depth	1	0-22	10YR 8/2	Sand	
Roberts_Rd	260027	1	N7250 E3100	Negative ST	2026-04-15 13:00:02	3157250	533100	Max Depth	2	22-92	10YR 7/2	Sand	
Roberts_Rd	260027	1	N7250 E3100	Negative ST	2026-04-15 13:00:02	3157250	533100	Max Depth	3	92-103	10YR 4/2	Sand	
Roberts_Rd	260027	1	N7400 E3150	Negative ST	2026-04-15 13:23:02	3157400	533150	Max Depth	1	0-23	10YR 7/1	Sand	
Roberts_Rd	260027	1	N7400 E3150	Negative ST	2026-04-15 13:23:02	3157400	533150	Max Depth	2	23-100	10YR 4/2	Sand	Moisture increasing with depth but never inundated
Roberts_Rd	260027	1	N7450 E3150	Negative ST	2026-04-15 14:07:05	3157450	533150	Max Depth	1	0-35	10YR 7/2	Sand	
Roberts_Rd	260027	1	N7450 E3150	Negative ST	2026-04-15 14:07:05	3157450	533150	Max Depth	2	35-102	10YR 4/2	Sand	Water content increase with depth

Roberts_Rd	260027	1	N7450 E3100	Negative ST	2026-04-15 14:44:04	3157450	533100	Inundated	1	0-38	10YR 2/2	Sand	
Roberts_Rd	260027	1	N7450 E3100	Negative ST	2026-04-15 14:44:04	3157450	533100	Inundated	2	38-83	10YR 4/2	Sand	Inundated at 83cmbs
Roberts_Rd	260027	1	N7500 E3150	Negative ST	2026-04-15 15:25:07	3157500	533150	Max Depth	1	0-19	10YR 6/2	Sand	
Roberts_Rd	260027	1	N7500 E3150	Negative ST	2026-04-15 15:25:07	3157500	533150	Max Depth	2	19-100	10YR 4/3	Sand	
Roberts_Rd	260027	1	N7750 E3100	Negative ST	2026-04-15 16:59:29	3157750	533100	Inundated	1	0-28	10YR 5/1	Sand	
Roberts_Rd	260027	1	N7750 E3100	Negative ST	2026-04-15 16:59:29	3157750	533100	Inundated	2	28-70	10YR 4/2	Sand	
Roberts_Rd	260027	1	N7750 E3050	Negative ST	2026-04-15 17:17:01	3157750	533050	Max Depth	1	0-25	10YR 7/1	Sand	
Roberts_Rd	260027	1	N7750 E3050	Negative ST	2026-04-15 17:17:01	3157750	533050	Max Depth	2	25-100	10YR 4/2	Sand	
Roberts_Rd	260027	1	N8100 E3050	Negative ST	2026-04-15 17:57:03	3158100	533050	Inundated	1	0-31	10YR 6/1	Sand	
Roberts_Rd	260027	1	N8100 E3050	Negative ST	2026-04-15 17:57:03	3158100	533050	Inundated	2	31-74	10YR 4/2	Sand	Inundated at 74cmbs
Roberts_Rd	260027	1	N8150 E3150	Negative ST	2026-04-15 18:25:12	3158150	533150	Inundated	1	0-35	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8150 E3150	Negative ST	2026-04-15 18:25:12	3158150	533150	Inundated	2	35-82	10YR 4/3	Sand	Inundated
Roberts_Rd	260027	1	N8100 E3150	Negative ST	2026-04-15 18:44:03	3158100	533150	Inundated	1	0-29	10YR 4/1	Sand	
Roberts_Rd	260027	1	N8100 E3150	Negative ST	2026-04-15 18:44:03	3158100	533150	Inundated	2	29-69	10YR 5/2	Sand	Inundated at 69cmbs
Roberts_Rd	260027	1	N7850 E3300	Negative ST	2026-04-16 11:35:01	3157850	533300	Inundated	1	0-27	10YR 4/1	Loamy Sand	
Roberts_Rd	260027	1	N7850 E3300	Negative ST	2026-04-16 11:35:01	3157850	533300	Inundated	2	27-70	10YR 5/2	Sand	
Roberts_Rd	260027	1	N7850 E3300	Negative ST	2026-04-16 11:35:01	3157850	533300	Inundated	3	70-82	10YR 8/2	Sand	
Roberts_Rd	260027	1	N7950 E3250	Negative ST	2026-04-16 11:53:11	3157950	533250	Inundated	1	0-24	10YR 5/1	Loamy Sand	
Roberts_Rd	260027	1	N7950 E3250	Negative ST	2026-04-16 11:53:11	3157950	533250	Inundated	2	24-67	7.5YR 5/3	Sand	
Roberts_Rd	260027	1	N7950 E3250	Negative ST	2026-04-16 11:53:11	3157950	533250	Inundated	3	67-80	10YR 2/1	Sand	Compact sand

			N7950	Negative								
Roberts_Rd	260027	1	E3300	ST	2026-04-16 12:13:01	3157950	533300	Inundated	1	0-30	10YR 7/1	Loamy Sand
			N7950	Negative								
Roberts_Rd	260027	1	E3300	ST	2026-04-16 12:13:01	3157950	533300	Inundated	2	30-96	7.5YR 5/2	Sand
			N8000	Negative								
Roberts_Rd	260027	1	E3300	ST	2026-04-16 12:31:04	3158000	533300	Inundated	1	0-26	10YR 7/1	Loamy Sand
			N8000	Negative								
Roberts_Rd	260027	1	E3300	ST	2026-04-16 12:31:04	3158000	533300	Inundated	2	26-95	7.5YR 5/2	Sand
			N8250	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 12:52:05	3158250	533350	Inundated	1	0-24	10YR 6/1	Loamy Sand
			N8250	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 12:52:05	3158250	533350	Inundated	2	24-74	7.5YR 5/2	Sand
			N8250	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 12:52:05	3158250	533350	Inundated	3	74-90	10YR 7/3	Sand
			N8500	Negative								
Roberts_Rd	260027	1	E3400	ST	2026-04-16 13:18:14	3158500	533400	Inundated	1	0-19	10YR 6/1	Loamy Sand
			N8500	Negative								
Roberts_Rd	260027	1	E3400	ST	2026-04-16 13:18:14	3158500	533400	Inundated	2	19-67	7.5YR 5/2	Sand
			N8500	Negative								
