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Supplemental Environmental Assessment to the December 2014 EA for Space Exploration Technologies Vertical Landing of the Falcon Vehicle and Construction at Launch Complex 13 at Cape Canaveral Air Force Station Florida

Prepared For

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and
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EXECUTIVE SUMMARY

Space Exploration Technologies Corporation (SpaceX) has prepared this Supplemental Environmental Assessment (SEA) with the United States Air Force (USAF) as Lead Agency to evaluate the potential environmental impacts resulting from operations and construction associated with landing up to three Falcon Heavy first stage boosters on two additional landing pads at Landing Zone 1 (LZ-1), which is also known as Launch Complex 13 (LC-13). Additionally included in the scope of this SEA is the operation and construction of a processing facility for the SpaceX Dragon capsule at LZ-1. A Finding of No Significant Impact/Finding of No Practical Alternative (FONSI/FONPA) was approved and signed by the USAF on January 8, 2015 for an Environmental Assessment (EA) that evaluated potential environmental impacts from activities associated with SpaceX constructing and operating a landing complex at LZ-1 located at Cape Canaveral Air Force Station (CCAFS), Brevard County, Florida. This current SEA is based on the EA and FONSI / FONPA dated 2015 and will be referred to throughout this document as "the original EA".

The conceptual site plan for which the original EA was developed included one (1) main pad approximately 200 feet square, and four (4) "contingency" pads, each approximately 150 feet in diameter, with inter-connecting crane paths. However, since that time substantial improvements in the landing vehicle navigation guidance system and radar precision has eliminated the need for the contingency pads, and allowed a slightly smaller apron around a circular concrete landing pad. This SEA addresses the addition of two landing pads, a north pad and south pad, so that LZ-1 can support up to three Falcon Heavy returning first stage boosters, and construction of a Dragon capsule processing facility

Concurrent with the option to land at an expanded LZ-1, SpaceX may also choose to land one or two stages on an offshore autonomous droneship, as SpaceX has accomplished in the recent past. SpaceX intends to utilize the LZ-1 area for future Dragon capsule processing and testing.

PURPOSE AND NEED

The original purpose and need for the Proposed Action have not changed from the original EA. The purpose of this action is to provide a reusable launch vehicle (RLV) landing area by constructing landing pads and associated supporting infrastructure for landing operations of the Falcon booster stages in order to reuse the boosters for future launches, and to temporarily process the Dragon capsule. This purpose continues to support SpaceX's overall missions for NASA and the USAF. The action continues to fulfill the U.S. expectation that space transportation costs are reduced in order to make continued exploration, development, and use of space more affordable. The Space Transportation section of the National Space Transportation Policy of 2013 addressed the commercial launch sector, stating that "assuring reliable and affordable access to space through U.S. space transportation capabilities is fundamental to achieving National Space Policy goals."

This action is needed in order to increase the effective and cost efficient operation of space flight by providing returnable, re-usable space vehicles (Falcon 9 and the Falcon Heavy) close to the location that they were launched from. The need for the Proposed Action also continues to be in line with NASA's Space Act Agreement (SAA) and the FAA's Office of Commercial Space Transportation mission, which is to support the U.S. goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure. In order for the

United States to be competitive, the cost and frequency of launches needs to keep pace with world demand which necessarily includes reusing booster stage vehicles.

PROPOSED ACTION

The Proposed Action would include constructing two additional concrete landing pads, each with an approximate diameter of 282 feet surrounded by an approximate 50 foot-wide hard-packed soil "apron", which would bring the diameter of each pad area to approximately 400 feet. These two additional landing pads would be in a north and a south area as shown in Figure 2-4 of the SEA. The pads would be approximately 18 inches thick and designed to support the weight and thrust energy of the Falcon booster vehicle; they would comply with all CCAFS and other relevant construction requirements, the same requirements as for the original main landing pad. These new pads would be constructed on previously undisturbed land. Two short access crane paths would be constructed from the existing crane path to those contingency pads for the retrieval crane movement following a landing event. Pedestals similar to what was constructed for the main pad may also be constructed at each pad. Additionally, the Proposed Action would include constructing a Dragon capsule processing facility including an approximately 130ft X 100ft 30-foot-tall building and related utilities.

The Proposed Action would also include the operation of LZ-1 which would support preparations for, and the landing of up to three booster stage vehicles. It would also support the post-flight landing and safing. Should one of the booster's land on the droneship, it would be safed at sea, then the droneship would be brought back to a local port. The original EA estimated that 12 landings would take place per year for the initial five-year license, of a single stage vehicle. SpaceX estimates there may be up to 6 events per year for a Falcon Heavy launch, and therefore up to 18 landings (12 Falcon 9 single core landings and 6 Falcon Heavy triple core landings) at LZ-1 or on the droneship. Operations at the LZ-1 area would also include Dragon Capsule processing and testing.

NO ACTION ALTERNATIVE

Under the No-Action Alternative the additional two concrete pads and other support facilities would not be built, and the controlled landing of the three Falcon Heavy boosters would not occur. The Falcon family of rockets would continue to be launched from LC-40 and from 39A, however only a single Falcon booster would return and land at LZ-1; two of the three Falcon Heavy boosters would fall into the Atlantic Ocean down range or land on droneships. Additionally, the Dragon capsule would not be able to be processed; delaying plans for use as a cargo carried to the ISS. SpaceX's ability to fully meet the National Space Transportation Policy goals of providing low-cost reliable access to and from space would be negatively affected.

SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

This SEA assessed the following 15 resource areas which were considered to provide a context for understanding the potential environmental effects of the Proposed Action and alternatives: land use/visual resources (which includes coastal resources), noise, biological resources, cultural resources, air quality, climate, hazardous materials/hazardous waste (which includes solid waste and pollution prevention), water resources, geology and soils, transportation, utilities, health and safety, socioeconomics, environmental justice, and Section 4(f) properties.

Additional resources required to be assessed by FAA Order 1050.1F of natural resources and energy, farmlands, and children's environmental health and safety risks are also discussed but are dismissed from detailed evaluation. The environmental consequences associated with the Proposed Action and the No Action Alternative were analyzed for the appropriate Region of Influence (ROI) for each resource area. The following table presents a summary of the resources considered and the potential impacts on those resources. The descriptions discuss both construction and operational related tasks associated with this Proposed Action.

TABLE E-1: Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Potential Environmental Impact from Proposed Action
Land Use / Visual Resources	Construction: There would be no significant impacts to coastal resources. The Proposed Action is compatible with existing land uses at LZ-1. Operations: There would be no significant impacts to coastal resources. There would be no significant impacts to land use compatibility. Visible impact would only include engine "re-light" and the normally seen and short-lived vehicle contrails for each landing event.
Noise	Construction: There would be minor impacts from noise levels at CCAFS, or in communities adjacent to CCAFS property due to construction activities. There would also be no effect on habitat from construction related noise. Operations: There would be no impacts to noise levels in communities adjacent to CCAFS property due to normal daily operations. Landing operations would generate a noise profile equivalent to approximately 33% of a Falcon 9 launch; therefore, there would not be a significant noise impact in sensitive areas nor exceed FAA Day-Night Average Sound Level (DNL) guidelines. Sonic booms generated by these landing events may occur over the local area. Surrounding areas at CCAFS and the local community may experience a slight overpressure of up to 5.5 psf at CCAFS, and less than 2 psf in communities, which is less than the generally accepted threshold of 2 psf. Central Florida, within an approximate 60-mile radius may hear sonic booms. During a multiple stage landing event, two sonic booms may occur for each returning stage several seconds apart. Public awareness and notification plans would reduce surprise, and increase the public's knowledge of the potential sonic boom events.
Biological Resources	Construction: Clearing of land would impact approximately 23 acres of scrub-jay habitat. The clearing would also impact southeastern beach mouse, indigo snake, and gopher tortoise habitat. The impact would be mitigated by a 2:1 restoration of scrub-jay habitat in LMU 33 at CCAFS as discussed in the attached Biological Opinion (BO). Operations: There would be no impacts on wildlife or vegetation (including federal and state-listed wildlife species) by daily operations. However, there would be impact to five species of marine turtles; a Light Management Plan would be developed and would need approval by the USAF and the USFWS to reduce or eliminate night-time impact to the sea turtle nesting/hatchling process. There would be no effect on marine resources in the ocean at or near the planned location for the returning vehicles. No effect from sonic booms on biological resources is expected.
Historical and Cultural Resources	Construction: Since there were no documented resources around LZ-1 in the areas of construction during the Archeological Phase I survey, there will be no impact to historical and cultural resources caused by construction activities. Operations: No cultural or historical resources were identified in the areas of the north and south pads; therefore, there would be no impact from normal day-to-day operations or vehicle landings.
Air Quality	Construction: Normal construction related air emissions would not significantly impact air quality in the region. Operations: The operational impacts from the Proposed Action on air quality would not be significant. CCAFS and Brevard County are in an "Attainment" area and the operational emissions for the proposed first stage booster landings represent an extremely small

	percentage of the Brevard County regional emissions and would not cause an exceedance of any National Ambient Air Quality Standards (NAAQS). Greenhouse gases (GHG) production would be essentially insignificant on a local, regional and global basis.
Climate	Construction: There would be no impact on climate from construction; and there would be no impact on the Proposed Action by climate change. Operations: Based upon the amount of GHG that would be produced (as discussed in Section 4.5) there would be no impact by the Proposed Action on the global climate.
Hazardous Materials / Waste	Construction: Normal hazardous material and/or waste, including solid waste, management processes would prevent impact to the environment. Pollution prevention Best Management Practices (BMPs) would also be used to prevent potential impacts. While LC-13 is listed as SWMU 038 by the Installation Restoration Program and soil contamination does not appear to exist in the north or south plan pad areas, the USAF Installation Restoration Program office should be notified of construction plans. Operations: All applicable federal, state, and county, regulations would continue to be followed for the proper storage, handling, and usage of hazardous materials under the Falcon Launch Vehicle Program Hazardous materials such as propellants, chemicals, and other hazardous material payload components would be transported to the facilities in accordance with Florida Department of Transportation (FDOT) regulations. However, continued implementation of existing material and waste management and handling procedures currently used during the operation of other similar facilities would limit or eliminate the potential for impacts. Therefore, there would be no significant impacts to the environment. Pollution prevention BMPs would also be used to prevent potential impacts.
Water Resources	Construction: Parts of LZ-1, including the area associated with the construction of the southern pad, are located in a floodplain; as such construction within a floodplain would consist of an impact; but would be minor with no practicable alternative. Wetlands located at the site will be avoided, therefore there would be no impact to wetlands as well as no impact on local surface water. Operations: Operations supporting the landing of the first stage boosters would not result in additional impacts to surface water, groundwater resources, groundwater quality, wetlands, or floodplains. Continued implementation of the existing Spill Prevention, Control, and Countermeasures (SPCC) plan would reduce the potential for adverse impacts to water resources. There would be no impact on local surface water.
Geology and Soils	Construction: No unique geologic features of exceptional interest or mineral resources occur within the project area. Contaminated soils exist in the northern part of the site. Prior to and during construction, erosion and sediment control measures such as silt fences (BMPs) are required to retain sediment on-site and to prevent violations of state water quality standards. The Proposed Action would therefore not have a significant impact on geology and soils at LZ-1. Operations: Daily operations and launches would not affect existing geology and soils, therefore there would be no significant impacts to this resource area.
Transportation	Construction: While there would be more vehicle and truck traffic during the construction period, it would not cause significant impacts to CCAFS traffic or roadways. Operations: While some roadways at CCAFS (ICBM Road) may be closed temporarily, operational traffic associated with the landing operations would not cause a significant impact to CCAFS traffic or roadways. Roadway closure associated with Dragon capsule processing is not expected. Limited positive affect would include not requiring as many first stage vehicles to be trucked to CCAFS, since stages would be reused.
Utilities	Construction: Construction period of services would not draw on local utilities; most potable water and electrical needs would be supplied by portable sources; waste disposal services would not be used until construction has been completed. Therefore, there would be no impact on utilities during construction. Operations: CCAFS supplies electrical power, potable water, fire water, and wastewater services for launch complexes at CCAFS. Supplies and capacities are more than sufficient to handle the additional pads at LZ-1. Therefore, there would be no significant impacts to water, electrical or wastewater resources.

Health and safety	Construction: SpaceX would follow all USAF and Occupational Safety and Health Administration (OSHA) regulations during construction activities and therefore there would not be a significant impact to health and safety of workers. Operations: All current and standard health and safety local, state, and federal procedures will be followed during operation and landing, therefore there would not be a significant impact to health and safety of workers. Explosive Site Safety was also assessed. Like all launch, landing, and hazardous operations at the Cape, the action must account for public safety distances and may require temporary road closures local to LZ-1. Any such mitigation measures for ICBM Road will be addressed in the USAF Explosive Siting Process. Following coordination between SpaceX and the 45SW/SEW, SpaceX has reached concurrence that explosive safety elements have been met for the purpose of the SEA and there is no significant impact.
Socioeconomics	Construction: Constructing additional pads and related facilities at LZ-1 would cause a slight positive impact to the local economy from direct labor use and from indirect material and consulting purchasing. Operations: Operations supporting landing events would not cause negative impacts on the area's socioeconomics.
Environmental Justice	Construction: There would be no impacts to Environmental Justice communities. Operations: Since the operations at LZ-1 would occur at the existing facilities at CCAFS, there would be no disproportionate impacts to Environmental Justice communities.
4(f) Properties	Construction: No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of CCAFS; there would be no impact on these areas from construction. Operations: No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of CCAFS. While several public parks, recreation areas, and wildlife refuges are located outside of CCAFS, including the Merritt Island National Wildlife Refuge and the Canaveral National Seashore, operation of LZ-1 and the landings of the first stage boosters would not result in a use of a Section 4(f) property.