Roberts_Rd	260027	1	E3400	ST	2026-04-16 13:18:14	3158500	533400	Inundated	3	67-85	10YR 7/3	Sand
			N8450	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 13:43:16	3158450	533350	Inundated	1	0-22	10YR 2/1	Loamy Sand
			N8450	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 13:43:16	3158450	533350	Inundated	2	22-70	7.5YR 5/2	Sand
			N8450	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 13:43:16	3158450	533350	Inundated	3	70-90	10YR 7/2	Sand
			N8500	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 14:00:01	3158500	533350	Inundated	1	0-19	10YR 2/1	Loamy Sand
			N8500	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 14:00:01	3158500	533350	Inundated	2	19-73	7.5YR 5/2	Sand
			N8500	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 14:00:01	3158500	533350	Inundated	3	73-96	10YR 7/2	Sand
			N8550	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 14:16:30	3158550	533350	Inundated	1	0-20	10YR 2/1	Loamy Sand
			N8550	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 14:16:30	3158550	533350	Inundated	2	20-65	7.5YR 5/2	Sand
			N8550	Negative								
Roberts_Rd	260027	1	E3350	ST	2026-04-16 14:16:30	3158550	533350	Inundated	3	65-87	10YR 7/2	Sand
			N8600	Negative								
Roberts_Rd	260027	1	E3400	ST	2026-04-16 14:39:07	3158600	533400	Inundated	1	0-19	10YR 2/1	Loamy Sand

Roberts_Rd	260027	1	N8600 E3400	Negative ST	2026-04-16 14:39:07	3158600	533400	Inundated	2	19-66	7.5YR 5/2	Sand		
Roberts_Rd	260027	1	N8600 E3400	Negative ST	2026-04-16 14:39:07	3158600	533400	Inundated	3	66-90	10YR 7/2	Sand		
Roberts_Rd	260027	1	N8750 E3400	Negative ST	2026-04-16 15:29:08	3158750	533400	Inundated	1	0-29	10YR 5/2	Sand		
Roberts_Rd	260027	1	N8750 E3400	Negative ST	2026-04-16 15:29:08	3158750	533400	Inundated	2	29-70	10YR 4/3	Sand		
Roberts_Rd	260027	1	N8750 E3400	Negative ST	2026-04-16 15:29:08	3158750	533400	Inundated	3	70-92	10YR 7/2	Sand		Inundated at 92cmbs
Roberts_Rd	260027	1	N8750 E3450	Negative ST	2026-04-16 15:14:01	3158750	533450	Inundated	1	0-22	10YR 4/2	Loamy Sand		
Roberts_Rd	260027	1	N8750 E3450	Negative ST	2026-04-16 15:14:01	3158750	533450	Inundated	2	22-70	7.5YR 5/2	Sand		
Roberts_Rd	260027	1	N8750 E3450	Negative ST	2026-04-16 15:14:01	3158750	533450	Inundated	3	70-81	10YR 2/1	Sand		Conpact sand
Roberts_Rd	260027	1	N8750 E3450	Negative ST	2026-04-16 15:14:01	3158750	533450	Inundated	4	81-94	10YR 7/2	Sand		
Roberts_Rd	260027	1	N9400 E3500	Negative ST	2026-04-16 16:34:02	3159400	533500	Max Depth	1	0-47	10YR 5/1	Sand		
Roberts_Rd	260027	1	N9400 E3500	Negative ST	2026-04-16 16:34:02	3159400	533500	Max Depth	2	47-101	10YR 5/4	Sand		
Roberts_Rd	260027	1	N9350 E3500	Negative ST	2026-04-16 16:45:04	3159350	533500	Max Depth	1	0-43	10YR 5/2	Sand		
Roberts_Rd	260027	1	N9350 E3500	Negative ST	2026-04-16 16:45:04	3159350	533500	Max Depth	2	43-102	10YR 4/3	Sand		
Roberts_Rd	260027	1	N9300 E3500	Negative ST	2026-04-16 16:57:00	3159300	533500	Inundated	1	0-19	10YR 5/1	Sand		
Roberts_Rd	260027	1	N9300 E3500	Negative ST	2026-04-16 16:57:00	3159300	533500	Inundated	2	19-40	10YR 7/2	Sand		
Roberts_Rd	260027	1	N9300 E3500	Negative ST	2026-04-16 16:57:00	3159300	533500	Inundated	3	40-87	10YR 8/3	Sand		
Roberts_Rd	260027	1	N7277 E3198	Negative ST	2026-04-16 17:38:00	3157276	533199	Inundated	1	0-34	10YR 4/2	Sand	None	Sand soil, by the creek
Roberts_Rd	260027	1	N7323 E3201	Negative ST	2026-04-16 17:28:13	3157325	533201	Max Depth	1	0-20	10YR 4/2	Loamy Sand		
Roberts_Rd	260027	1	N7323 E3201	Negative ST	2026-04-16 17:28:13	3157325	533201	Max Depth	2	20-45	10YR 2/2	Loamy Sand		
Roberts_Rd	260027	1	N7323 E3201	Negative ST	2026-04-16 17:28:13	3157325	533201	Max Depth	3	45-55	10YR 3/3	Sand		

			N7323	Negative										
Roberts_Rd	260027	1	E3201	ST	2026-04-16 17:28:13	3157325	533201	Max Depth	4	55-65	10YR 2/1	Loamy Sand		
			N7323	Negative										
Roberts_Rd	260027	1	E3201	ST	2026-04-16 17:28:13	3157325	533201	Max Depth	5	65-70	10YR 5/1	Sand		
			N7323	Negative										
Roberts_Rd	260027	1	E3201	ST	2026-04-16 17:28:13	3157325	533201	Max Depth	6	70-100	10YR 8/1	Sand		
			N7313	Negative										
Roberts_Rd	260027	1	E3200	ST	2026-04-16 17:39:03	3157313	533200	Max Depth	1	0-18	10YR 4/2	Loamy Sand		
			N7313	Negative										
Roberts_Rd	260027	1	E3200	ST	2026-04-16 17:39:03	3157313	533200	Max Depth	2	18-31	10YR 4/2	Loamy Sand		
			N7313	Negative										
Roberts_Rd	260027	1	E3200	ST	2026-04-16 17:39:03	3157313	533200	Max Depth	3	31-47	10YR 3/3	Sand		
			N7313	Negative										
Roberts_Rd	260027	1	E3200	ST	2026-04-16 17:39:03	3157313	533200	Max Depth	4	47-50	10YR 2/1	Loamy Sand		
			N7313	Negative										
Roberts_Rd	260027	1	E3200	ST	2026-04-16 17:39:03	3157313	533200	Max Depth	5	50-72	10YR 5/1	Sand		
			N7313	Negative										
Roberts_Rd	260027	1	E3200	ST	2026-04-16 17:39:03	3157313	533200	Max Depth	6	72-100	10YR 8/1	Sand		
			N7292	Negative										Grass roots
Roberts_Rd	260027	1	E3196	ST	2026-04-16 17:59:14	3157288	533199	Max Depth	1	0-36	10YR 4/2	Sand	None	
			N7292	Negative										Very sandy
Roberts_Rd	260027	1	E3196	ST	2026-04-16 17:59:14	3157288	533199	Max Depth	2	36-78	10YR 4/1	Sand	None	
			N7292	Negative										Sand
Roberts_Rd	260027	1	E3196	ST	2026-04-16 17:59:14	3157288	533199	Max Depth	3	78-102	10YR 6/2	Sand	None	
			N9250	Negative										
Roberts_Rd	260027	1	E3450	ST	2026-04-16 17:25:02	3159250	533450	Inundated	1	0-24	10YR 4/2	Loamy Sand		
			N9250	Negative										
Roberts_Rd	260027	1	E3450	ST	2026-04-16 17:25:02	3159250	533450	Inundated	2	24-70	7.5YR 5/2	Sand		
			N9250	Negative										Conpact sand
Roberts_Rd	260027	1	E3450	ST	2026-04-16 17:25:02	3159250	533450	Inundated	3	70-81	10YR 8/3	Sand		
			N8450	Negative										
Roberts_Rd	260027	1	E3050	ST	2026-04-16 18:51:19	3158450	533050	Inundated	1	0-36	10YR 2/2	Sand		
			N8450	Negative										Inundated
Roberts_Rd	260027	1	E3050	ST	2026-04-16 18:51:19	3158450	533050	Inundated	2	36-85	10YR 4/3	Sand		
			N8300	Negative										
Roberts_Rd	260027	1	E3050	ST	2026-04-16 19:02:08	3158300	533050	Inundated	1	0-29	10YR 2/2	Sand		
			N8300	Negative										Inundated
Roberts_Rd	260027	1	E3050	ST	2026-04-16 19:02:08	3158300	533050	Inundated	2	29-80	10YR 4/3	Sand		
			N8400	Negative										
Roberts_Rd	260027	1	E2900	ST	2026-04-16 18:29:01	3158400	532900	Sterile Subsoil	1	0-37	10YR 2/1	Sandy Loam		

Roberts_Rd	260027	1	N8400 E2900	Negative ST	2026-04-16 18:29:01	3158400	532900	Sterile Subsoil	2 37-74	10YR 4/2	Sand		Compact sterile soils at 74cmbs
Roberts_Rd	260027	1	N9400 E3050	Negative ST	2026-04-16 19:17:01	3159400	533050	Other	1 0-32	10YR 2/2	Sand		
Roberts_Rd	260027	1	N9400 E3050	Negative ST	2026-04-16 19:17:01	3159400	533050	Other	2 32-67	7.5YR 2.5/2	Loamy Sand	Other	Organic inclusions, compaction impass at 67cmbs
Roberts_Rd	260027	1	N9250 E3050	Negative ST	2026-04-16 19:39:12	3159250	533050	Inundated	1 0-19	10YR 5/2	Sand		
Roberts_Rd	260027	1	N9250 E3050	Negative ST	2026-04-16 19:39:12	3159250	533050	Inundated	2 19-47	10YR 3/3	Sand		
Roberts_Rd	260027	1	N9250 E3050	Negative ST	2026-04-16 19:39:12	3159250	533050	Inundated	3 47-71	10YR 6/4	Sand		Water table at 71cmbs
Roberts_Rd	260027	1	N8150 E3300	Negative ST	2026-04-16 11:47:03	3158150	533300	Max Depth	1 0-16	10YR 7/1	Sand		
Roberts_Rd	260027	1	N8150 E3300	Negative ST	2026-04-16 11:47:03	3158150	533300	Max Depth	2 16-89	10YR 7/1	Sand		
Roberts_Rd	260027	1	N8150 E3300	Negative ST	2026-04-16 11:47:03	3158150	533300	Max Depth	3 89-102	10YR 8/2	Sand		
Roberts_Rd	260027	1	N8100 E3300	Negative ST	2026-04-16 12:08:01	3158100	533300	Inundated	1 0-13	10YR 7/1	Sand		
Roberts_Rd	260027	1	N8100 E3300	Negative ST	2026-04-16 12:08:01	3158100	533300	Inundated	2 13-70	10YR 4/1	Sand		
Roberts_Rd	260027	1	N8100 E3300	Negative ST	2026-04-16 12:08:01	3158100	533300	Inundated	3 70-93	10YR 8/2	Sand		
Roberts_Rd	260027	1	N8050 E3300	Negative ST	2026-04-16 12:35:03	3158050	533300	Max Depth	1 0-38	10YR 8/2	Sand		
Roberts_Rd	260027	1	N8050 E3300	Negative ST	2026-04-16 12:35:03	3158050	533300	Max Depth	2 38-100	10YR 5/1	Sand		
Roberts_Rd	260027	1	N8300 E3350	Negative ST	2026-04-16 12:58:00	3158300	533350	Inundated	1 0-20	10YR 7/2	Sand		
Roberts_Rd	260027	1	N8300 E3350	Negative ST	2026-04-16 12:58:00	3158300	533350	Inundated	2 20-68	10YR 4/2	Sand		
Roberts_Rd	260027	1	N8300 E3350	Negative ST	2026-04-16 12:58:00	3158300	533350	Inundated	3 68-90	10YR 8/2	Sand		Inundated at 90cmbs
Roberts_Rd	260027	1	N8600 E3250	Negative ST	2026-04-16 13:38:09	3158600	533250	Inundated	1 0-24	10YR 2/2	Sand		
Roberts_Rd	260027	1	N8600 E3250	Negative ST	2026-04-16 13:38:09	3158600	533250	Inundated	2 24-70	10YR 4/2	Sand		Inundated at 70cmbs