CUMULATIVE IMPACTS

Cumulative impacts are defined by the Council on Environmental Quality (CEQ) in 40 CFR §1508.7 as impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. The CEQ regulations further require that National Environmental Policy Act (NEPA) environmental analyses address connected, cumulative, and similar actions in the same document (40 CFR 1508.25). The cumulative impact analysis for this SEA focuses on the incremental interaction the Proposed Action may have with other past, present, and reasonably foreseeable future actions, and evaluates cumulative impacts potentially resulting from these interactions. These past, present, and reasonably foreseeable future actions at CCAFS, Kennedy Space Center (KSC), and the Port Canaveral area including the Shiloh launch complex, focus on constructing facilities, operating and launching other space vehicles, and their cumulative impacts. Implementation of the Proposed Action would likely not cause any significant cumulative impacts to resource areas.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

45 SW	45 th Space Wing, USAF
AADT	Average Annual Daily Traffic
ACHP	Advisory Council on Historic Preservation
ACM	Asbestos Containing Material
AE	Adverse Effect
AFB	Air Force Base
AFI	Air Force Instruction
AFSPC	Air Force Space Command
AFMAN	Air Force Manual
AFTOX	Air Force Toxic Chemical Dispersion Model
AIRFA	American Indian Religious Freedom Act
Al2O3	Aluminum Oxide
AMU	Applied Meteorology Unit
ANSI	American National Standards Institute
ARPA	Archaeological Resources Protection Act
ASME	American Society of Mechanical Engineers
AST	Aboveground Storage Tank
Avg	Average
AWSPL	A-Weighted (dBA) Sound Pressure Levels
BEBR	Bureau of Economic and Business Research
bls	below land surface
BMP	Best Management Practice
CAA	Clean Air Act
CCAFS	Cape Canaveral Air Force Station
CCEMP	Consolidated Comprehensive Emergency Management Plan
CCS	Cape Canaveral Spaceport
CDNL	C-Weighted Day-Night Average Sound Level
CE	Commercially Exploited
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERL	Construction Engineering Research Laboratories
CFR	Code of Federal Regulations
CMD	Corrective Measures Design
CMI	Corrective Measures Implementation
CMS	Corrective Measures Studies
CO	Carbon Monoxide
COPC	Contaminants of Potential Concern
COPV	Carbon Overwrap Pressure Vessel
CRM	Cultural Resources Manager
CRMP	Cultural Resources Management Plan
CSEL	C-Weighted Sound Exposure Level
CSLA	Commercial Space Launch Act
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
dB	Decibel
dBA	A-Weighted Decibel
DCE	Dichloroethene
DCG	Disaster Control Group
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EDC	Economic Development Commission of Florida's Space Coast
EELV	Evolved Expendable Launch Vehicle
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
EPCs	Envelope Payload Characteristics
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Eastern Range
ERA	Ecological Risk Assessment
ERAP	Environmental Risk Assessment Program
ERP	Environmental Resource Permit
ESA	Endangered Species Act
ESB	Engineering Support Building
ESC	Environmental Support Contractor
EWRSP	Eastern and Western Range Safety Policies and Processes
FAA	Federal Aviation Administration
FAAQS	Florida Ambient Air Quality Standards
F9R	Falcon 9 test first stage vehicle

FAC	Florida Administrative Code
FCMA	Florida Coastal Management Act
FCMP	Florida Coastal Management Program
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEIS	Final Environmental Impact Statement
FETSA	Florida Endangered and Threatened Species Act
FWC	Florida Fish and Wildlife Conservation Commission
FMOs	Fishery Management Officials
FNAI	Florida Natural Areas Inventory
FONSI	Finding of No Significant Impact
FONPA	Finding of No Practical Alternative
FSTR	Full Spectrum Threat Response
ft	feet
ft2	square feet
FTS	Flight Termination System
GDSS	General Dynamics Space Systems
GHG	Greenhouse Gases
GLV	Generic Launch Vehicle
GPS	Global Positioning System
GSDO	Ground Systems Development and Operations
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HAP	Hazardous Air Pollutants
HAPCs	Habitat Areas of particular Concern
HAZMAT	Hazardous Material
HCl	Hydrogen Chloride
HHRA	Human Health Risk Assessment
HMTA	Hazardous Materials Transportation Act
HQ AFSPC	Headquarters Air Force Space Command
IM	Interim Measure
IMS	Incident Management System
INRMP	Integrated Natural Resources Management Plan
IPA	Isopropyl Alcohol
IRP	Installation Restoration Program
ISS	International Space Station
KSC	Kennedy Space Center
kVA	Kilo-Volt Amperes
LBP	lead-based paint
LC	Launch Complex
LDCG	Launch Disaster Control Group
LEO	Low-Earth Orbit
LMU	Land Management Unit
LOX	Liquid Oxygen
LTM	Long Term Monitoring
LUCIP	Land Use Control Implementation Plan
LZ-1	Landing Zone 1
MACT	Maximum Available Control Technology
max	Maximum
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
MEK	Methyl Ethyl Ketone
MGD	Million Gallons per Day
µg/m 3	Micrograms per Cubic Meter
MHz	Mega-Hertz
MMH	Monomethylhydrazine
MMPA	Marine Mammal Protection Act
MNA	Monitored Natural Attenuation
MOA	Memorandum of Agreement
MPPF	Multi-Payload Processing Facility
MR	Mitigation Required
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MST	Mobile Service Tower
MW	Mega-watt
MWH	Mega-watt Hours
N/A	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutant
NFRAP	No Further Remedial Action Planned
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO2	Nitrogen Dioxide

NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOx	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
NTO	Nitrogen tetroxide
NWS	National Weather Service
NWSO	National Weather Service Office
O3	Ozone
OCST	Office of Commercial Space Transportation
ODS	Ozone Depleting Substances
OFW	Outstanding Florida Water
ONAC	Office of Noise Abatement and Control
OPLAN	Operations Plan
OSHA	Occupational Safety and Health Administrations
OASPL	Overall Sound Pressure Level
OWS	Oil-Water Separator
PAE	Potentially Adverse Effect
PAFB	Patrick Air Force Base
PAH	Poly-nuclear aromatic hydrocarbons
Pb	lead
PCB	Poly-chlorinated biphenyl
PE	Positive Effect
PFDP	Preliminary Flight Data Package
PHSF	Payload Hazardous Servicing Facility
PHV	Peak-hour volume
PM10	Particulate matter equal to or less than 10 microns in diameter
PM2.5	Particulate matter equal to or less than 2.5 microns in diameter
POL	Petroleum Products, Oils, Lubricants
PPF	Payload Processing Facility
ppm	parts per million
PPMP	Pollution Prevention Management Action Plan
Psf	Pounds per square foot (overpressure)
RCRA	Resource Conservation Recovery Act
REEDM	Rocket Exhaust Effluent Dispersion Model
RFI	RCRA Facility Investigation
RLV	Reusable Launch Vehicle
RMP	Risk Management Plan
ROI	Region of Influence
RP-1	Rocket Propellant 1 (standard kerosene rocket fuel MIL-P-25576)
RPM	Remediation Project Manager
SAA	Space Act Agreement
SAFMC	South Atlantic Fishery Management Council
SARA	Superfund Amendments and Reauthorization Act
SCTL	Soil Cleanup Target Level
SEA	Supplemental Environmental Assessment
SEL	Sound Exposure Level
SHPO	State Historic Preservation Officer
SJRWMD	St. Johns River Water Management District
SLC	Space Launch Complex
SO2	Sulfur Dioxide
SPCC	Spill Prevention, Control, and Countermeasures
SPIF	Spacecraft Processing and Integration Facility
SPL	Sound Pressure Level
SR	State Route
SSC	Species of Special Concern
SW	Space Wing
SWI	Space Wing Instruction
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
T&E	Threatened and Endangered
TCE	Trichloroethylene
THC	Toxic Hazard Corridor
TPH	Total Petroleum Hydrocarbons
TPY	Tons per Year
TSCA	Toxic Substance Control Act
TSD	Treatment, Storage, or Disposal
TSDF	Treatment, Storage, or Disposal Facility
TSP	Total Suspended Particulate
UFC	Unified Facilities Criteria
U.S.	United States
US	U.S. Highway
USACE	U.S. Army Corps of Engineers

USAF	United States Air Force
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
VAFB	Vandenberg Air Force Base
VC	Vinyl Chloride
VOC	Volatile Organic Compounds
VTVL	Vertical Takeoff Vertical Landing
WWTP	Wastewater Treatment Plant

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

On January 8, 2015, the United States Air Force (USAF) approved and signed a Finding of No Significant Impact / Finding of No Practical Alternative (FONSI/FONPA) for an Environmental Assessment (EA) that evaluated potential environmental impacts resulting from activities associated with Space Exploration Technologies Corporation (SpaceX) constructing and operating a landing complex. SpaceX planned to conduct vertical landings of the Falcon first stage (booster) vehicle at Launch Complex (LC) 13 at Cape Canaveral Air Force Station (CCAFS), in Brevard County, Florida (USAF 2014), which is referred to in this SEA as the original EA. A copy of the original EA FONSI/FONPA is included as APPENDIX A, and interested parties can review that EA on the Air Force website: www.patrick.af.mil. Also in January 2015, the USAF approved an Environmental Baseline Survey (EBS) and license allowing the use of approximately 164 acres around LC-13 for the development of a vehicle landing complex (GEAR 2014). The original EA for SpaceX Vertical Landing of Falcon 9 at LC-13 CCAFS was developed with the USAF as lead agency, and the Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) as cooperating agencies. The original EA addressed related land clearing and construction of a main landing pad, contingency pads, and supporting infrastructure modifications to the existing facility. On December 21, 2015, SpaceX successfully landed the first stage booster vehicle at the newly constructed landing zone following its launch at LC-40 as part of the F9-21 mission. A second successful landing occurred on July 18, 2016.

This Supplemental EA (SEA) supports the original intent for LC-13 to be developed as a landing complex for the Falcon booster vehicle, but also evaluates a revised Proposed Action to land the three Falcon Heavy boosters on additionally cleared land and landing pads at this location, and construct and operate a Dragon 2 Capsule processing facility. Additionally, while known historically as LC-13, the complex is also known as Landing Zone 1 (LZ-1).

The original EA was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] §4321 et seq.), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), and the USAF Environmental Impact Analysis Process (EIAP) as promulgated in Title 32 CFR Part 989, and FAA Order 1050.1E, Change 1, *Environmental Impacts: Policies and Procedures*. (NOTE: In July 2015 the FAA Order was modified to 1050.1F which has been referenced within this SEA). NASA's mission is to expand commercial uses of space and the space industry; this directive is detailed in the NASA Authorization Act of 2010 and the Commercial Space Act as amended. NASA chose to be a cooperating agency in part because they have an interest in using the Falcon vehicles for various payloads, therefore the original EA considered the Procedures of Implementation of NEPA for NASA [Title 14, Code of Federal Regulations, part 1216 subparts 1216.1 and 1216.3]. This SEA has also been prepared in accordance to these referenced documents.

The Commercial Space Launch Amendment Act of 2004 (51 U.S.C. Subtitle V, Ch. 509, §§ 50901-50923) declares that the development of commercial launch vehicles, reentry vehicles, and associated services would enable the United States (U.S.) to retain its competitive position internationally, contributing to the national interest and economic well-being of the U. S. The Act authorizes the Secretary of Transportation to oversee and coordinate commercial launch and reentry operations, issue commercial licenses authorizing those operations, and protect the

public health and safety, safety of property, and national security and foreign policy interests of the U.S. Within the Department of Transportation, the Secretary's authority has been delegated to the FAA's Office of Commercial Space Transportation. Therefore, the FAA is a cooperating agency in the development of this SEA. The FAA expects to receive a launch license application from SpaceX to conduct Falcon Heavy landing operations at LZ-1. In addition to the SEA, applicants that apply to the FAA for a launch license must complete a policy review and approval, safety review and approval, payload review and determination, and a financial responsibility determination. All of these reviews, including the environmental review, must be completed prior to receiving an FAA launch license. The FAA's safety review is conducted separately from the FAA's environmental review and is included in the terms and conditions of the launch license.

1.2 LOCATION AND BACKGROUND

CCAFS occupies approximately 15,800 acres (25 square miles) of land on Florida's Cape Canaveral barrier island (Figure 1-1). The USAF 45th Space Wing (45 SW) is currently the host wing under Air Force Space Command (AFSPC) and conducts east coast military, civilian, and commercial launch operations. SpaceX received USAF authority to land Falcon booster stage vehicles at LC-13 in January 2015. At that time the designation "Landing Zone 1" (LZ-1) was added to LC 13. The nomenclature LZ-1 is used throughout this SEA to designate the landing site which is located in the east-central portion of CCAFS between LC-12 to the south and LC-14 to the north, see Figure 1-2.

Throughout many years of operation at this complex, the facility launched various versions of the Atlas rocket. Since the Air Force's first launch in 1958 of an Atlas B rocket, the complex has supported 51 rocket launches from its pad. The last launch was an Atlas vehicle in April 1978. The USAF demolished the complex's Mobile Service Tower (MST) and its associated infrastructure in 2005 and the block house in 2012.

In order to fly a Falcon 9 first stage back to LZ-1, it must first return safely to Earth after delivering the second stage and payload to orbit. In 2014, SpaceX conducted testing of the Falcon 9 test first stage vehicle (F9R) development test vehicle, an advanced prototype for the reusable Falcon 9. The F9R test vehicle was essentially a Falcon 9 first stage with landing legs designed to test the precision landing techniques needed to return a rocket to Earth intact. The F9R completed successively higher tests in McGregor, Texas, topping out with a 1000m test using steerable grid fins. These tests provided invaluable information for future flight testing.

Prior to the F9R program, SpaceX's reusability testing began with the Grasshopper program. SpaceX's Grasshopper was a 10-story Vertical Takeoff Vertical Landing (VTVL) vehicle consisting of a Falcon 9 first stage, a single Merlin 1D engine, four steel landing legs with hydraulic dampers, and a steel support structure. In 2013, Grasshopper completed a series of eight flight tests with successful landings, reaching 2,440.94 feet (744 meters) in altitude.

Recent efforts were focused on reentering the first stage through Earth's atmosphere and conducting precision landings, initially on an autonomous spaceport droneship at sea, and eventually on land. In 2014, SpaceX twice reentered a Falcon 9 first stage from space and landed it in the Atlantic Ocean as a "soft-landing" with legs first. Using lessons learned from those attempts, in January 2015 SpaceX attempted a precision landing on a droneship. The rocket made it to the droneship, but landed hard, breaking up upon impact. SpaceX attempted a second

precision landing the following month, this time over water, and the rocket came within approximately 33 feet (10.06 meters) of its precise target. Unfortunately, extreme weather and heavy seas prevented a fully successful recovery. The Falcon 9's first stage landed on the droneship for the first time, within approximately 33 feet (10.06 meters) of its precise target spot, in April 2015. However, higher than planned lateral velocity at landing prevented a successful recovery. On April 8, 2016, after launching the CRS-8 resupply mission to the International Space Station from CCAFS, SpaceX successfully landed the Falcon 9 first stage booster on its autonomous droneship, which was located off of the Atlantic Coast. On May 6, 2016, after launching the JCSAT-14 into geostationary transfer orbit from CCAFS, SpaceX also successfully landed a second Falcon 9 on its autonomous droneship, which was located approximately 200 miles (320 kilometers) offshore in the Atlantic Ocean. On May 27, 2016, after launching the Thaicom-8 into geostationary transfer orbit from CCAFS, SpaceX successfully landed a third Falcon 9 on its autonomous droneship, which was located offshore in the Atlantic Ocean. On August 14, 2016, after launching the JCSAT-1 into geostationary transfer orbit from CCAFS, SpaceX again successfully landed the Falcon 9 first stage on its autonomous droneship, which was located offshore in the Atlantic Ocean.

On December 21, 2015, under an FAA license, SpaceX launched the Falcon 9 from LC-40 with commercial satellites as payload under mission F9-21. The launch occurred at approximately 8:30 PM on a standard trajectory out over the Atlantic Ocean to an altitude of approximately 70 miles and down range approximately 400 miles. After nominal stage separation, and approximately ten minutes later, the first stage booster approached the LZ-1 area, and from an almost complete vertical approach, landed successfully and precisely on target at LZ-1. The first stage was "safed" as planned and moved from LZ-1 to a pedestal where it remained for transportation preparation. The first stage was then lowered onto a truck and transported to a SpaceX hangar for inspection. On July 18, 2016 following a launch from LC-40 (F9-21 ORBCOM-2), the returning first stage vehicle made the second successful landing at LZ-1.