Roberts_Rd	260027	1	N8700 E3350	Negative ST	2026-04-16 14:07:04	3158700	533350	Inundated	1	0-25	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8700 E3350	Negative ST	2026-04-16 14:07:04	3158700	533350	Inundated	2	25-53	10YR 6/2	Sand	
Roberts_Rd	260027	1	N8700 E3350	Negative ST	2026-04-16 14:07:04	3158700	533350	Inundated	3	53-67	10YR 7/2	Sand	
Roberts_Rd	260027	1	N8750 E3350	Negative ST	2026-04-16 14:19:02	3158750	533350	Inundated	1	0-20	10YR 3/2	Sand	
Roberts_Rd	260027	1	N8750 E3350	Negative ST	2026-04-16 14:19:02	3158750	533350	Inundated	2	20-58	10YR 5/2	Sand	Inundated at 58cmbs
Roberts_Rd	260027	1	N8750 E3200	Negative ST	2026-04-16 14:52:04	3158750	533200	Sterile Subsoil	1	0-28	10YR 7/2	Sand	
Roberts_Rd	260027	1	N8750 E3200	Negative ST	2026-04-16 14:52:04	3158750	533200	Sterile Subsoil	2	28-53	10YR 5/2	Sand	
Roberts_Rd	260027	1	N8750 E3200	Negative ST	2026-04-16 14:52:04	3158750	533200	Sterile Subsoil	3	53-73	10YR 2/2	Sandy Clay	Compact subsoil, impassable beyond 73cmbs
Roberts_Rd	260027	1	N7300 E3175	Negative ST	2026-04-16 17:28:09	3157300	533175	Max Depth	1	0-28	10YR 6/1	Sand	
Roberts_Rd	260027	1	N7300 E3175	Negative ST	2026-04-16 17:28:09	3157300	533175	Max Depth	2	28-54	10YR 2/2	Sand	
Roberts_Rd	260027	1	N7300 E3175	Negative ST	2026-04-16 17:28:09	3157300	533175	Max Depth	3	54-100	10YR 4/3	Loamy Sand	Moisture increasing with depth
Roberts_Rd	260027	1	N7298 E3188	Negative ST	2026-04-16 17:44:01	3157300	533188	Max Depth	1	0-38	10YR 5/2	Sand	
Roberts_Rd	260027	1	N7298 E3188	Negative ST	2026-04-16 17:44:01	3157300	533188	Max Depth	2	38-83	10YR 4/3	Sand	
Roberts_Rd	260027	1	N7298 E3188	Negative ST	2026-04-16 17:44:01	3157300	533188	Max Depth	3	83-100	10YR 7/2	Sand	
Roberts_Rd	260027	1	N7300 E3217	Negative ST	2026-04-16 18:01:01	3157300	533217	Max Depth	1	0-51	10YR 3/3	Sandy Loam	
Roberts_Rd	260027	1	N7300 E3217	Negative ST	2026-04-16 18:01:01	3157300	533217	Max Depth	2	51-56	10YR 2/2	Sand	
Roberts_Rd	260027	1	N7300 E3217	Negative ST	2026-04-16 18:01:01	3157300	533217	Max Depth	3	56-100	10YR 6/2	Sand	
Roberts_Rd	260027	1	N7950 E2900	Negative ST	2026-04-16 18:17:04	3157950	532900	Inundated	1	0-20	10YR 5/1	Sand	
Roberts_Rd	260027	1	N7950 E2900	Negative ST	2026-04-16 18:17:04	3157950	532900	Inundated	2	20-40	10YR 6/1	Sand	

Roberts_Rd	260027	1	N7950 E2900	Negative ST	2026-04-16 18:17:04	3157950	532900	Inundated	3	40-64	10YR 7/1	Sand	
Roberts_Rd	260027	1	N7950 E2900	Negative ST	2026-04-16 18:17:04	3157950	532900	Inundated	4	64-74	10YR 2/1	Sand	Compact sand
Roberts_Rd	260027	1	N9502 E2203	Negative ST	2026-04-17 11:40:07	3159502	532203	Disturbed	1	0-27	10YR 4/1	Sand	Gravel	Height level of rocks; disturbed surface
Roberts_Rd	260027	1	N9150 E2150	Negative ST	2026-04-17 11:49:04	3159150	532150	Disturbed	1	0-40	10YR 6/1	Sand	Gravel	Gravels from built up berm terminated due to disturbance
Roberts_Rd	260027	1	N8750 E2500	Negative ST	2026-04-17 12:11:03	3158750	532500	Max Depth	1	0-73	10YR 5/1	Sand	Gravel	Gravel and clay disturbance
Roberts_Rd	260027	1	N8750 E2500	Negative ST	2026-04-17 12:11:03	3158750	532500	Max Depth	2	73-100	10YR 7/1	Sand	
Roberts_Rd	260027	1	N8568 E2686	Negative ST	2026-04-17 12:33:00	3158650	532700	Bedrock	1	0-35	10YR 4/1	Sand	Gravel	
Roberts_Rd	260027	1	N8281 E2106	Negative ST	2026-04-17 13:19:27	3158281	532106	Sterile Subsoil	1	0-40	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8281 E2106	Negative ST	2026-04-17 13:19:27	3158281	532106	Sterile Subsoil	2	40-61	10YR 5/1	Sandy Clay		Redox staining throughout
Roberts_Rd	260027	1	N7662 E2162	Negative ST	2026-04-17 13:51:03	3157662	532162	Sterile Subsoil	1	0-32	10YR 5/1	Sand	
Roberts_Rd	260027	1	N7662 E2162	Negative ST	2026-04-17 13:51:03	3157662	532162	Sterile Subsoil	2	32-63	10YR 4/1	Sandy Clay		Clay substrate
Roberts_Rd	260027	1	N7853 E2076	Negative ST	2026-04-17 14:13:04	3157853	532076	Sterile Subsoil	1	0-27	10YR 4/1	Sand	
Roberts_Rd	260027	1	N7853 E2076	Negative ST	2026-04-17 14:13:04	3157853	532076	Sterile Subsoil	2	27-42	10YR 5/3	Sandy Clay		Sandy clay inclusion
Roberts_Rd	260027	1	N8045 E2015	Negative ST	2026-04-17 14:29:23	3158045	532015	Sterile Subsoil	1	0-40	10YR 5/1	Sand	
Roberts_Rd	260027	1	N8045 E2015	Negative ST	2026-04-17 14:29:23	3158045	532015	Sterile Subsoil	2	40-60	10YR 4/1	Sandy Clay		Clay substrate