The original concept site plan for which the original EA was developed included one (1) main pad approximately 200 feet (60.96 meters) square, and four (4) "contingency" pads, each approximately 150 feet (45.72 meters) in diameter, with inter-connecting crane paths as shown in Figure 1-3. However, since that time and based upon lessons learned from the landing attempts described above, substantial improvements in the landing vehicle navigation guidance system and radar precision eliminated the need for the contingency pads, and allowed a slightly smaller apron around the circular concrete landing pad. These changes resulted in less potential impacts on the environment than originally considered in the original EA. Subsequently, the revised site design included only the single main pad and is shown in Figure 1-4.

This SEA expands upon the original EA to include additional land clearing and construction of two additional landing pads (referred to as the North pad and South pad in this SEA) so that LZ-1 can support up to three Falcon first-stage boosters, as shown in the conceptual site plan in Figure 1-5. The SEA also includes constructing a processing building to support the Dragon capsule.

Concurrent with the option to land at an expanded LZ-1, SpaceX may also choose to land one or two stages on their autonomous droneship positioned east in the Atlantic Ocean. As of August 18, 2016, SpaceX has successfully landed a first stage booster on the autonomous droneship four times.

1.3 PURPOSE AND NEED FOR ACTION

The original purpose and need for the Proposed Action have not changed from the original 2014 EA. The **purpose** of this action is to provide a reusable launch vehicle (RLV) landing area by constructing landing pads and associated supporting infrastructure for landing operations of the Falcon booster stages in order to reuse the boosters for future launches, and to temporarily process the Dragon capsule. This purpose continues to support SpaceX's overall missions for NASA and the USAF. The action continues to fulfill the U.S. expectation that space transportation costs are reduced in order to make continued exploration, development, and use of space more affordable. The Space Transportation section of the National Space Transportation Policy of 2013 addressed the commercial launch sector, stating that "assuring reliable and affordable access to space through U.S. space transportation capabilities is fundamental to achieving National Space Policy goals."

This action is **needed** in order to increase the effective and cost efficient operation of space flight by providing returnable, reusable space vehicles (Falcon 9 and the Falcon Heavy) close to the location that they were launched from. The Proposed Action is also needed to continue the goals of the National Space Transportation Policy of 2013 and the Commercial Space Launch Amendments Act of 2004 to achieve affordable access to space. The need for the Proposed Action also continues to be in line with NASA's Space Act Agreement (SAA) and the FAA's Office of Commercial Space Transportation mission, which is to support the U.S. goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure. In order for the U.S. to be competitive, the cost and frequency of launches needs to keep pace with world demand which necessarily includes reusing booster stage vehicles.

1.4 SCOPE OF THE SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

1.4.1 Lead and Cooperating Agency Actions

This SEA addresses additional site development at LZ-1 and vertical landing operations of the Falcon Heavy RLV at LZ-1. SpaceX currently holds a 5-year license agreement with the USAF to conduct landing operations at LZ-1. If, after public review of this SEA, the USAF determines that the Proposed Action would not individually or cumulatively result in significant impacts on the natural and human environment, the USAF would issue a FONSI to permit SpaceX to use LZ-1 for the landing of two or three Falcon Heavy boosters. The site would accept one landing vehicle for future Falcon 9 launches or up to three landing vehicles for future Falcon Heavy launches. The site would also process the Dragon capsule.

The FAA will rely on this analysis to support its environmental review when it is evaluating SpaceX's license application to conduct RLV landing operations of up to three booster stage vehicles at LZ-1. If, after reviewing the SEA, the FAA determines the Proposed Action would not individually or cumulatively result in significant impacts on the natural or human environment, the FAA would issue its own FONSI to support issuing launch licenses to SpaceX for Falcon Heavy booster landings at LZ-1. The FAA will draw its own conclusions from the analysis presented in this SEA and assume responsibility for its environmental decision and any related mitigation measures. In order for the FAA to use this analysis to support its determination, the SEA must meet the requirements of FAA Order 1050.1F,

Environmental *Impacts: Policies and Procedures*, which contains the FAA's policies and procedures for compliance with NEPA.

NASA is also a cooperating agency and provides special expertise with respect to potential environmental impacts from space launches and the operation of a launch site. NASA also has special expertise and interest in the operation of reusable suborbital rockets through its programs, such as its Flight Opportunities Program, which are intended to help foster the development of the commercial reusable suborbital transportation industry.

1.4.2 Structure of this SEA

This SEA presents the analysis and description of potential environmental impacts that could result from the Proposed Action and the No Action Alternative. As appropriate, the affected environment and environmental consequences of the Proposed Action and the No Action Alternative are discussed in context with resource area descriptions. This SEA incorporates the original EA by reference to minimize redundancies, and notes any changes since it was published. The original EA is available online at the USAF web site www.patrick.af.mil. The structure of the EA is as follows:

- Section 2.0 of this EA describes the Proposed Action and the No Action Alternative. Since this SEA only addresses expanded operations at LZ-1, no other location alternatives are being considered.

- Section 3.0 provides a brief review of the affected environment for the following resource areas which includes USAF requirements, NASA requirements, and FAA requirements. The resource areas include: land use/visual resources (which includes coastal resources), noise, biological resources, cultural resources, air quality, climate, hazardous materials/hazardous waste (which includes solid waste and pollution prevention), water resources, geology and soils, transportation, utilities, health and safety, socioeconomics, environmental justice, and Section 4(f) properties. The following additional resources, which are required to be assessed by FAA Order 1050.1F, are discussed briefly in Section 3 but are dismissed from detailed evaluation: natural resources and energy supply, farmland, and children's environmental health and safety risks. The information included in this section describes existing conditions which provides background for understanding the context of the action, and justification for elimination of resource areas that would not be impacted by the proposed action.

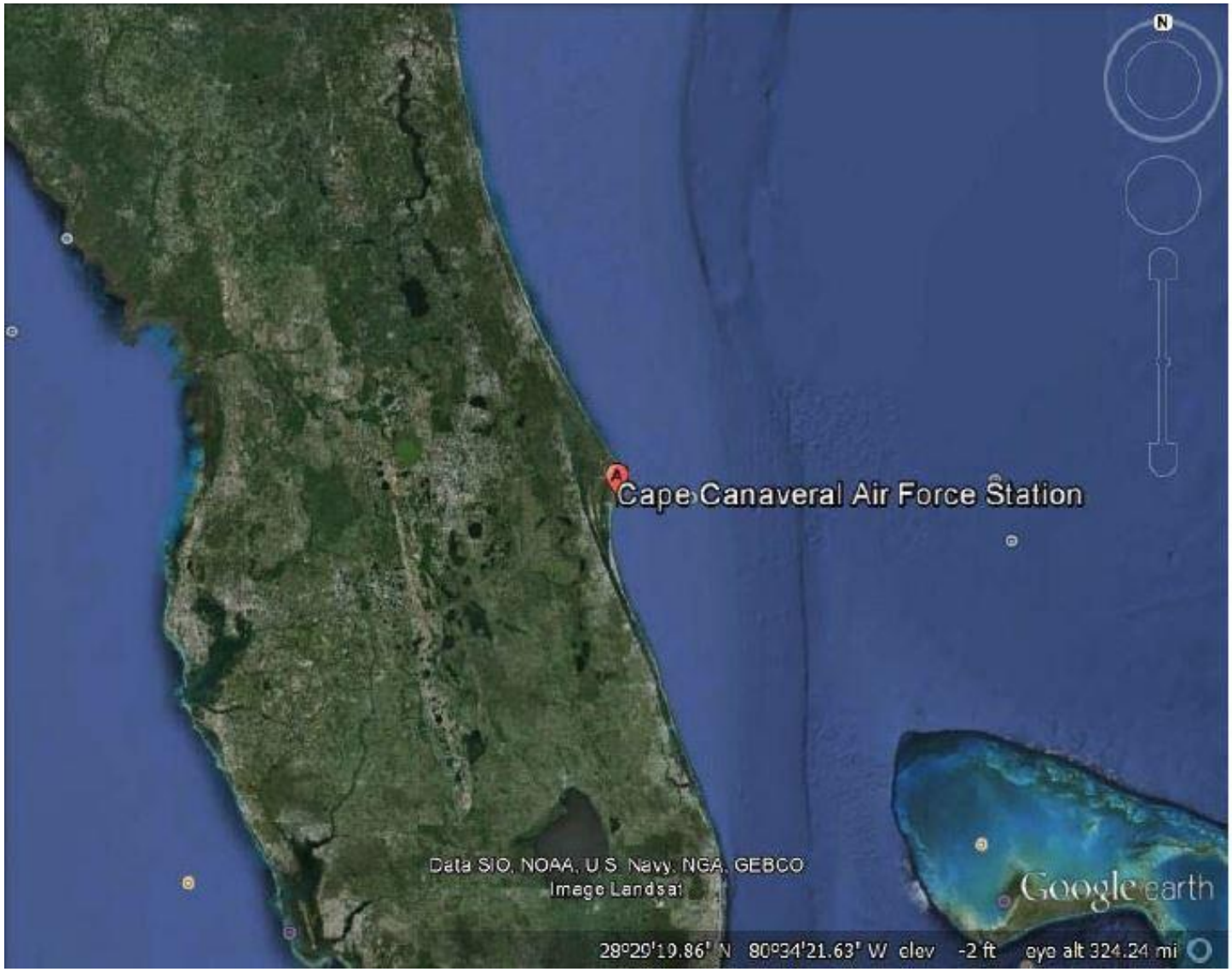
- Section 4.0 addresses the potential direct and indirect effects of the Proposed Action and the No Action Alternative on the resource areas discussed in Section 3.0. Any proposed or required mitigation measures are also discussed in Section 4.0.

- Section 5.0 describes cumulative impacts on the resource areas from other past, present, and reasonably foreseeable future actions.

- Section 6.0 presents a list of key personnel and agencies who were contacted in the preparation of the SEA and a summary of public coordination and review of the document.

- Section 7.0 lists those who prepared the SEA.

- Section 8.0 lists references cited during the SEA's preparation.



LOCATION OF CAPE CANAVERAL

Gator Engineering & Aquifer Restoration, Inc.
185 Middle Street, Suite 1351 • Lake Mary, FL 32746 • 407.878.0950

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.

1-1

LOCATION OF LZ-1 AT CAPE CANAVERAL

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.

1-2

PROPOSED LZ-1 LANDING AREA – ORIGINAL CONCEPTUAL PLAN (ORIGINAL EA)

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
1-3

LZ-1 LANDING AREA – EXISTING CONDITION

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.

1-4

PROPOSED LZ-1 LANDING AREA – HEAVY CONCEPTUAL PLAN

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
1-5

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Introduction and Background

Since 2010, and as of August 18, 2016, SpaceX has launched the Falcon 9 vehicle 24 times from LC-40, which SpaceX leases from the USAF (USAF 2013). The most recent launch occurred on August 14, 2016. Of the 24 launches from LC-40, there has been one mishap upon launch, which occurred on June 28, 2015. The Falcon 9 vehicle (with a Dragon resupply capsule was bound for the ISS); launched from LC-40 at CCAFS; however, at approximately 139 seconds into the flight, the vehicle failed to achieve its mission when the second stage exploded over the Atlantic Ocean. After a period of time to assess operations, on December 21, 2015, SpaceX successfully launched the Falcon 9 with a payload consisting of 11 ORBCOM satellites from LC-40; approximately 10 minutes after launch the first stage landed successfully at LZ-1. Again on July 18, 2016 following a successful launch of the Falcon 9, the returning first stage vehicle landed at LZ-1. The Falcon first stage booster has landed successfully on the autonomous droneship four times as of August 18, 2016. The first was April 8, 2016, the second was May 6, 2016 the third was May 27, and the fourth time was August 14, 2016. An anomaly also occurred to a Falcon 9 vehicle at LC-40 during a scheduled static test fire on September 1, 2016.

The Falcon 9 is a medium-lift class launch vehicle with a gross lift-off weight of approximately 1,100,000 pounds (498,952 kilograms), an approximate length of 224 ft (68.28 meters), and a lift-off thrust of about 1.53 million pounds of force (6805779.05 newtons). The Falcon 9 first stage (booster) vehicle uses liquid oxygen (LOX) and highly refined kerosene, also known as rocket propellant-1 or refined petroleum-1 (RP-1), as propellants to carry payloads into orbit. Details of the full vehicle launch/takeoff and potential environmental impacts can be found in the USAF's 2007 *Environmental Assessment for the Operation and Launch of the Falcon 1 and Falcon 9 Space Vehicles at Cape Canaveral Air Force Station, Florida* (USAF 2007) and the 2013 *Supplemental Environmental Assessment to the November 2007 Environmental Assessment for the Operation and Launch of the Falcon 1 and Falcon 9 Space Vehicles at Cape Canaveral Air Force Station Florida* (USAF 2013).

The Falcon Heavy is a heavy-lift class launch vehicle. The Falcon Heavy booster stage consists of essentially three Falcon 9 booster stage cores structurally held together in a row. Each of the three booster stages of the Falcon Heavy are approximately 12 ft (3.66 meters) wide by 134 ft (40.84 meters) tall. Each stage or core contains nine Merlin engines for a total lift off thrust of about 1.53 million pounds (6805779.05 newtons) per booster. The Merlin engine is a very advanced design which contains a pump-fed gas generator cycle, turbine exhaust roll control, and hydraulic thrust-vector control, making the engine very controllable within short time response periods. Each booster stage consists of aluminum LOX and RP-1 tanks that hold approximately 62,000 gallons (gal) (234695.53 liters) of LOX and 38,000 gal (143845.65 liters) of RP-1. Thrust on lift-off of the Falcon Heavy is approximately 4.59 million lbs of force (20417337.144 newtons). Figure 2-1 is a conceptual rendering of a Falcon Heavy launch. The Falcon Heavy is currently scheduled to launch from LC-39A located at Kennedy Space Center (KSC). SpaceX has leased this complex from NASA and the detailed information on the Heavy's planned operation can be found in NASA's *Final Environmental Assessment for Multi-Use of Launch Complexes 39A and 39B John F. Kennedy Space Center, FL, 25 June, 2013* (NASA 2013). NASA issued a FONSI on February 20, 2014. Figures 2-2 and 2-3 show the engine arrangement for the Falcon 9 and the Falcon Heavy launch vehicles, respectively.

A main goal of the Falcon program is to reduce the cost of space travel by utilizing RLVs which would land nearby and shorten delays between launches due to standard water splashdowns. These vehicles have been built with the goal of becoming RLVs, by landing the booster stages at LZ-1 or offshore on an offshore platform (i.e. autonomous drone ship).

The Falcon 9 booster stage landing at LZ-1 is discussed in detail within the original EA. As noted in Chapter 1, the USAF signed the EBS on January 14, 2015, which officially began SpaceX-licensed use of this area for landing operations. On January 30, 2015 the St. John's River Water Management District (SJRWMD) issued Environmental Resource Permit (ERP) **permit # 140524-1** for the original construction site plan and operation at LZ-1, and construction activities began in February 2015.

The scope for this SEA is limited to the activities required to construct two additional landing pads and associated supporting infrastructure, the construction of a Dragon 2 processing facility and the landing operations of up to three Falcon Heavy booster stage vehicles at LZ-1. This SEA assumes a normal launch mission of a Falcon Heavy vehicle continues forward with the successful separation of the second stage and payload, while the booster stages begin their boost-back and landing sequence. This SEA also assumes that SpaceX will continue to utilize the option to land a first stage booster on an autonomous drone ship as discussed and assessed in two separate USAF FORM 813s developed by the 45 SW.

2.2 DESCRIPTION OF PROPOSED ACTION

This SEA expands on the Proposed Action and analysis provided in the original EA to include the assessment of clearing an additional approximately 23 acres of land at LZ-1; which includes land for the landing pads themselves, as well as room for roadways, the Dragon capsule procesing facility, and stormwater management systems. The original landing pad required over 20 acres of cleared area so that the landing vehicle radar navigation system would function accurately. While the additional clearing for this Proposed Action is also needed for the radar altimeter system on the Falcon 9 boosters to work properly, much less is needed because the landing navigation system is more advanced and has become more accurate. The following subsections address planned construction and operations at LZ-1.

Construction

The Proposed Action would include constructing two additional concrete landing pads, each with an approximate radius of 141 feet (42.98 meters) surrounded by an approximate 50 foot (15.24 meter)-wide hard-packed soil "apron", which would bring the diameter of each pad area to approximately 400 feet (122 meters). These two additional landing pads would be in a north and a south area as shown in Figure 2-4. The pads would be approximately 18 inches think and designed to support the weight and thrust energy of the Falcon booster vehicle; they would comply with all CCAFS and other relevant construction requirements, the same requirements as for the original main landing pad. These new pads would be constructed on previously undisturbed land. Two short crane access paths would be constructed from the existing crane path to the landing pads. To simplify operations, SpaceX may install a set of pedestals within the compacted apron around each landing pads, similar to what exists now at the LZ-1 main pad.

This would allow parallel processing of landed boosters, and would reduce the distance over which the crane has to walk the booster prior to placing it onto the fixture.

Additionally, a Dragon capsule processing facility would be built at LZ-1 to support the initial but temporary capsule operations at CCAFS. The facility would be approximately 130 feet long, 100 feet wide and 30 feet tall. It would serve as the temporary home for Dragon refurbishment at CCAFS until long-term operations can be established at a new and larger facility elsewhere, an action which is not part of this SEA. The processing facility would provide a location for vehicle propellant load and propulsion system servicing. Total quantity of the propellant MMH would be 2558 lbs, and the total quantity of NTO would be 4203 lbs. The facility would include electrical, communications, water utility connections to existing lines, and other related service equipment.

In the northern area, construction would require clearing approximately 11 acres of vegetation and roller-chopping approximately two (2) acres of vegetation just east of the site ditch; clearing is needed for proper operation of the landing navigational systems. (See Figure 2-5). The northern area would avoid the wetlands to the west and northeast of the landing pad. In the southern area, construction would require clearing approximately 10 acres of vegetation. Wetlands further to the south, and an existing drainage ditch to the west would be avoided (see Figure 2-6). The combined LZ-1 three-pad site plan is shown in Figure 2-6.

The removed vegetation would be either taken off site to an approved burn or burial area, or burned onsite with appropriate coordination/permissions. Site grading would be required in order to provide a flat, compacted area to construct the two landing pads and aprons, and connecting crane paths. Soil relocation and placement is considered to be moderate and may exceed 30,000 cubic yards.

Existing power distribution infrastructure discussed in the original EA would be extended to support the two new pads and Dragon processing facility. These utilities, along with water, video camera, and nitrogen gas lines would be contained within buried conduit in the immediate vicinity of the pad and traverse above ground throughout the rest of the site. Up to four additional lattice towers, approximately 20 feet high, would also be positioned on the site. The towers would contain equipment needed to ensure adequate wireless internet service for the site, and would be integrated into the system being installed for the original landing pad.

A FireX system similar to one installed for the original landing pad would be constructed at each pad with three or four remote controlled water cannons mounted on posts above ground to allow for remote firefighting capabilities. An additional above ground 12,000-gallon water storage tank would be placed on the western side of the LZ-1 area. The tank would be pressurized with nitrogen and provide water for the fire-fighting equipment. Nitrogen would be supplied to the tank using a mobile trailer. The tank would be filled using the existing pad water supply. Water supply lines to the pads would be in directly buried pipe in the vicinity of the pads and traverse above ground throughout the rest of the site.

SpaceX would continue to use portable sanitary facilities at LZ-1. The landing pads would be constructed to control all stormwater runoff from the pads. In addition, all stormwater flowing off the landing pads would be directed to a retention basin, swale, or similar infiltration feature according to federal, state and local storm water run-off

regulations. The exact location and size of the stormwater management infrastructure would be determined during final site design, and would consider avoiding or minimizing potential effects to wetlands and protected species.

Falcon Stage Vehicle Boost-back and Landing Operations

Following a nominal launch of the Falcon Heavy from LC-39A as discussed in the NASA EA (NASA 2013), the Falcon boosters would separate from the second stage and return to LZ-1 at CCAFS for potential reuse. The Falcon Heavy boosters are designed with landing legs, which would have the capability to land each core safely at some point after lift-off. SpaceX would also have the option to land returning boosters on the at-sea droneship.

Each of the boosters of the Falcon family of vehicles has carbon overwrapped pressure vessels (COPVs), which are filled with either nitrogen or helium, and are used to orient the position of the booster stage. After the side boosters separate and engine cutoff occurs, the center engine in each would burn to control the booster's trajectory safely away from the rocket. The center core would continue to fire until stage separation. Exoatmospheric cold gas thrusters would be triggered to flip each of the booster stages into position for retrograde burn, and three of the nine booster stage Merlin engines would be restarted to conduct the retrograde burn in order to reduce the velocity of the booster stage vehicles and place them at the correct angle and course to return to the CCAFS LZ-1 air space over the Atlantic Ocean. As each of the three boosters successively are in position and approaching its own landing target, two of the three engines would be shut down to end the boost-back burn, and landings would occur using one to three engines per stage, on the three separate pads.

It is anticipated that the three boosters would begin to return to the three landing pads (or two pads and the floating at-sea droneship) approximately 10 minutes after lift-off. Each of the three stages would be controlled separately so their approach and landing at LZ-1 or the droneship would be managed independently. During the boost-back phase, each returning vehicle may produce one larger sonic boom, and one smaller sonic boom (a total of up to six booms); while the noise (pressure waves) are initiated when the vehicle reaches sub-sonic speeds, the boom is not actually heard until close to or upon landing. The landing legs on each stage would deploy in preparation for a final one to three engine burn that would slow each stage to a velocity of zero before landing at two or three LZ-1 landing pads, and/or on the droneship.

The detailed sequence of events for booster stage landings along with trajectory data would be provided in the Flight Safety Data Plan (FSDP) once it is finalized. Although most of the on-board propellant volumes would be expended during flight, there is a potential for a relatively small amount of LOX (less than 5,840 lbs) and RP-1 fuel (less than 2,160 lbs) to remain in the Falcon booster stages upon landing. Final volumes of fuel would also be included in the FSDP.

A small amount of ordnance, such as small explosive bolts and on-board batteries would typically also be onboard each stage. Any hazardous materials would be handled in accordance with federal, state, and local laws and regulations. SpaceX has an established emergency response team and any unexpected spills would be contained

and cleaned up per the procedures identified in the SpaceX Emergency Action Plan (EAP) and in an appendix to the LC-40 Spill Prevention Control and Countermeasures (SPCC) Plan.

The guidance, navigation, and control system of the Falcon vehicles is triplicated such that the system is one-fault tolerant and would be the same as that for the Falcon 9 system described in the original EA. Well in advance of any planned mission (launch and landing), SpaceX has, and would continue to, develop a Preliminary Flight Data Package (PFDP) which takes into consideration the landing trajectory which avoids over-flights of known structures such as oil rigs, and establishes potential debris corridors for the vehicle.

Operations at LZ-1 would support preparations for, and the landing of, up to three booster stage vehicles as well as post-flight landing and safing. Should one of the boosters land on the droneship, it would be safed at sea, and then the droneship would be brought back to either the port of Jacksonville, Florida or the Port Canaveral. Safing activities would begin upon completion of all landing activities, and engine shutdowns would be the same as for a single stage landing. The LOX oxidizer systems would be purged, and any excess fuel would be drained into a suitable truck mounted container or tanker. Any remaining pressurants (i.e., helium or nitrogen) would be vented, and any Flight Termination System (FTS) explosives would also be rendered "inert" prior to declaring the vehicles safe. The vehicles would then be lifted and moved by a crane, in a planned sequence, and placed on to the stand one at a time. The landing legs would then be removed or folded back into place. Each vehicle would then be lowered into a horizontal position, placed on a transport vehicle, and taken to a SpaceX facility, again sequentially. A ground crew would perform and supervise all landing operations and would be familiar with the operating protocol including all potential "off nominal" events.

The original EA estimated that 12 landings would take place per year for the initial five-year FAA launch license, of a single stage vehicle. SpaceX estimates there may be up to 6 events per year for a Falcon Heavy launch, and therefore up to 18 landings (12 Falcon 9 single core landings and 6 Falcon Heavy triple core landings) at LZ-1. SpaceX prefers to conduct all of their launch operations during daylight hours, but, based on mission needs, there is a possibility that some of the additional fly-back missions could be performed during the night. Accordingly, up to two Falcon Heavy night landings (3 stages each time) are assumed for this SEA. Both the December 2015 and the July 2016 landing events were night-time events. These operations would continue for the duration of any operator license issued for the Proposed Action.

Dragon Capsule Processing Facility Operations

SpaceX initiated a facility assessment process with the Air Force in May of 2016 in an attempt to locate an existing site capable of accommodating Dragon capsule processing requirements. In coordination with 45 SW it was determined that locating the processing facility at LZ-1 would allow immediate mission requirements to be met. Long –term CCAFS real estate planning efforts are underway; that effort may result in the development of a new facility at a different location. In this instance, a new location facility would be evaluated under a separate study.

LZ-1provides a location to perform propellant servicing operations and post-flight refurbishment for Dragon capsule missions. Following space flight operations, the Dragon capsule would splashdown off the coast of Florida where vehicle recovery would occur. The Dragon capsule would be transported back to the processing facility for post-flight processing and refurbishment. In order to support pre- and post-flight operations, the Dragon capsule would require

a processing facility to perform various vehicle checkouts, final flight closeouts, propellant load, propellant unload and propellant servicing operations.

The Dragon capsule would also require a location to perform periodic vehicle static fires in order to test the SuperDraco launch abort and landing system. The Capsule would be fastened to a portable mechanical stand than can be configured to varying heights. The mobile static fire stand would be integrated to the northern edge of the North Pad, and would not be permanently installed. The un-fueled Dragon capsule would be trucked to the LZ-1 facility. The transport method would follow the approved Department of Transportation methods for transporting the Dragon capsule; the transport fixture would be the same fixture used for recovery and transport of Dragon capsule in the past. Road slopes, grades, and turn radii are all consistent with current methods of transporting Dragon. At this time, the planned facility would be a temporary location.

In addition to the vehicle propellant loading, propulsion system servicing and pre- and post- static fire preparation the facility would also serve as the home for Dragon refurbishment. The facility would incorporate the experience that SpaceX has gained from the Dragon post-flight processing building at the SpaceX Rocket Development Facility in McGregor, Texas. The Texas facility is currently used to process all flown Dragon capsule vehicles and is also the home to all Dragon capsule propulsive landing tests.

Planned activities at the LZ-1 Hypergol Processing Facility therefore include:

- Hypergolic Propellant (MMH and NTO) Load and Offload
- Post Flight and Static Fire Helium and Prop Tank Ullage Venting
- System and/or component decontamination
- Non-Hazardous component removal, inspection, repair and replacement
- Integrated vehicle checkouts

All ground support equipment (GSE) would be sized to high factors of safety to ensure compliance with USAF range regulations. The only permanent GSE surrounding the pad would be safety systems, such as FireX and Hypergol detectors, in the case of an anomaly. No additional permanent support structure would be built as all Dragon capsule support system would be integrated on to a mobile platform and only brought to the pad during test operations.

The propellants NTO and MMH would be vacuum loaded into Dragon propellant tanks from custom SpaceX storage cylinders in the hangar annex. The hypergol ground support equipment used to transfer the propellant to the Dragon capsule would include systems similar to those used in Texas, and used at LC-40 for the Dragon as discussed in the Crew Dragon Pad Abort test at LC-4 (USAF 2014).

2.3 ALTERNATIVES CONSIDERED AND ELIMINATED FROM FURTHER CONSIDERATION

Title 32 Code of Federal Regulations (CFR) 989.8 discusses the analysis of alternatives. Reasonable alternatives to the Proposed Action and the “No-Action” alternative must be analyzed in EAs. “Reasonable” alternatives are those that meet the underlying purpose and need for the Proposed Action. In addition, alternatives may be expressly eliminated from detailed analysis, based on reasonable selection standards (for example, operational, technical, or

environmental standards) suitable to a particular project. Certain selection standards were discussed and developed in accordance with these requirements. For an alternative to be considered "reasonable" it first had to fully support the stated purpose and need discussed in Section 1 of this EA. Other required selection standards include the following:

- The landing location should be as close to the launch pad as practical.
- The Action should be undertaken at a location that minimizes major modifications to (including the removal of) existing infrastructure.
- The Action should take place at a location that is readily available (i.e., with no current or future use declared for the site).
- The Action should take place at a location that minimizes ground disturbance of undisturbed areas to the maximum extent possible.
- Water, electrical and communication infrastructure required for a landing site must exist at the location.
- The landing flight profile should avoid to the greatest extent possible inhabited areas and existing structures.

Several complexes at CCAFS were also considered, many of which have been inactive for numerous years. Specific facilities considered but removed from further analysis include LC-11, LC-36A and B, LC-46 (both of which are currently used by Space Florida and/or Blue Origin), LC-2, LC-12, and LC 47. These facilities are located along the coast and away from inhabited areas and structures; however they are all not available due to existing operational requirements and incompatibility with previously planned actions.

It became clear in the early stages of planning that the USAF would have to end operations or have them curtailed in most if not all other alternate locations. Additionally, since LC-13 (LZ-1) already contained an operational landing pad which satisfied all other considerations, adding additional pads to LZ-1 became the logical alternative. This choice also eliminated the potential for significant additional demolition and re-construction at some other facilities, therefore these locations were not considered reasonable alternatives. In addition, new locations on previously undisturbed land at CCAFS were considered but dismissed from detailed analysis in this EA because locating landing operations on previously undisturbed land would result in greater and unacceptable environmental impact to various resources, including wetlands, biological, and archeological resources and were therefore determined to be unreasonable alternatives.

2.4 DESCRIPTION OF THE NO ACTION ALTERNATIVE

Under the No-Action Alternative the additional two concrete pads and other support facilities would not be built and the controlled landing of the three Falcon Heavy boosters would not occur. The Dragon 2 Capsule temporary processing facility would also not be built. The Falcon family of rockets would continue to be launched from LC-40 and from 39A, however only a single Falcon booster would return and land at LZ-1; the remaining Falcon Heavy boosters would either fall into the Atlantic Ocean downrange or land on the droneship. Temporary Dragon capsule operations at CCAFS LZ-1 would not occur. SpaceX's ability to fully meet the National Space Transportation Policy goals of providing low-cost reliable access to and from space would be negatively affected. Therefore, this alternative is not preferred.