Roberts_Rd	260027	1	N8282 E2274	Negative ST	2026-04-17 14:53:05	3158282	532274	Sterile Subsoil	1	0-42	10YR 2/2	Sandy Clay	
Roberts_Rd	260027	1	N8282 E2274	Negative ST	2026-04-17 14:53:05	3158282	532274	Sterile Subsoil	2	42-57	10YR 5/1	Clay	
Roberts_Rd	260027	1	N8302 E2473	Negative ST	2026-04-17 15:07:06	3158302	532473	Root Impasse	1	0-30	10YR 4/1	Sandy Loam	Gravel	Rock impasse at 30cmbs
Roberts_Rd	260027	1	N8330 E2660	Negative ST	2026-04-17 15:23:06	3158330	532660	Root Impasse	1	0-31	10YR 2/2	Sandy Loam	

Roberts_Rd	260027	1	N8330 E2660	Negative ST	2026-04-17 15:23:06	3158330	532660	Root Impasse	2 31-61	10YR 6/1	Clay	Sterile clay
Roberts_Rd	260027	1	N7200 E9900	Negative ST	2026-04-17 16:53:03	3157200	529900	Disturbed	1 0-34	10YR 4/2	Sandy Loam	
Roberts_Rd	260027	1	N7200 E9900	Negative ST	2026-04-17 16:53:03	3157200	529900	Disturbed	2 34-57	10YR 8/3	Sandy Loam	
Roberts_Rd	260027	1	N6168 E0732	Negative ST	2026-04-17 17:42:03	3156168	530732	Sterile Subsoil	1 0-51	10YR 5/1	Loamy Sand	
Roberts_Rd	260027	1	N6168 E0732	Negative ST	2026-04-17 17:42:03	3156168	530732	Sterile Subsoil	2 51-85	10YR 6/2	Sandy Clay	
Roberts_Rd	260027	1	N6159 E0537	Negative ST	2026-04-17 18:00:09	3156159	530537	Disturbed	1 0-20	10YR 4/3	Sand	
Roberts_Rd	260027	1	N6159 E0537	Negative ST	2026-04-17 18:00:09	3156159	530537	Disturbed	2 20-31	10YR 7/3	Sand	
Roberts_Rd	260027	1	N6787 E0754	Negative ST	2026-04-18 12:22:07	3156787	530754	Inundated	1 0-8	10YR 2/2	Sand	
Roberts_Rd	260027	1	N6787 E0754	Negative ST	2026-04-18 12:22:07	3156787	530754	Inundated	2 8-38	10YR 6/8	Sand	Water table at base
Roberts_Rd	260027	1	N6895 E0916	Negative ST	2026-04-18 12:32:15	3156895	530916	Bedrock	1 0-50	10YR 2/2	Sand	
Roberts_Rd	260027	1	N6895 E0916	Negative ST	2026-04-18 12:32:15	3156895	530916	Bedrock	2 50-58	10YR 5/3	Sand	10YR8/1 degrading bedrock in base
Roberts_Rd	260027	1	N7057 E1029	Negative ST	2026-04-18 12:40:05	3157057	531032	Bedrock	1 0-53	10YR 2/2	Sand	
Roberts_Rd	260027	1	N7057 E1029	Negative ST	2026-04-18 12:40:05	3157057	531032	Bedrock	2 53-70	10YR 8/1	Sandy Clay Loam	10YR8/1 degrading bedrock in base
Roberts_Rd	260027	1	N7129 E1175	Negative ST	2026-04-18 12:53:11	3157129	531175	Inundated	1 0-46	10YR 4/2	Sand	
Roberts_Rd	260027	1	N7129 E1175	Negative ST	2026-04-18 12:53:11	3157129	531175	Inundated	2 46-60	10YR 5/1	Loamy Sand	Water at 60cmbs
Roberts_Rd	260027	1	N7128 E1103	Negative ST	2026-04-18 13:09:04	3157128	531103	Inundated	1 0-17	10YR 2/2	Sand	
Roberts_Rd	260027	1	N7128 E1103	Negative ST	2026-04-18 13:09:04	3157128	531103	Inundated	2 17-50	10YR 6/2	Loamy Sand	Water at 60cmbs
Roberts_Rd	260027	1	N7128 E1103	Negative ST	2026-04-18 13:09:04	3157128	531103	Inundated	3 50-72	10YR 4/3	Sandy Clay	Water at 72
Roberts_Rd	260027	1	N7650 E1700	Negative ST	2026-04-18 14:15:10	3157650	531700	Sterile Subsoil	1 0-37	10YR 5/1	Sand	

			N7650	Negative									
Roberts_Rd	260027	1	E1700	ST	2026-04-18 14:15:10	3157650	531700	Sterile Subsoil	2	37-53	10YR 7/3	Sand	
			N7650	Negative									Hydric clay
Roberts_Rd	260027	1	E1700	ST	2026-04-18 14:15:10	3157650	531700	Sterile Subsoil	3	53-65	10YR 7/2	Sandy Clay	
			N9531	Negative									
Roberts_Rd	260027	1	E0874	ST	2026-04-18 15:59:03	3159541	530879	Sterile Subsoil	1	0-32	10YR 2/2	Sand	
			N9531	Negative									
Roberts_Rd	260027	1	E0874	ST	2026-04-18 15:59:03	3159541	530879	Sterile Subsoil	2	32-58	10YR 6/1	Sandy Loam	
			N9531	Negative									Redox staining
Roberts_Rd	260027	1	E0874	ST	2026-04-18 15:59:03	3159541	530879	Sterile Subsoil	3	58-72	10YR 7/2	Sandy Clay	
			N7280	Negative									Moisture
Roberts_Rd	260027	1	E0828	ST	2026-04-18 16:01:14	3157280	530828	Sterile Subsoil	1	0-56	10YR 2/1	Sandy Loam	None
			N7280	Negative									Soil
Roberts_Rd	260027	1	E0828	ST	2026-04-18 16:01:14	3157280	530828	Sterile Subsoil	2	56-70	10YR 6/6	Clay Loam	None
			N9354	Negative									
Roberts_Rd	260027	1	E0919	ST	2026-04-18 16:20:02	3159354	530919	Sterile Subsoil	1	0-26	10YR 2/2	Sand	
			N9354	Negative									
Roberts_Rd	260027	1	E0919	ST	2026-04-18 16:20:02	3159354	530919	Sterile Subsoil	2	26-40	10YR 5/1	Sandy Loam	
			N9354	Negative									Water at base
Roberts_Rd	260027	1	E0919	ST	2026-04-18 16:20:02	3159354	530919	Sterile Subsoil	3	40-72	10YR 4/2	Loamy Sand	
			N7640	Negative									
Roberts_Rd	260027	1	E0702	ST	2026-04-18 16:26:01	3157640	530702	Sterile Subsoil	1	0-53	10YR 2/2	Sand	