CONCEPTUAL FALCON HEAVY LAUNCH FROM KENNEDY SPACE CENTER PAD 39A

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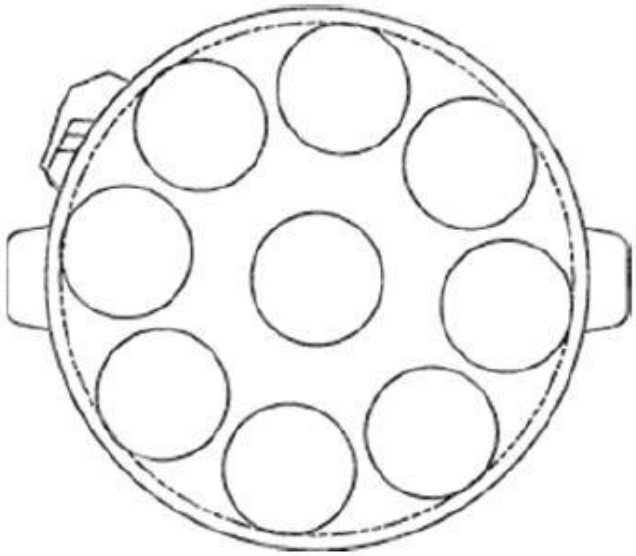
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.

2-1



FALCON 9 VEHICLE AND FIRST STAGE ENGINE ARRANGMENT

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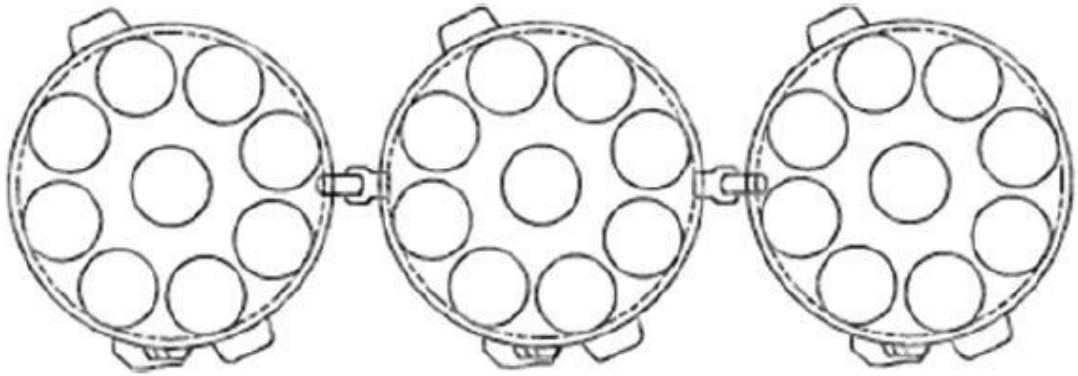
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
2-2



FALCON HEAVY VEHICLE AND FIRST STAGE ENGINE ARRANGMENT

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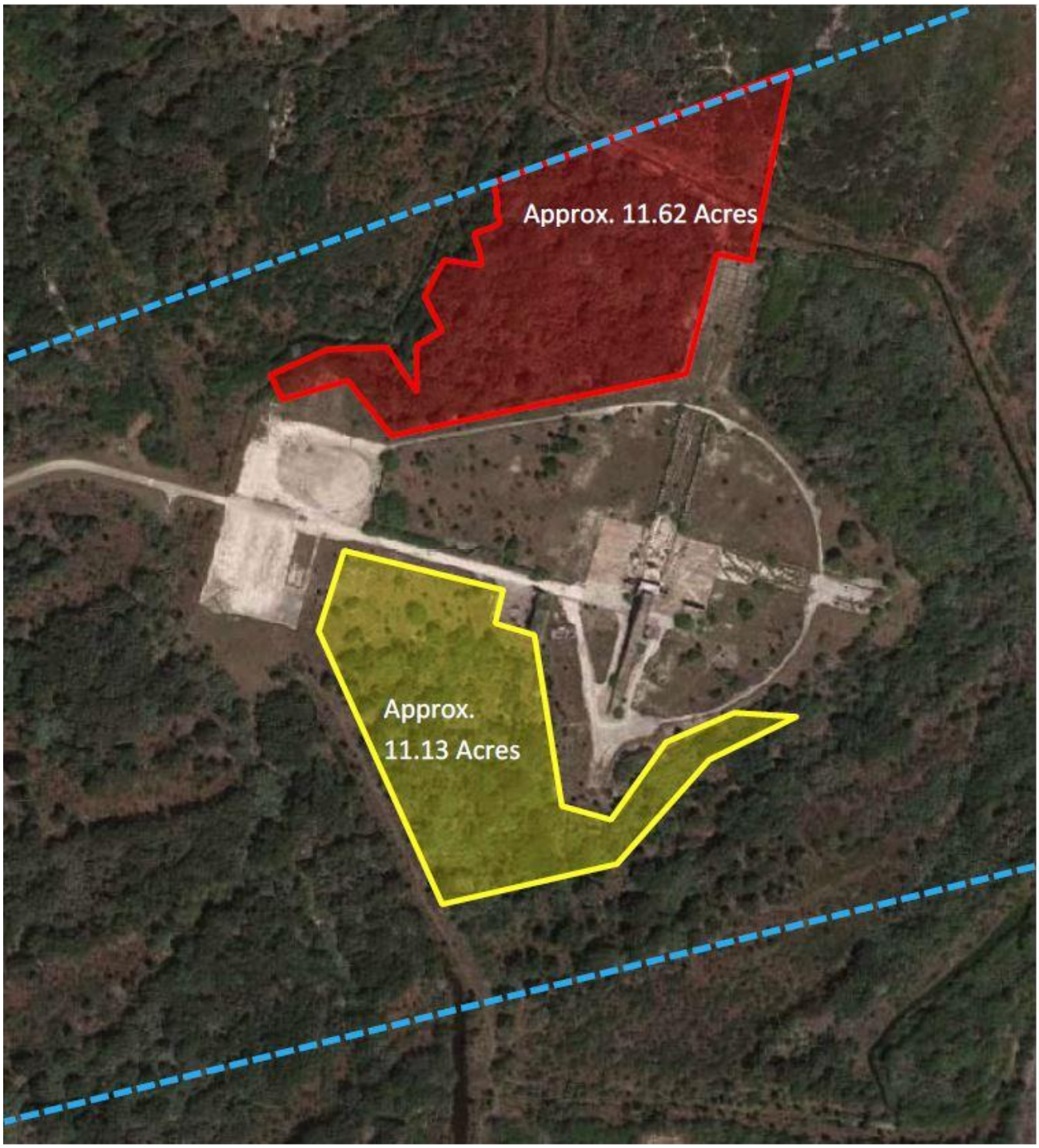
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
2-3



Licensed Land North Pad Area South Pad Area

COMBINED NORTH/SOUTH PAD PLANNED CLEARED AREA

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
2-4

25 ft Buffer

Processing Facility
130'x100' Footprint

LEGEND

- Managed Property
- 25' Buffer Zone
- Wetland Boundary
- Concrete Pad
- Crushed Gravel
- Sloped Apron

N

0' 125' 150'
SCALE 1" = 150'

CONCEPTUAL NORTH PAD LAYOUT

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

LANDING ZONE 1 (LZ-1)
CCAFS, BREVARD COUNTY, FLORIDA

Drawn by:MH
Revised by:
Date: 10/24/2016
Scale: 1":150'

G.A.R.
Gator Engineering & Aquifer Restoration, Inc.

Figure No.
2-5

LEGEND

- Managed Property
- 25' Buffer Zone
- Wetland Boundary
- Concrete Pad
- Crushed Gravel
- Sloped Apron

N

0' 125' 250'

SCALE 1" = 250'

CONCEPTUAL HEAVY LANDING PAD LAYOUT

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

LANDING ZONE 1 (LZ-1)

CCAFS, BREVARD COUNTY, FLORIDA

Drawn by:MH

Revised by:

Date: 10/24/2016

Scale: 1":250'

G.E.A.R.

Gator Engineering & Aquifer Restoration, Inc.

Figure No.

2-6

3.0 AFFECTED ENVIRONMENT

In compliance with NEPA and CEQ regulations, this section describes the existing environment at CCAFS associated with the Proposed Action and No Action Alternative location. Since the Prosed Action occurs within the same Region of Influence (ROI) and at the same complex — Launch Complex 13 (also known as LZ-1) — to minimize redundancy, this section incorporates by reference the description of the affected environment contained in the original EA and information from the 2014 EBS. Although updates to the affected environment are noted as appropriate, no substantive changes or alterations have occurred in the resource areas or the ROI with the exception of biological resources, since the specific location of the Proposed Action covers an additional approximately 23 acres of land. Therefore, the original EA and the 2014 EBS are considered valid discussions of the affected environment for the Proposed Action. Generally, the ROI for this SEA is LZ-1 and the land directly east of the complex to the Atlantic Ocean and the surrounding CCAFS area. Figure 3-1 shows the area of LZ-1 which has been previously disturbed and discussed in the original EA (the land area within the solid yellow borders and orange boarders); and the additional area associated with this Proposed Action, which has not been previously disturbed (the area within the red border and yellow dashed boarder).

While the same fourteen environmental resource areas analyzed in the original EA are considered in this SEA to provide a context for understanding the potential effects of the Proposed Action and as a basis for assessing the significance of potential impacts, the additional resource of climate has been included in this SEA. The areas which were reviewed include land use/visual resources (which includes coastal resources), noise, biological resources, cultural resources, air quality, climate, hazardous materials/hazardous waste (which includes sold waste and pollution prevention), water resources, geology and soils, transportation, utilities, health and safety, socioeconomics, environmental justice, and Section 4(f) properties. The following additional resources, which are required to be assessed by FAA Order 1050.1F and USAF guidance, are discussed briefly but are dismissed from detailed evaluation: natural resources and energy supply (addressed in the utilities sub-section), farmlands, and children's environmental health and safety risks (addressed in the land use sub-section). This information serves as a baseline from which to identify and evaluate environmental changes resulting from activities associated with the Proposed Action at LZ-1 at CCAFS, Florida.

3.1 LAND USE ZONING / VISUAL RESOURCES

Compatible land use is achieved when the Proposed Action fits within the land use patterns (vehicle launches, residential, commercial, industrial, recreational, etc.), land ownership (federal, state, private), and land use management plans. Zoning, management plans, and policies regulate how land is used. The ROI for visual resources includes the viewshed around LZ-1 such as adjacent lands at and surrounding CCAFS that would be able to view the landing pads, buildings and/or vehicles during landings, such as off-station lands within safety clear zones. Visual resources are any naturally occurring or man-made feature that contributes to the aesthetic value of an area. Areas such as coastlines and national parks are usually considered to have high visual sensitivity. The term coastal zone is defined as the coastal waters (including the lands therein and thereunder) and the adjacent shore-lands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal States, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches (16 U.S.C. 1453). The ROI for coastal resources at CCAFS

encompasses the station boundaries and potentially affected adjacent lands, including off-station lands within launch safety clear zones or land uses that may be affected by activities on the station.

Brevard County and the City of Cape Canaveral are the local planning authorities for incorporated and unincorporated areas near CCAFS. Port Canaveral is used by NASA, the U.S. Navy, the USAF, and the U.S. Coast Guard to support space vehicle operations and shipping activities. Neither Brevard County nor the City of Cape Canaveral has land use or zoning authority over CCAFS land because it is federally owned. The general plans of Brevard County and City of Cape Canaveral designate compatible land uses and zoning around CCAFS. The CCAFS General Plan defines the installation's land uses and zoning.

CCAFS encompasses an area of 15,800 acres, representing approximately two percent of the total land area of Brevard County. The area surrounding LZ-1 is generally flat with scrub oak and palmettos. LZ-1 is located on the eastern side of CCAFS, between ICBM Road to the west and the Atlantic Ocean to the east; LC-14 is adjacent to the north and LC-12 is adjacent to the south.

The Florida Department of Environmental Protection (FDEP) is the state's lead coastal zone management agency. The USAF is responsible for making the final coastal zone consistency determinations for its activities within the state, and the FDEP along with state agencies will review the coastal zone consistency determination through submittal of this SEA to the Florida Clearinghouse. The location of the additional approximately 23 acres for this SEA (See Figure 2-4) is located within the area currently licensed to SpaceX and Florida's zoning authority approved the work described in the original EA, which contains additional detail about the location.

The lands at CCAFS do not include prime farm land; therefore, this resource area is not evaluated further in this SEA. Similarly, CCAFS also does not contain any schools, child-care facilities, or other children related activities or facilities. Therefore, children's environmental health and safety risk is not evaluated further in this SEA.

3.2 NOISE

Noise is usually defined as unwanted sound. High-amplitude noise can be unwanted because of potential structural damage. The ROI for this resource includes the area around LZ-1, CCAFS, the Atlantic Ocean east of LZ-1, and surrounding communities including central Florida south to Palm Bay and west to the Orlando and Kissimmee areas. CCAFS is a relatively isolated facility, which reduces the potential for noise impacts on adjacent communities. The closest residential communities to LZ-1 are the City of Merritt Island, located approximately seven miles to the west southwest and the City of Cape Canaveral, located approximately seven miles to the south. Ambient noise levels in these communities are normally low, with higher noise levels occurring in the communities' industrial areas, and lower noise levels (normally about 45 to 55 A-weighted sound level (dBA)) in the residential areas and along the beaches. Infrequent aircraft fly-overs and rocket launches from CCAFS and KSC increase noise levels for short periods of time. Existing noise sources at CCAFS include construction related noise, aircraft noise associated with aircraft take-off and landing facilities, and current rocket launch operations at CCAFS and KSC.

The FAA has a defined significance threshold for noise. Per FAA Order 1050.1F, a significant noise impact would occur if the action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at

or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dB to 65 dB.

3.2.1 Construction Related Noise Description and Considerations

Under the Clean Air Act, the EPA administrator established the Office of Noise Abatement and Control (ONAC) to carry out investigations and studies on noise and its effect on the public health and welfare. Through ONAC, the EPA coordinated all Federal noise control activities, but in 1981 the EPA concluded that noise issues were best handled at the State and local level. As a result, ONAC was closed and primary responsibility of addressing noise issues was transferred to State and local governments. However, EPA retains authority to investigate and study noise and its effect, disseminate information to the public regarding noise pollution and its adverse health effects, respond to inquiries on matters related to noise, and evaluate the effectiveness of existing regulations for protecting the public health and welfare, pursuant to the Noise Control Act of 1972 and the Quiet Communities Act of 1978. The Noise Control Act identified 65 dB (A-scale) as a desirable noise level for compatible land uses. This level is not regarded as a noise standard, but as a basis to set appropriate standards that should also factor in local considerations and issues.

Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. Equipment and vehicles associated with the construction aspects of the Proposed Action typically have a dBA between 65 and 100, at a distance of 50 feet, as shown in Table 3-1 below.

TABLE 3-1: Selected Construction Equipment Noise Emission Levels

Equipment	Noise Level (dBA) 50ft from source
Air Compressor	81
Backhoe	80
Bull Dozer or Grader	95
Concrete Mixer	85
Portable Generator	81
Loader	85
Pneumatic Tool	85
Pump	76
Saw	76

(USEPA, 1971)

With respect to potential hearing damage, according to OSHA noise standards, no worker shall be exposed to noise levels higher than 115 dBA. The exposure level of 115 dBA is limited to 15 minutes or less during an 8 hour work shift. The OSHA standards are the maximum allowable noise levels for the personnel in the vicinity of the launch pad. The maximum level during a noise event is called Lmax. In order to compare noise events with different magnitudes

and durations, the Sound Exposure Level (SEL) was developed which normalizes the sound energy of the event into one second.

3.2.2 Launch Operations Related Noise Description and Considerations

Traditionally, operation-related noise refers to noise generated from activities such as actual launches or landings and also temporary ongoing noise generated from worker traffic to and from the selected site. The amount of launch and landing noise produced is directly related to total engine thrust; therefore, the more thrust, the more noise. Historically, the highest recorded noise levels were those produced by the launches of the Space Shuttle, which in the launch vicinity exceeded 160 dBA. Space vehicles currently launched at CCAFS are the Falcon 9, the Delta IV and the Atlas V, usually with a liquid center core and additional solid rocket motors attached (Falcon 9 uses only liquid fuel). Until December 21, 2015, vertical landing events have not occurred at CCAFS. Three distinct noise events are associated with launch and ascent of a launch vehicle: on-pad engine noise, in-flight engine noise, and sonic booms. Landing events would be similar but occur essentially in reverse order.

3.2.2.1 Engine Noise

Launches and landings are a major source of operational noise; all other noise sources in the launch area are considered minor compared to rocket noise. Generally, three types of noise occur during a standard vehicle launch or landing: (1) combustion noise from the launch vehicle chambers, (2) jet noise generated by the interaction of the exhaust jet and the atmosphere, and (3) combustion noise from post-burning of combustion products. The initial loud, low frequency noise heard in the immediate vicinity of the launch pad is a result of the first three types of noise combined. SpaceX measured noise levels for their May 22, 2012 Falcon 9 (Block 1) launch at LC-40. Table 3-2 below and the associated figure present that data. The launch time was 3:44 in the afternoon with all nine Merlin engines firing.

TABLE 3-2 Falcon 9 (Block 1) Acoustic Data

Location	Distance from vehicle (feet)	Acoustics (OASPL)
1	800	145 db
2	975	136 db
3	1450	132 db
4	1600	130 db
5	1900	129 db
6	2500	126 db

3.2.2.2 On-Pad Noise

On-pad engine noise occurs when engines are firing but the vehicle is still on the pad. On-pad noise levels are typically much lower than in-flight noise levels because sound propagates in close proximity to the ground and undergoes substantial attenuation when the vehicle is on or near the pad. Landing events at LZ-1 do not have the benefit of deflectors, exhaust tunnels, or deluge water. These items are engineered into the physical set-up of a launch pad to help reduce or redirect noise and heat energy. Each of the three Falcon stages would be landed with one engine, or one ninth of the thrust energy used on launch, and that engine would be shut down immediately upon landing.

3.2.2.3 In-Flight Noise

In-flight noise occurs when a standard vehicle is in the air, and the engine exhaust plume is in line with the vehicle. In the early part of the flight when the vehicle's motion is primarily vertical, typical noise contours are circular, particularly for the higher levels near the center. The outer contours tend to be somewhat distorted. They can be stretched out in the launch direction or broadened across the launch direction, depending on specific details of the launch. As the contours are approximately circular, it is often adequate to summarize noise by giving the sound levels at a few distances from the launch site. The basic contours for landing vehicles would be similar.

The emitted acoustic power from a standard rocket engine and the frequency spectrum of the noise can be calculated from the number of engines, their size and thrust, and their flow characteristics. Normally, the largest portion of the total acoustic energy is contained in the low-frequency end of the spectrum (1 to 100 hertz). The returning stages would only have three or less engines firing at the time of landing. During the December 21, 2015 and July 18, 2016 landing events, anecdotal evidence suggested that in-flight engine noise was minimal.

3.2.3 Sonic Booms

Another characteristic of typical launch or landing vehicles is that they reach supersonic speeds (faster than the speed of sound) and generate sonic booms. A sonic boom, the shock wave resulting from the displacement of air in supersonic flight, differs from other sounds in that it is impulsive and very brief (less than 1 second for aircraft; up to several seconds for launch or landing vehicles). Sonic booms are measured in pounds per square foot (psf) of overpressure. This is the amount of the increase over the normal surrounding atmospheric pressure (2,116 psf/14.7 psi). At one-pound overpressure, no damage to structures would be expected. Overpressures of 1 to 2 psf are produced by supersonic aircraft flying at normal operating altitudes. Some public reaction could be expected between 1.5 and 2 psf. Rare, minor damage may occur with 2 to 5 psf of overpressure (NASA, 2014). During the shuttle landing events, a double sonic boom was heard at times across central Florida and the east coast, depending upon the specific flight profile.

An original Sonic Boom study performed for the original EA was included in that EA, however since that time; the USAF produced a sonic boom study and model with more fidelity to actual measurements taken; a copy of the most recent study is included in Appendix B. Additionally, SpaceX has been measuring sonic boom events for their droneship landings, and for the two landings at LZ-1. This data and further discussions of sonic boom impacts are discussed in detail in Section 4.2 of this SEA. A copy of the measurement report is included in Appendix C.

3.3 BIOLOGICAL RESOURCES

This section describes the existing vegetation and animal species that occur or could potentially occur within the ROI of the CCAFS area immediately surrounding LZ-1 and the additional area which could be affected by construction activities and the effects of landing operations for the additional two landing pad areas. Biological resources include native or naturalized plants and animals, and their habitats in which they exist. Sensitive and protected biological resources include plant and animal species that are threatened or endangered (T&E) and species of special concern

(SSC) as listed by the United States Fish and Wildlife Service (USFWS) and the Florida Wildlife Conservation Commission (FWC). Listed species that are known to be present in or near the additional approximate 23 acres that would be disturbed are presented in Table 3-3 below.

The USAF, is committed to the long-term management of all natural areas on its installations, as directed by Air Force Instruction (AFI) 32-7064, Integrated Natural Resources Management. Long-term management objectives are identified in the 45 SW's 2015 Integrated Natural Resources Management Plan (INRMP) with specific land management objectives identified in the Scrub-Jay and Sea Turtle Management Plans located in the appendices of the INRMP. The following information was derived from several sources, including the 45 SW 2015 INRMP. Additionally, recent information has been included from a Biological Assessment (BA) for this project area originally completed in July 2015, then modified and resubmitted in August 2015. The BA was completed after the 45 SW determined that the Proposed Action may affect federally listed species. As a result of this BA, the USFWS issued an (amended) Biological Opinion (BO) on February 12, 2016 to address impacts resulting from the Proposed Action; see Section 4.3 and Appendix D.

3.3.1 Vegetation

3.3.1.1 Native Vegetation Communities

Vegetation can be categorized as coastal/oak scrub. Scrub oaks are the dominant species with a closely associated shrub layer of saw palmetto (*Serenoa repens*). Within the ROI Proposed Action area, species such as live oak, sand live oak, wax myrtle, nakedwood and tough buckthorn are found in higher densities. These identified community types have joined and developed into a closed canopy, maximized height forest generally categorized as xeric hammock. The scrub oak area within the ROI is considered scrub jay suitable habitat.

A site environmental survey was accomplished in late April and early May 2015. The area currently supports three (3) land use types/vegetative communities. These land use types were identified utilizing the Florida Land Use, Cover and Forms Classification System, Level III (FLUCFCS, FDOT, January 1999). The on-site upland land use type/vegetative community are classified as Disturbed Land (740). The wetland/surface water land use types/vegetative communities found just north and east of the northern landing area on the site are classified as Streams and Waterways (510) and Exotic Wetland Hardwoods (619). The following provides a brief description of the on-site land use types/vegetative communities:

Uplands:

740 – Disturbed Land

The uplands associated with the project site are most consistent with the Disturbed Land (740) FLUCFCS classification. The dominant vegetation within the project area is Brazilian pepper (*Schinus terebinthifolius*). Other observed vegetation within this community type includes slash pine (*Pinus elliottii*), sand live oak (*Quercus geminata*), buckthorn (*Rhamnus cathartica*), Spanish bayonet (*Yucca aloifolia*), live oak (*Quercus virginiana*), laurel oak (*Quercuslaurifolia*), winged sumac (*Rhus copallium*), saw palmetto (*Serenoa repens*), blackberry (*Rubuscuneifolius*), wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), winged sumac (*Rhus copallinum*), lantana (*Lantana camara*), chalky bluestem (*Andropogon glomeratus*), broomsedge (*Andropogon* spp.), greenbriar

(*Smilax* spp.), pokeweed (*Phytolacca americana*), prickly pear cactus (*Opuntia humifusa*), muscadine vine (*Vitis rotundifolia*), sand cordgrass (*Spartina bakeri*), dogfennel (*Eupatorium capillifolium*), maidencane (*Panicum hemitomon*), air potato (*Dioscorea bulbifera*), guineagrass (*Panicum maximum*), cogongrass (*Imperata cylindrica*), primrose willow (*Ludwigia peruviana*), chinaberry tree (*Melia azedarach*), rattlebox (*Sesbania punicea*), and caesarweed (*Urena lobata*).

Wetlands

510 – Streams and Waterways

Ditches that boarder the project boundaries are most consistent with the Streams and Waterways (510) FLUCFCS classification. Vegetation observed within this community type includes wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), maidencane (*Panicum hemitomon*), sawgrass (*Cladium jamaicense*), primrose willow (*Ludwigia peruviana*), Brazilian pepper (*Schinius terebinthifolius*), pickerel weed (*Pontederia cordata*), and water hyssops (*Hydrocotyle umbellate).*

619 – Exotic Wetland Hardwoods

The remainder of the wetland areas just north of the North pad and south of the South pad are most consistent with the Exotic Wetland Hardwoods (619) FLUCFCS classification. Vegetation observed within this community type includes loblolly bay (*Gordonia lasianthus*), wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), winged sumac (*Rhus copallinum*), lantana (*Lantana camara*), sand cordgrass (*Spartina bakeri*), white-topped sedge (*Rhynchospora colorata*), dogfennel (*Eupatorium capillifolium*), maidencane (*Panicum hemitomon*), chalky bluestem (*Andropogon glomeratus*), Brazilian pepper (*Schinus terebinthifolius*), air potato (*Dioscorea bulbifera*), guineagrass (*Panicum maximum*), cogongrass (*Imperata cylindrica*), primrose willow (*Ludwigia peruviana*), chinaberry tree (*Melia azedarach*), rattlebox (*Sesbania punicea*), and caesarweed (*Urena lobata*).

3.3.1.2 Invasive Species

Most of the areas on CCAFS that are disturbed, including roads, utility corridors, launch complexes have a substantial invasive species component. Brazilian pepper predominates the invasive flora at CCAFS and at the ROI in and around the LZ-1 facility; Australian pine did not appear to be present.

3.3.2 Wildlife

The coastal scrub and associated woodlands provide habitat for a wide range of wildlife including migratory birds and mammals including the white-tailed deer, armadillo, bobcat, feral hog, raccoon, long-tailed weasel, round-tailed muskrat, and the Florida mouse (a State species of special concern). Amphibians observed at CCAFS include the spade foot and eastern narrow-mouth toads, squirrel and southern leopard frogs, and green tree frogs. Reptiles observed include the American alligator, the Florida box turtle, the gopher tortoise, the Florida softshell, the green anole, the six-lined racerunner, the broadhead skink, the southern ringneck snake, everglades racer, the eastern coachwhip, and the mangrove salt marsh snake. Numerous marine mammals populate the coastal and lagoon waters including the bottlenose dolphin, the spotted dolphin, and the manatee. The seagrass beds in the northern Indian River system provide important nursery areas, shelter, and foraging habitat for a wide variety of fish and

invertebrates, and for manatees. The inland rivers and lagoons provide habitat for marine worms, mollusks and crustaceans. The Mosquito Lagoon is an important shrimp nursery area.

A number of saltwater fish species can be found within Indian and Banana River Systems including the bay anchovy, pipefish, goby, silver perch, lined sole, spotted sea trout, and oyster fish. The small freshwater habitats found on CCAFS contain bluegill, garfish, largemouth bass, killifishes, sailfin molly, and top minnow (USAF, 2014). The following paragraphs give a broad overview of specific species of concern in the ROI.

3.3.2.1 Migratory Birds

At CCAFS, resident and migrating bird species include numerous common land and shore birds. Cape Canaveral is situated along a major flyway route for migratory birds and therefore home to numerous birds listed on the USFWS migratory bird list, all of which are protected at the Federal level by the Migratory Bird Treaty Act (MBTA). All but a few bird species (i.e. pigeons, European starlings, etc.) found on CCAFS are on this list. Multiple species of birds, such as mockingbirds, grackles and great horned owls, have been documented nesting along ICBM Road and LZ-1. Executive Order 13186, signed in 2001, and the MBTA require federal agencies to protect migratory birds and their habitats. This would require that if nests may be impacted, the nest be empty of eggs or young prior to relocation or removal. CCAFS also supports a large population of ospreys. They are most often found near water, nesting near the top of large trees, bore-sight towers, utility poles, antennas and gantries. The osprey is federally protected by the MBTA, which makes it illegal to destroy a nest without the proper permits. At this time, ospreys do not appear to be nesting on or in any trees in the additional north and south areas.

3.3.3 Threatened and Endangered and Species of Special Concern

CCAFS contains habitat utilized by a large number of federal and state- listed species. Listed species that are known to be present at or near (within 100 feet) LZ-1 boundaries, or in the Proposed Action area complex, are presented in the original EA. Using methodologies outlined in the Florida's Fragile Wildlife (Wood, 2001); Measuring and Monitoring Biological Diversity Standard Methods for Mammals (Wilson, et al., 1996); Wildlife Methodology Guidelines (1988); and FFWCC Gopher Tortoise Permitting Guidelines (April 2013 - revised February 2015); a cursory assessment for "listed" floral and faunal species was conducted at the site on April 27, 2015. This assessment included both direct observations and indirect evidence, such as tracks, burrows, tree markings and birdcalls that indicated the presence of species observed. No plant species "listed" by either the state or federal agencies were identified on the subject site during the assessments conducted.

Table 3-3 presents a summary of the protected species found within or near the additional approximately 23 acres of land needed for the two landing pads and Dragon capsule processing facility.