			N7640	Negative									
Roberts_Rd	260027	1	E0702	ST	2026-04-18 16:26:01	3157640	530702	Sterile Subsoil	2	53-64	10YR 3/3	Sand	
			N7640	Negative									Hydric clay
Roberts_Rd	260027	1	E0702	ST	2026-04-18 16:26:01	3157640	530702	Sterile Subsoil	3	64-75	10YR 7/2	Sandy Clay	
			N7799	Negative									
Roberts_Rd	260027	1	E0646	ST	2026-04-18 16:41:01	3157799	530646	Sterile Subsoil	1	0-25	10YR 2/2	Sand	
			N7799	Negative									
Roberts_Rd	260027	1	E0646	ST	2026-04-18 16:41:01	3157799	530646	Sterile Subsoil	2	25-42	10YR 7/1	Sand	
			N7799	Negative									Hydric clay
Roberts_Rd	260027	1	E0646	ST	2026-04-18 16:41:01	3157799	530646	Sterile Subsoil	3	42-62	10YR 7/2	Sandy Clay	
			N9176	Negative									
Roberts_Rd	260027	1	E0977	ST	2026-04-18 16:41:01	3159176	530977	Sterile Subsoil	1	0-24	10YR 5/2	Sand	
			N9176	Negative									F
Roberts_Rd	260027	1	E0977	ST	2026-04-18 16:41:01	3159176	530977	Sterile Subsoil	2	24-55	10YR 4/3	Loamy Sand	
			N9176	Negative									Redox staining
Roberts_Rd	260027	1	E0977	ST	2026-04-18 16:41:01	3159176	530977	Sterile Subsoil	3	55-86	10YR 7/2	Sandy Clay	
			N9045	Negative									
Roberts_Rd	260027	1	E1020	ST	2026-04-18 16:53:01	3159045	531020	Sterile Subsoil	1	0-42	10YR 6/2	Sand	

Roberts_Rd	260027	1	N9045 E1020	Negative ST	2026-04-18 16:53:01	3159045	531020	Sterile Subsoil	2	42-50	10YR 3/3	Loamy Sand		F
Roberts_Rd	260027	1	N9045 E1020	Negative ST	2026-04-18 16:53:01	3159045	531020	Sterile Subsoil	3	50-71	10YR 7/4	Loamy Sand		Redox staining
Roberts_Rd	260027	1	N7909 E0749	Negative ST	2026-04-18 16:57:01	3157909	530749	Sterile Subsoil	1	0-25	10YR 2/2	Sand		
Roberts_Rd	260027	1	N7909 E0749	Negative ST	2026-04-18 16:57:01	3157909	530749	Sterile Subsoil	2	25-70	10YR 5/2	Sand		
Roberts_Rd	260027	1	N7909 E0749	Negative ST	2026-04-18 16:57:01	3157909	530749	Sterile Subsoil	3	70-80	10YR 5/4	Sandy Clay		Hydric clay
Roberts_Rd	260027	1	N7857 E0945	Negative ST	2026-04-18 17:08:05	3157857	530945	Sterile Subsoil	1	0-24	10YR 2/2	Sand		
Roberts_Rd	260027	1	N7857 E0945	Negative ST	2026-04-18 17:08:05	3157857	530945	Sterile Subsoil	2	24-65	10YR 5/2	Sand		
Roberts_Rd	260027	1	N7857 E0945	Negative ST	2026-04-18 17:08:05	3157857	530945	Sterile Subsoil	3	65-80	10YR 5/4	Sandy Clay		Hydric clay
Roberts_Rd	260027	1	N8811 E0935	Negative ST	2026-04-18 17:16:02	3158811	530935	Other	1	0-37	10YR 4/2	Sand		
Roberts_Rd	260027	1	N8811 E0935	Negative ST	2026-04-18 17:16:02	3158811	530935	Other	2	37-52	10YR 5/2	Sand		
Roberts_Rd	260027	1	N8811 E0935	Negative ST	2026-04-18 17:16:02	3158811	530935	Other	3	52-56	10YR 2/1	Sand		Highly compact with decomposing organics (rootmatter) impassable
Roberts_Rd	260027	1	N7986 E0979	Negative ST	2026-04-18 17:23:31	3158013	530989	Sterile Subsoil	1	0-53	10YR 2/2	Sand		
Roberts_Rd	260027	1	N7986 E0979	Negative ST	2026-04-18 17:23:31	3158013	530989	Sterile Subsoil	2	53-69	10YR 5/2	Sand		
Roberts_Rd	260027	1	N7986 E0979	Negative ST	2026-04-18 17:23:31	3158013	530989	Sterile Subsoil	3	69-83	10YR 5/4	Sandy Clay		Hydric clay
Roberts_Rd	260027	1	N8640 E1024	Negative ST	2026-04-18 17:36:01	3158640	531024	Bedrock	1	0-25	10YR 7/2	Sand		
Roberts_Rd	260027	1	N8640 E1024	Negative ST	2026-04-18 17:36:01	3158640	531024	Bedrock	2	25-45	10YR 4/2	Sand		
Roberts_Rd	260027	1	N8640 E1024	Negative ST	2026-04-18 17:36:01	3158640	531024	Bedrock	3	45-49	10YR 8/1	Sand	Gravel	Degrading bedrock
Roberts_Rd	260027	1	N8200 E1030	Negative ST	2026-04-18 17:37:04	3158200	531030	Sterile Subsoil	1	0-50	10YR 2/2	Sand		

Roberts_Rd	260027	1	N8200 E1030	Negative ST	2026-04-18 17:37:04	3158200	531030	Sterile Subsoil	2 50-66	10YR 5/2	Sand	
Roberts_Rd	260027	1	N8200 E1030	Negative ST	2026-04-18 17:37:04	3158200	531030	Sterile Subsoil	3 66-76	10YR 5/4	Sandy Clay	Hydric clay
Roberts_Rd	260027	1	N8438 E1058	Negative ST	2026-04-18 17:49:03	3158438	531058	Rock Impasse	1 0-47	10YR 4/1	Sand	Root impasse at base of STP
Roberts_Rd	260027	1	N7800 E1700	Negative ST	2026-04-18 14:33:01	3157800	531700	Sterile Subsoil	1 0-33	10YR 5/1	Sand	
Roberts_Rd	260027	1	N7800 E1700	Negative ST	2026-04-18 14:33:01	3157800	531700	Sterile Subsoil	2 33-55	10YR 7/3	Sand	
Roberts_Rd	260027	1	N7800 E1700	Negative ST	2026-04-18 14:33:01	3157800	531700	Sterile Subsoil	3 55-65	10YR 7/1	Silty Clay	Hydric. Redox staining
Roberts_Rd	260027	1	N7750 E1450	Negative ST	2026-04-18 14:43:08	3157750	531450	Sterile Subsoil	1 0-35	10YR 5/1	Sand	
Roberts_Rd	260027	1	N7750 E1450	Negative ST	2026-04-18 14:43:08	3157750	531450	Sterile Subsoil	2 35-61	10YR 7/3	Sand	
Roberts_Rd	260027	1	N7750 E1450	Negative ST	2026-04-18 14:43:08	3157750	531450	Sterile Subsoil	3 61-73	10YR 7/1	Silty Clay	Hydric. Redox staining
Roberts_Rd	260027	1	N7483 E0800	Negative ST	2026-04-18 16:14:05	3157483	530800	Sterile Subsoil	1 0-51	10YR 2/2	Sand	
Roberts_Rd	260027	1	N7483 E0800	Negative ST	2026-04-18 16:14:05	3157483	530800	Sterile Subsoil	2 51-65	10YR 6/3	Sand	
Roberts_Rd	260027	1	N7483 E0800	Negative ST	2026-04-18 16:14:05	3157483	530800	Sterile Subsoil	3 65-75	10YR 7/2	Sandy Clay	
Roberts_Rd	260027	1	N8270 E1049	Negative ST	2026-04-19 12:15:01	3158270	531049	Sterile Subsoil	1 0-45	10YR 4/2	Sand	
Roberts_Rd	260027	1	N8270 E1049	Negative ST	2026-04-19 12:15:01	3158270	531049	Sterile Subsoil	2 45-59	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8270 E1049	Negative ST	2026-04-19 12:15:01	3158270	531049	Sterile Subsoil	3 59-68	10YR 7/3	Sandy Clay	
Roberts_Rd	260027	1	N8270 E1049	Negative ST	2026-04-19 12:15:01	3158270	531049	Sterile Subsoil	4 68-69	10YR 8/2	Sandy Clay	
Roberts_Rd	260027	1	N8356 E1225	Negative ST	2026-04-19 12:39:18	3158356	531225	Sterile Subsoil	1 0-29	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8356 E1225	Negative ST	2026-04-19 12:39:18	3158356	531225	Sterile Subsoil	2 29-63	10YR 7/2	Sand	
Roberts_Rd	260027	1	N8356 E1225	Negative ST	2026-04-19 12:39:18	3158356	531225	Sterile Subsoil	3 63-84	2.5Y 6/2	Sandy Clay	
Roberts_Rd	260027	1	N8418 E1404	Negative ST	2026-04-19 12:56:15	3158418	531404	Sterile Subsoil	1 0-41	10YR 6/2	Sand	

Roberts_Rd	260027	1	N8418 E1404	Negative ST	2026-04-19 12:56:15	3158418	531404	Sterile Subsoil	2	41-65	10YR 4/2	Sand	
Roberts_Rd	260027	1	N8418 E1404	Negative ST	2026-04-19 12:56:15	3158418	531404	Sterile Subsoil	3	65-70	10YR 7/2	Sandy Clay	Redox staining
Roberts_Rd	260027	1	N8314 E1569	Negative ST	2026-04-19 13:15:27	3158314	531569	Sterile Subsoil	1	0-30	10YR 5/2	Sand	
Roberts_Rd	260027	1	N8314 E1569	Negative ST	2026-04-19 13:15:27	3158314	531569	Sterile Subsoil	2	30-48	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8314 E1569	Negative ST	2026-04-19 13:15:27	3158314	531569	Sterile Subsoil	3	48-64	2.5Y 6/6	Sandy Clay	
Roberts_Rd	260027	1	N8314 E1569	Negative ST	2026-04-19 13:15:27	3158314	531569	Sterile Subsoil	4	64-70	10YR 8/1	Sandy Clay	Degrading bedrock
Roberts_Rd	260027	1	N9559 E1629	Negative ST	2026-04-19 13:57:02	3159559	531629	Sterile Subsoil	1	0-68	10YR 2/2	Sand	
Roberts_Rd	260027	1	N9559 E1629	Negative ST	2026-04-19 13:57:02	3159559	531629	Sterile Subsoil	2	68-74	10YR 3/3	Sand	
Roberts_Rd	260027	1	N9559 E1629	Negative ST	2026-04-19 13:57:02	3159559	531629	Sterile Subsoil	3	74-90	10YR 6/4	Sand	Water at base
Roberts_Rd	260027	1	N9370 E1638	Negative ST	2026-04-19 14:14:05	3159370	531638	Sterile Subsoil	1	0-18	10YR 5/2	Sand	
Roberts_Rd	260027	1	N9370 E1638	Negative ST	2026-04-19 14:14:05	3159370	531638	Sterile Subsoil	2	18-75	10YR 4/3	Sand	Inundated at 75
Roberts_Rd	260027	1	N9175 E1700	Negative ST	2026-04-19 14:34:02	3159175	531700	Sterile Subsoil	1	0-19	10YR 5/2	Sand	
Roberts_Rd	260027	1	N9175 E1700	Negative ST	2026-04-19 14:34:02	3159175	531700	Sterile Subsoil	2	19-49	10YR 6/1	Sand	
Roberts_Rd	260027	1	N9175 E1700	Negative ST	2026-04-19 14:34:02	3159175	531700	Sterile Subsoil	3	49-93	2.5Y 5/2	Sandy Clay	Clay with redox staining
Roberts_Rd	260027	1	N8988 E1700	Negative ST	2026-04-19 14:56:04	3158988	531700	Inundated	1	0-41	10YR 6/2	Sand	
Roberts_Rd	260027	1	N8988 E1700	Negative ST	2026-04-19 14:56:04	3158988	531700	Inundated	2	41-73	10YR 4/4	Sand	
Roberts_Rd	260027	1	N8988 E1700	Negative ST	2026-04-19 14:56:04	3158988	531700	Inundated	3	73-91	10YR 5/6	Sand	Water in base
Roberts_Rd	260027	1	N8834 E1588	Negative ST	2026-04-19 15:11:08	3158834	531588	Sterile Subsoil	1	0-30	10YR 5/2	Sand	
Roberts_Rd	260027	1	N8834 E1588	Negative ST	2026-04-19 15:11:08	3158834	531588	Sterile Subsoil	2	30-50	10YR 3/2	Sand	
Roberts_Rd	260027	1	N8834 E1588	Negative ST	2026-04-19 15:11:08	3158834	531588	Sterile Subsoil	3	50-63	2.5Y 5/2	Sandy Clay	clay with redox staining

Roberts_Rd	260027	1	N8690 E1483	Negative ST	2026-04-19 15:28:01	3158690	531483	Sterile Subsoil	1	0-35	10YR 6/2	Sand	