Table 3-3 Federal and State Protected Wildlife Species that Occur or Have Potential to Occur within or near the ROI			
Common Name	**Scientific Name**	**Status**	
		Federal	**State**
Plants			
Beach star	*Remirea maritime*		E
Coastal mock vervain	*Glandularia maritima*		E
Curtiss' milkweed	*Asclepias curtissii*		E
Golden Leather Fern	*Acrostichum aureum*		CE
Hand fern	*Ophioderma palmatum*		E
Nodding pinweed	*Lycopodiella cernua*		T
Satin leaf	*Chrysophyllum olivaeforme*		E
Inkberry	*Scaevola plumieri*		T
Nakedwood, Simpson's Stopper	*Myrcianthes fragrans*		T
Sand dune spurge	*Euphorbia telephioides*		E
Sea-lavender	*Argusia gnaphalodes*		E
Erect prickly-pear cactus	*Opuntia stricta*		T
Birds			
American Oystercatcher	*Haematopus palliatus*	T (S/A)	SSC
Audubon's Crested Caracara	*Polyborus plancus audubonii*	T	T
Bald Eagle	*Haliaeetus leucocephalus*		T
Florida Scrub-Jay	*Aphelocoma coerulescens*	T	T
Least Tern	*Sternula antillarum*		T
Piping Plover	*Charadrius melodus*	T	T
Rufa Red Knot	*Calidris canutus rufa*	T	T
Roseate Spoonbill	*Platalea ajaja*		SSC
Roseate Tern	*Sterna dougallii*	T	T
Snowy Egret	*Egretta thula*		SSC
Southeastern American Kestrel	*Falco sparverius paulus*		T
Tricolored Heron	*Egretta tricolor*		SSC
White Ibis	*Eudocimus albus*		SSC
Wood Stork	*Mycteria americana*	T	T
Reptiles and Amphibians			
Atlantic Green Sea Turtle	*Chelonia mydas*	T	T
American alligator	*Alligator mississippiensis*	T (S/A)	SSC
Eastern indigo snake	*Drymarchon corais couperi*	T	T
Florida gopher frog	*Rana capito*		SSC
Florida pine snake	*Pituophis melanoleucus mugitus*		SSC
Gopher Tortoise	*Gopherus polyphemus*		T
Hawksbill Sea Turtle	*Eretmochelys imbricata imbricata*	E	E
Kemp's Ridley Sea Turtle	*Lepidochelys kempi*	E	E
Leatherback Sea Turtle	*Dermochelys coriacea*	E	E
Loggerhead Sea Turtle	*Caretta caretta*	T	T
Green Sea Turtle	*Chelonia mydas*	T	T
Mammals (Whales listed for completeness even though they are not near LZ-1)			

Table 3-3 Federal and State Protected Wildlife Species that Occur or Have Potential to Occur within or near the ROI			
Common Name	**Scientific Name**	**Status**	
		Federal	**State**
West Indian manatee	*Trichechus manatus*	E	E
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	T	T
Fin whale	*Balaenoptera physalus*	E	E
Humpback whale	*Megaptera novaeangliae*	E	E
Northern Atlantic right whale	*Eubalaena glacialis*	E	E
Sei whale	*Balaenoptera borealis*	E	E
Sperm whale	*Physeter catodon*	E	E

CE – Commercially Exploited E – Endangered SSC – Species of Special Concern
S/A – Similar in Appearance T – Threatened

Sources: NASA 2015 KSC Environmental Resource Document, March 2015, USFWS. USFWS: 2016
NOTE: Bald eagles were removed from the endangered species list in June 2007 because their populations recovered sufficiently. However, the protections under the Bald and Golden Eagle Act (Eagle Act) continue to apply. Please see the eagle information on the national website at http://www.fws.gov/migratorybirds/baldeagle.htm accessed May 2016 for information regarding new requirements.
Marine Mammal Protection Act (MMPA)

During winter months, the endangered North Atlantic right whale (*Eubalaena glacialis*) heads south from feeding grounds off the coast of Canada and New England to give birth in the warmer waters of the Atlantic, along the Florida and Georgia coastlines. In 2004, the NMFS proposed these coastal areas, including offshore CCAFS, be designated as critical habitat to reduce ship-whale collisions. In critical habitat areas boats are not to get within 500 yards (418 sq. m) of the Right Whale. In 2008 the rule was finalized and included mandatory reduced speed for ships greater than 65 ft. (59 m) in length for certain areas in the Atlantic Ocean. That area of reduced speed extends no further south than the Cocoa Beach area. The final rule had a "sunset provision" of ending on December 9, 2013; however on June 6, 2013 the Federal Register published a proposed rule and requested comments to eliminate that sunset provision. On January 27, 2016 the Federal Register (81 FR 4837) the NMFS issued a final rule that extended the critical habitat of the North Atlantic Right Whale south to Cape Canaveral, and eastward approximately 5 miles from the coast.

3.3.3.1 Florida Scrub-Jay

The Florida scrub-jay (*Aphelocoma coerulescens*) is a federally threatened bird endemic to open, oak-dominated scrub habitats of Florida. Widespread destruction and degradation of scrub habitat over the last century has resulted in dramatic declines in the distribution and abundance of this species. Because the scrub-jay is intimately tied to open, oak-dominated scrub, conservation of the species depends upon restoration of sufficient optimal habitat to support large populations. The scrub-jay population on CCAFS figures prominently in recovery plans for the species. Believed to be one of the largest remaining populations, the CCAFS population has been designated as belonging to one of three core populations for the species.

The USAF conducts a yearly census, as well as monitoring, of the Cape population of scrub-jays. All suitable accessible jay habitat is surveyed on a yearly basis. The USAF 2014 census resulted in 150 groups with a total of 480 birds, which included 49 juveniles. Data from the 2014 census indicates the presence of one group northeast of

the LZ-1 project site directly east of LC-14, well removed from the ROI (see Figure 3-2). The USAF has not been monitoring this group, therefore territory information is not available. There was an additional group observed in 2013 just north of the proposed North pad; however this group was not observed in 2014 or during the April 2015 environmental survey performed for this BA.

Management actions for scrub-jays on CCAFS are primarily oriented toward habitat improvement. Since a large portion of CCAFS is or could be scrub-jay habitat, many land clearing activities have the potential to adversely impact scrub-jays and their habitat. The USFWS has designated CCAFS as part of a core scrub-jay area, indicating that all scrub habitat on CCAFS is highly valuable to the recovery of the species. Consultations between the USFWS and the USAF have resulted in a requirement to mitigate loss of scrub or potential scrub at a rate of 2:1. The objective of scrub habitat restoration on CCAFS is to restore the over-mature scrub to a condition suitable to support the Florida scrub-jay. The main methods used for habitat restoration are mechanical treatment to reduce height of the scrub and prescribed burning of mechanically treated sites to provide open patches of sand and prevent accumulation of fuels. Due to strict restrictions associated with burning on CCAFS, the USAF has been using mechanical methods to create openings for the past several years. Although burning is the preferred method of creating these openings, mechanical methods have proven to be very effective at creating the desired results in the short-term until burning can occur.

The ROI is located within Land Management Unit (LMU) 42 north of LZ-1, and LMU 51 which is south and east of LZ-1. Evidence of past land management activities exist (cut and burned vegetation) in certain areas within these units. According to the 45 SW both LMU 42 and LMU 51 were managed by mechanical cutting and treatment of Brazilian pepper in early 2015 and have been under monitor and control for invasive species. These are the only LMU affected by the proposed clearing where scrub-jays habitat exists.

3.3.3.2 Southeastern Beach Mouse

The southeastern beach mouse (*Peromyscus polionotus niveiventris)* is a subspecies of the widely distributed beach mouse (*P. polionotus*). Originally occurring on coastal dunes and coastal strand communities along the Atlantic coast of Florida, this beach mouse generally occurs along the primary dune line of the Atlantic Ocean. It is presently known to exist in six sites in Brevard, Indian River, and St. Lucie Counties. Past studies have shown the beach mouse to be present in a discontinuous pattern. Most breeding activity occurs November through January, and females can produce two or more litters per year, with litters averaging three to four (USAF 2010). The original EA documented presence of the beach mouse on the beach area, however there is no documented presence of the beach mouse in the new Proposed Action area.

3.3.3.3 Eastern Indigo Snake

The longest of North American snakes (up to 8.6 ft), the eastern indigo snake (*Drymarchon corais couperi*) is locally abundant in parts of Florida, but as a top carnivore, population densities are typically low. The eastern indigo snake has been found on CCAFS and likely occurs throughout the station. This primarily diurnal snake is known to occur in most types of habitat and is often associated with gopher tortoise burrows, although this has never been observed on CCAFS, and was not observed during the April 2015 gopher tortoise survey. The reproductive season encompasses

copulation (November through April), egg laying (May through June), and hatching (late July through October). Home ranges for male indigo snakes range from 191 to 360 acres and female home ranges vary between 14 and 130 acres. Major threats to the indigo snake on CCAFS are habitat loss and vehicle traffic. There has not been an installation wide census completed for indigo snakes; however, based on the different habitat types around LZ-1, it is likely to occur within the areas to be cleared.

3.3.3.4 Marine Turtles

Three species of federally protected sea turtles have been documented as nesting on CCAFS: the loggerhead (*Caretta caretta*), green (*Chelona mydas*) and leatherback *(Dermocheyls coriacea*) sea turtles. Additionally, two Kemp Ridley (*Lepidochelys kempii*) sea turtle nests were documented in May 2015 by 45 SW USAF personnel. Based on nest surveys from 2009-2013, the average number of loggerhead and green nests created annually is 2,084 and 152, respectively. Forty-three (43) leatherback nests have been documented since 2009.

In 1988, in compliance with Section 7 of the ESA, the USAF developed Light Management Plans (LMPs) for various areas and facilities on CCAFS to protect sea turtles. An earlier Biological Opinion (BO) issued by the USFWS specifically addressing marine turtles required that LMPs be developed for all new facilities that are in close proximity to the beach, are not compliant with wing lighting policies, have lighting directly visible from the beach, and/or may cause significant sky glow. In addition, USAF biologists conduct nighttime inspections to ensure all exterior lighting is being operated in accordance with policies. The current 2016 BO (Appendix D**)** re-authorized no more than 3% incidental take of turtles as the result of disorientation on CCAFS. SpaceX maintains a current, USAF-approved LMP for operations at CCAFS.

3.3.3.5 Gopher Tortoise

The gopher tortoise is state-listed as a threatened species in Florida, and is a candidate species for federal listing in several other regions of the U.S. Gopher tortoises inhabit upland habitats common in central Florida, including scrub, pine flatwoods, and the dune area along beaches, ditches, fence lines, and other mounded areas. Their diet consists mainly of grasses, grass-like plants, and legumes. It is illegal to take, harm or harass this species. Likewise, the destruction of gopher tortoise burrows constitutes a "take" under this law except as authorized by specific permit. Although the gopher tortoise is not federally protected in Florida, it is afforded protection by the USAF due to its state ranking and the commensurable use of its burrow by other federally protected species (e.g., indigo snake). The area around LZ-1 is habitat for gopher tortoises. To support construction at LZ-1, a gopher tortoise survey was accomplished on April 27, 2015. A 100% survey was conducted; a total of 10 burrows were marked and recorded as shown in Figure 3-3. Prior to construction related activities a new survey would be required to identify and relocate any burrows.

3.4 HISTORICAL AND CULTURAL RESOURCES

Historical and cultural resources include prehistoric and historic sites, man-made structures or remnants of legacy launch vehicles, districts, artifacts or any other physical evidence of human activity considered important to a culture or community for scientific, traditional, religious or any other reasons. The ROI for historical and cultural resources includes the approximately 23 acres that would be affected for construction of the additional landing pads.

Proposed Action Location Status

The mobile service tower (MST) at LC-13 was erroneously declared a part of the Cape Canaveral National Historic Landmark District in April 1984 (Florida Master Site File Number 8Br216). However, after reviews in 1988 and 1996, the site status was reversed, and in 2012 the "new" MST was demolished and the complex was never listed as a historical landmark.

While there were no previously identified historic properties or archeological sites located within the complex boundary or in the immediate vicinity, as part of the original EA, a Phase I Archeological Survey was accomplished by 45th SW personnel. Between June and August 2014, the 45 SW Cultural Resource Manager (CRM) visited LC-13 as part of a Cultural Resource Assessment Survey (CRAS) and conducted an archeological and historical survey for the proposed project area described in the original EA. The 45 SW CRM investigated three previously unrecorded archeological sites: 8BR3176 through 8BR3178. Angy's scatters (8BR3176) is a 20th century domestic refuse scatter. The Atlas Missile Debris Site (8BR3177) is associated with a 1959 missile mishap on the LC-12 Pad. The Canaveral Rose's Garden (8BR3178) is a coquina midden that contained no diagnostic artifacts. The 45 SW CRM determined that these sites were ineligible for listing in the NRHP.

To support this SEA, the 45 SW CRM conducted a separate investigation and Phase I Archeological Survey in and around the additional 23 acres of the Proposed Action location between October 2015 and January 2016. The survey consisted of a pedestrian walk-over and additional historical research. Results of that survey, which indicated that there were no historic or archaeological sites within the ROI were provided to the State of Florida Historical Preservation Office (SHPO) who submitted a letter of concurrence that the Proposed Action would have no adverse effect on historic properties. A copy of that letter can be found in Appendix E.

3.5 AIR QUALITY

This section describes air quality conditions at CCAFS for the atmosphere at altitudes below 914 m (3000 ft), which contains the atmospheric boundary layer for the KSC and CCAFS areas and is considered the ROI for this EA. Atmospheric monitoring for chemicals at CCAFS occurs within the atmospheric boundary layer that people inhabit.

CCAFS is located in Brevard County and is classified as "an attainment area" with National Ambient Air Quality Standards (NAAQS). Air quality at CCAFS is regulated federally under Title 40 CFR 50 NAAQS, Title 40 CFR 51 (Implementation Plans), Title 40 CFR 61 and 63 (National Emission Standards for Hazardous Air Pollutants [NESHAPs]), and Title 40 CFR 70 (Operating Permits). Florida ambient Air Standards (Rule 62-204.240 Florida Administrative Code (FAC)) was repealed in February 2012. CCAFS is considered a major source of air pollution for regulated criteria pollutants and is now classified as a minor source of regulated Hazardous Air Pollutants HAPs under the current Title V Operating Permit. No conformity determination is required as the facility is located within a NAAQS attainment area for all regulated criteria pollutants. As of the writing of this SEA, data supplied in the original EA is accurate; however, Tables 3-4 through 3-6 have been revised to show updated standards and data.

Table 3-4: National Ambient Air Quality Standards (NAAQS)					
Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3-month period	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

NOTES:
(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m^3 as a calendar quarter average) also remain in effect.
(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.
(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which implementation

plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

SOURCE: EPA Website, accessed February 2016.

Table 3-5 below is a summary of the 2013, 2014, and 2015 ambient air quality measurement data for the local region. The updated table below shows that ground-level concentrations of criteria pollutants in the ROI around LZ-1 continue to be within the NAAQS.

Table 3-5: Measured Ambient Air Concentrations of Criteria Pollutants in the Region

Pollutant	Averaging Time	Nearest Monitoring Station	Maximum Measured Concentration (ppm, except PM in µg/m^3)		
			2013	2014	2015
O_3	8 Hours	Palm Bay-Melbourne-Titusville	0.063(4th max)	0.063(4th max)	0.059(4th max)
CO	8 Hour	Orlando-Kissimmee-Sanford	1.0	1.5	1.2
NO_2	1 Hour	Orlando-Kissimmee Sanford	0.034	0.036	0.025
SO_2	1 Hour	Palm Bay-Orlando-Kissimmee-Sanford	.003	0.007	0.003
PM_{10}	24 Hour	Palm Bay-Melbourne-Titusville	54 (2nd max)	44(2nd max)	47 (2nd max)
$PM_{2.5}$	24 Hour	Palm Bay-Melbourne-Titusville	21	14	12
Lead	Quarterly	No lead monitors are located within 100 miles of LZ-1	-	-	-

a The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standards, average over three consecutive years, is equal to or less than one. By this statistic, the standard is met when the fourth-highest average concentration in each or the three years is less that the value of the standard.

Source: EPA, 2015

Presented below in Table 3-6 is a summary for years 2013 and 2014 for CCAFS Air Emissions Inventory Report actual tons per year the NAAQS regulated criteria pollutants and total hazardous air pollutants (HAPs) that are included in the current CCAFS Title V Air Operating Permit. CCAFS is still listed as a "synthetic minor" source for HAPs but remains a Title V "major" source of criteria pollutants (45 SW, 2016). In all categories CCAFS has reduced HAPs emissions from 2011 levels; 2012 measurements were not available.