Roberts_Rd	260027	1	N8690 E1483	Negative ST	2026-04-19 15:28:01	3158690	531483	Sterile Subsoil	2	35-50	10YR 4/2	Sand	
Roberts_Rd	260027	1	N8690 E1483	Negative ST	2026-04-19 15:28:01	3158690	531483	Sterile Subsoil	3	50-85	2.5Y 5/2	Sandy Clay	clay with redox staining and 10YR8/1 degrading bedrock at base
Roberts_Rd	260027	1	N8499 E1510	Negative ST	2026-04-19 15:43:02	3158499	531510	Root Impasse	1	0-33	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8499 E1510	Negative ST	2026-04-19 15:43:02	3158499	531510	Root Impasse	2	33-50	10YR 4/2	Sand	Root impasse at 50cmbs
Roberts_Rd	260027	1	N8391 E1711	Negative ST	2026-04-19 15:59:01	3158391	531711	Sterile Subsoil	1	0-46	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8391 E1711	Negative ST	2026-04-19 15:59:01	3158391	531711	Sterile Subsoil	2	46-55	10YR 3/3	Sand	
Roberts_Rd	260027	1	N8391 E1711	Negative ST	2026-04-19 15:59:01	3158391	531711	Sterile Subsoil	3	55-60	10YR 6/3	Sandy Clay	Sterile clay with redox
Roberts_Rd	260027	1	N8465 E1904	Negative ST	2026-04-19 16:12:27	3158465	531904	Sterile Subsoil	1	0-27	10YR 5/2	Sand	
Roberts_Rd	260027	1	N8465 E1904	Negative ST	2026-04-19 16:12:27	3158465	531904	Sterile Subsoil	2	27-33	10YR 3/3	Sand	
Roberts_Rd	260027	1	N8465 E1904	Negative ST	2026-04-19 16:12:27	3158465	531904	Sterile Subsoil	3	33-44	10YR 7/1	Sandy Clay	Sterile clay with redox
Roberts_Rd	260027	1	N8323 E2030	Negative ST	2026-04-19 16:26:04	3158323	532030	Sterile Subsoil	1	0-28	10YR 2/2	Sand	
Roberts_Rd	260027	1	N8323 E2030	Negative ST	2026-04-19 16:26:04	3158323	532030	Sterile Subsoil	2	28-70	10YR 4/2	Sand	
Roberts_Rd	260027	1	N8323 E2030	Negative ST	2026-04-19 16:26:04	3158323	532030	Sterile Subsoil	3	70-76	10YR 7/3	Sandy Clay	Sterile clay with redox
Roberts_Rd	260027	1	N9649 E0586	Negative ST	2026-06-24 17:18:01	3159649	530586	Inundated	1	0-13	10YR 4/2	Sandy Loam	High moisture content; hydric soil
Roberts_Rd	260027	1	N9649 E0586	Negative ST	2026-06-24 17:18:01	3159649	530586	Inundated	2	13-40	10YR 6/2	Sand	Very high moisture content; hydric soil; roots and organic matter throughout

Roberts_Rd	260027	1	N9649 E0586	Negative ST	2026-06-24 17:18:01	3159649	530586	Inundated	3	40-87	10YR 2/1	Sandy Loam		Inundated at 80 cmbs; high organic content
Roberts_Rd	260027	1	N9456 E9537	Negative ST	2026-06-25 12:11:01	3159456	529537	Inundated	1	0-25	10YR 2/1	Sandy Loam	None	Lots of roots
Roberts_Rd	260027	1	N9456 E9537	Negative ST	2026-06-25 12:11:01	3159456	529537	Inundated	2	25-40	10YR 5/1	Sand	None	
Roberts_Rd	260027	1	N9280 E9575	Negative ST	2026-06-25 12:37:11	3159280	529575	Inundated	1	0-40	10YR 2/1	Sandy Loam	None	Lots of roots
Roberts_Rd	260027	1	N9239 E9727	Negative ST	2026-06-25 13:02:15	3159239	529727	Inundated	1	0-40	10YR 2/1	Sandy Loam	None	Lots of roots
Roberts_Rd	260027	1	N9223 E9806	Negative ST	2026-06-25 13:37:09	3159223	529806	Inundated	1	0-72	10YR 2/2	Sandy Loam	None	
Roberts_Rd	260027	1	N9125 E9814	Negative ST	2026-06-25 14:06:04	3159125	529814	Other	1	0-50	10YR 3/2	Sandy Loam	None	
Roberts_Rd	260027	1	N9125 E9814	Negative ST	2026-06-25 14:06:04	3159125	529814	Other	2	50-58	10YR 3/3	Sandy Loam	None	Very compact
Roberts_Rd	260027	1	N9022 E9713	Negative ST	2026-06-25 14:47:03	3159022	529713	Inundated	1	0-42	10YR 4/3	Sandy Loam	None	
Roberts_Rd	260027	1	N9090 E9569	Negative ST	2026-06-25 15:01:10	3159090	529569	Inundated	1	0-35	10YR 2/1	Sandy Loam	None	
Roberts_Rd	260027	1	N9380 E9738	Negative ST	2026-06-25 15:31:04	3159380	529738	Inundated	1	0-48	10YR 4/3	Sandy Loam	None	
Roberts_Rd	260027	1	N9625 E2800	Negative ST	2026-06-25 18:07:27	3159625	532800	Disturbed	1	0-62	10YR 5/3	Sandy Loam	Cobble	Heavily disturbed
Roberts_Rd	260027	1	N9625 E2453	Negative ST	2026-06-25 18:26:05	3159625	532453	Bedrock	1	0-15	10YR 4/3	Sandy Loam	Cobble	
Roberts_Rd	260027	1	N9625 E2453	Negative ST	2026-06-25 18:26:05	3159625	532453	Bedrock	2	15-30	10YR 7/1	Sand	Gravel	Degrading limestone bedrock
Roberts_Rd	260027	1	N9637 E1209	Negative ST	2026-06-25 18:43:08	3159637	531209	Inundated	1	0-30	10YR 4/2	Sandy Loam	None	
Roberts_Rd	260027	1	N9637 E1209	Negative ST	2026-06-25 18:43:08	3159637	531209	Inundated	2	30-53	10YR 2/1	Sandy Loam		
Roberts_Rd	260027	1	N9643 E0839	Negative ST	2026-06-25 18:57:02	3159643	530839	Inundated	1	0-55	10YR 2/2	Sandy Loam		