Table 3-6: Summary of CCAFS Criteria Pollutant & HAPs Emissions (Tons per Year-TPY) for 2011, 2013, and Actual 2014			
Pollutant	**2011 Actual (TPY)**	**2013 Actual (TPY)**	**2014 Actual (TPY)**
PM 2.5	364.923	172.230	0.657
PM10	167.561	78.082	0.723
NOx	65.525	36.595	6.800
SO2	4.160	2.094	0.081
CO	15.018	11.731	5.329
VOC	10.816	9.695	3.805
HAPs	0.945	0.725	0.719

2014 criteria pollutants and HAP emission numbers are lower because a number of emission units were shut down and some did not operate in 2014. For example, Launch Complex 18 and 46 Blast Yards have been experiencing sporadic operations since 2013. Hangar U Paint Booth, the Engine-Driven Chiller Unit at the XY facility, two diesel-fired boilers at Bldg. 70000, and one diesel-fired boiler at the Carpenter Shop have been shut down permanently. Additionally, there has been a reduction in prescribed burn (vegetation burning) operations (45 SW, 2016).

3.6 CLIMATE

The topic of climate, especially impacts from proposed action is global in nature. However, for this SEA, the ROI is considered the area around LZ-1 specifically, and the CCAFS-KSC area generally. According to the FAA (1050.1F Desk Reference) there are currently no accepted methods of determining significance applicable to aviation or commercial space launch projects given the small percentage of emissions they contribute. CEQ's *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* dated August 1, 2016 has noted that "it is not currently useful for the NEPA analysis to attempt to link specific climatological changes, or the environmental impacts thereof, to the Climate." As noted by CEQ, "climate change is a particularly complex challenge given its global nature and inherent interrelationships among its sources, causation, mechanisms of action, and impacts; however, analyzing the proposed action's climate impacts and the effects of climate change relevant to the proposed action's environmental outcomes can provide useful information to decision makers and the public and should be very similar to considering the impacts of other environmental stressors under NEPA." Therefore the CEQ specifically asks agencies to consider;

1) The potential effects of a proposed action on climate change as indicated by its Green House Gas (GHG) emissions; and
2) The implications of climate change for the environmental effects of a proposed Action

Current GHG emissions and sea level considerations are discussed below.

3.6.1 Climate Features

The ROI lies along the Atlantic coast in Brevard County, Florida. This area experiences a subtropical climate indicative of hot, humid summers with distinct wet and dry seasons. From 1981 to 2010 precipitation averaged 52.00 inches per year, with high precipitation months averaging 7.6 inches for August and September, and the driest month averaging 2.27 inches in January (NASA, 2013). During the same time period, temperatures vary between an average high of 71.4 degrees in January to an average of 90.6 degrees in July and August. At the coast, mean sea level (MSL) is defined as the height of the sea with respect to a local land benchmark, averaged over a period of time long enough to eliminate the effects of wave, tidal, and seasonal fluctuations. Changes in MSL as measured by coastal tide gauges are called "relative sea level changes," because they can come about either by movement of the land on which the tide gauge is situated or by changes in the height of the adjacent sea surface. MSL from NOAA is established at CCAFS as 19.86 ft. (6.05 m). The average high tide for CCAFS is 21.54 ft. (6.57 m), while the average low tide is 18.15 ft. (5.53 m). The highest observed water level at CCAFS was 25.91 ft. (7.90 m) on September 26, 2004 (NASA, 2013). An eustatic sea level change is that which is caused by an alteration to the volume of water in the world ocean. According to the International Panel on Climate Change (IPCC), global mean sea level continues to rise due to thermal expansion of the oceans in addition to the loss of mass from glaciers, ice caps and the Greenland and Antarctic Ice Sheets (NASA, 2013).

Inclement weather for Brevard County is characterized by large storm cells moving west to east across North America in the cool, winter months and local or tropical systems during the hot, summer months. Occasional hurricanes do affect the area, with storm surge and wind playing a dominant factor in the damage incurred. Hurricane season extends from August through November. The most active hurricane season in the area's history was 2004, when damages to KSC facilities alone exceeded $100M. Additionally, many habitats, such as marshes, shoreline, and dunes were affected, at least temporarily, due to the storm surge and beach erosion (NASA 2013). The central Florida region has the highest number of thunderstorms in the U.S. during the summer months (May – September), and over 70% of the annual 122 cm (48 in.) of rain occurs in the summer. During thunderstorms, wind gusts of more than 97 kilometers/hour (60 mi./hr.) and rainfall of over 2.5 cm (1.0 in.) often occur in a one-hour period, and there are numerous cloud-to-ground lightning strikes.

Green House Gases (GHG) are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Some scientific evidence indicates a trend of increasing global temperature over the past century which may be due to an increase in GHG emissions from human activities. The climate change that may be associated with this global warming may produce negative economic and social consequences across the globe. . In August 2016 the CEQ issued NEPA guidance for considering the effects of climate change and GHG emissions. Specifically, GHG analysis and quantitative estimates of GHG emissions are to be included in evaluation of the Proposed Action. Per 2016 CEQ guidance, GHGs are discussed in EA Section 4.5 Air Emissions and Section 4.6 Climate (CEQ Memorandum 1 August 2016).

Table 3-7 below shows the most recent summary of GHG for all activities at CCAFS (45 SW, 2016). While all data is not yet available for 2014 and 2015, the CCAFS landfill was the primary methane emission source for all GHG. The landfill was closed in 2013 and a decision was made by the USAF that residual methane emissions would be negligible. Therefore, methane emission can be taken as zero for 2014 and beyond (45 SW 2016). Data for 2014 and 2015 is not yet available.

TABLE 3-7 Summary of Greenhouse Gases Emissions for CCAFS (Years 2011 through 2013)			
GHG	GHG Emissions for 2011		
	Ton (Short)	Ton (Metric)	$MtCO_2e$
CO_2	3,160.034	2,866.735	2,866.735
N_2O	0.052	0.047	14.624
CH_4	122.215	110.872	2,328.303
TOTAL REPORTABLE GHG* for 2011			**5,209.662**
GHG	GHG Emissions for 2012		
	Ton (Short)	Ton (Metric)	$MtCO_2e$
CO_2	2,827.90	2,565.43	2,565.42
N_2O	0.05	0.04	13.21
CH_4	211.41	191.79	4,027.65
TOTAL REPORTABLE GHG* for 2012			**6,606.28**
GHG	GHG Emissions for 2013		
	Ton (Short)	Ton (Metric)	$MtCO_2e$
CO_2	6,148.266	5,577.651	5,577.651
N_2O	227.900	206.500	61,153.000
CH_4	241.542	219.085	5,433.214
R-22	0.085	0.077	0.004
R-123	0.076	0.069	0.002
TOTAL REPORTABLE GHG* for 2013			**72,547.870**

NOTE: $MtCO_2e$ = Metric Ton Carbon Dioxide Equivalent

R-22 = Chlorodifluoromethane or difluoromonochloromethane is a hydrochlorofluorocarbon (HCFC-22) refrigerant being phased out.

R-123= 2,2-Dichloro-1,1,1-trifluoroethane or HCFC-123 is a replacement refrigerant being phase in.

3.7 HAZARDOUS MATERIALS/HAZARDOUS WASTE

The ROI for this resource area is CCAFS. Numerous types of hazardous materials are used to support the missions and general maintenance operations at CCAFS and at complexes such as LZ-1. Typical material has included petroleum products, oils, lubricants, volatile organic compounds, corrosives, refrigerants, adhesives, sealants, epoxies, and propellants (USAF 2014). Information contained in the original EA is the same and has not changed for this SEA.

The EPA regulates hazardous chemicals, substances, and wastes under RCRA, CERCLA, and the Toxic Substances Control Act. These provide requirements for the generation, storage, transportation, treatment, and disposal of hazardous materials and hazardous waste. EPA and various states also have regulations regarding the operation and maintenance of underground and aboveground storage tanks. In addition, OSHA has definitions and

workplace safety-related requirements and thresholds for approximately 400 hazardous and toxic substances, and the DOT has requirements for the safe transport of hazardous material. Numerous types of hazardous materials are currently used at CCAFS to support the various missions and general maintenance operations. Categories of hazardous materials used in support of current lift vehicle system activities include petroleum products, oils, lubricants, volatile organic compounds, corrosives, refrigerants, adhesives, sealants, epoxies, and propellants (USAF, 2000). In the event of a spill of hazardous materials at LZ-1, the USAF would provide initial emergency spill response; however, the remaining emergency/corrective actions would be the responsibility of SpaceX. SpaceX is responsible for preparing its own Emergency Response Plan for the Falcon Launch Vehicle Program in accordance with the CCAFS Hazardous Materials Emergency Response Plan.

SpaceX has developed its own Spill Prevention Control and Countermeasure (SPCC) plans for petroleum related storage tanks and systems at other CCAFS facilities such as LC-40. There are no plans to build or install any Underground Storage Tank (UST) at LZ-1 however in 2015 SpaceX placed a 500-gallon diesel AST near the parking area to support an electrical generator. They also placed a 500 gallon RP-1 AST to accept drainage from landed vehicles. These are unregulated tanks, but for potential spill prevention and clean-up are addressed within the LC-40 SPCC Plan. SpaceX also has developed and successfully uses hypergolic fuel handling procedures at their LC-40 facility; these will be used to manage any related operations at LZ-1 for the Dragon capsule temporary processing facility.

Solid Waste

Solid waste, more commonly known as trash or garbage, consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries (EPA, 2008a). General solid refuse at CCAFS is collected by a private contractor and disposed of off-site at the Brevard County Landfill, a Class I landfill located at 2250 Adamson Road in the in the City of Cocoa, or other appropriate and permitted facilities. According to the Brevard County website, the existing facility has capacity until 2018, but has land to develop additional capacity that could last another decade. The USAF 45 SW also manages a recycling program for appropriate waste material from CCAFS sites. SpaceX collects solid waste in appropriately labeled containers for disposal.

Installation Restoration Program

The DoD established the Installation Restoration Program (IRP) to identify, characterize, and evaluate past disposal sites and remediate associated contamination as needed to protect human health and the environment. The IRP was initiated at CCAFS in 1984. The IRP efforts at CCAFS have been conducted in parallel with the program at PAFB and in close coordination with the EPA, the FDEP and NASA. CCAFS is not a National Priorities List (NPL) site, and the IRP sites are being evaluated and remediated under RCRA authority while meeting the CERCLA regulations.

As a former active launch complex, a number of hazardous chemicals were stored and used at LC 13 (SWMU C038) onsite, including trichloroethylene (TCE), trichloroethane, fuels, methyl ethyl ketone, alcohols, oils, hydrazine, red fuming nitric acid, paints, lubricants, Freon and PCBs. It has also been established that historical paint formulations

used on launch structures included PCBs and lead. Routine sand blasting activities following launches dispersed the PCBs throughout site surface soils. Additionally, paint delamination from the launch structure also contributed to PCB and lead contamination throughout the site (3E, 2013a).

The groundwater is monitored on a semi-annual basis, the last report was dated September 29, 2013 (3E 2013b). Prior to any land disturbances the 45 SW Installation Restoration Program Office must be contacted to obtain additional information, including: the 45 SW Land Use Controls Management Plan; the CCAFS HSWA Permit; a complete record of corrective actions at LC-13 (LZ-1); or other related documents, guidance, and regulations.

Pollution Prevention

Pollution prevention is reducing or eliminating waste at the source by modifying production processes, promoting the use of non-toxic or less-toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream (EPA, 2008b). EO 12088, *Federal Compliance with Pollution Control Standards*, directs Federal agencies to comply with "applicable pollution control standards" in prevention, control, and abatement of environmental pollution and to consult with EPA, State, and local agencies concerning the best techniques and methods available for prevention, control, and abatement of environmental pollution. The CEQ Memorandum on Pollution Prevention and NEPA encourages early consideration of opportunities for pollution prevention (CEQ, 1993). Municipal solid waste is regulated and managed at the State and community level (EPA, 2008b).

Project design engineers must consider the environmental implications of all projects during the design phase, develop designs that minimize or eliminate environmental liability, and perform a pollution prevention environmental analysis for the project early in the design phase. The analysis should focus on potential pollution that may result from the proposed project and must make recommendations that promote pollution prevention measures whenever feasible. SpaceX has developed its own pollution prevention methods and processes that would meet or exceed USAF and local requirements.

3.8 WATER RESOURCES

The ROI for water resources include groundwater, surface water bodies including wild and scenic rivers, floodplains, and wetlands, and their physical, chemical and biological characteristics located at CCAFS. CCAFS is within the Florida Middle East Coast Basin watershed and situated on a barrier island that separates the Banana River Lagoon (BLR) from the Atlantic Ocean. There are no wild and scenic rivers located within the ROI therefore this aspect of water resources is not addressed. The description of the basins and bodies of water remain as described in the original EA.

Groundwater

The surficial and the Floridan aquifer system underlie CCAFS. The surficial aquifer system, which is comprised generally of sand and marl, is under unconfined conditions and is approximately 70 ft thick. The water table in the aquifer is generally a few feet below the ground surface. The surficial aquifer is recharged by infiltration of precipitation through the thin vadose zone. Overall groundwater flow direction across LZ-1 is predominantly to the

southwest under a relatively flat hydraulic gradient that averaged 0.0009 ft/ft. in April 2013. Depth to groundwater varies but generally ranges between 2 and 6 ft in areas off LZ-1 (3E 2013a).

Wetlands and Floodplains

Wetlands are defined in AFI 32-1067, "Water and Fuel Systems" (4 February, 2015), as those areas that are inundated by surface or ground waters that support plants and animals that need saturated or seasonally saturated soil to grow and reproduce. Wetlands include swamps, marshes, bogs, sloughs, mud flats and natural ponds, and the ecosystems are considered to be some of the most biologically productive of all habitats. There is a man-made ditch northeast of the LZ-1 facility that runs east, then south as previously shown in Figure 2-6. The ditch drains land between ICBM road-based launch complex's and the Atlantic Ocean. The ditch leads south to another set of ditches to the south of LZ-1 and LC-12 which then eventually drain to the BRL to the west. The ditches usually contain water and have been noted to support various water species such as mullet, mud turtles and at times nesting alligators. Another ditch exists on the south side of the southern area of the Proposed Action as shown in Figure 2-6.

Wetlands near the Proposed Action are also shown in "yellow hatch" in Figure 2-6. On April 27, 2015, the off-site wetland boundaries closest to the project areas were delineated and flagged in accordance with state and federal guidelines utilizing pink flagging tape. These wetland limits were also captured using a handheld GPS device. This area has recently been subject to invasive species management to control Brazilian pepper or other nuisance/exotic wetland vegetation. Vegetation within the area consists of white top sedge (*Dichromena colorata*), sawgrass (*Cladium jamaicense*), thistle (*Cirsium nuttallii*), white beggar ticks (*Bidens alba*), broom grass (*Andropogon virginicus*), wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), grape vine (*Vitis* sp.), and St. Johns wort (*Hypericum* sp.). The wetland is surrounded by a designated 25-foot "buffer zone" which is intended to protect the wetland. The buffer zone is indicated by an orange border in Figure 2-6.

Floodplains are lowland and relatively flat areas adjoining inland and coastal waters and other flood prone areas such as offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year. The base floodplain is typically called the 100-year floodplain (one percent chance floodplain). The 100-year floodplain is located immediately east and south of LZ-1, essentially extending to the beach as shown on the Brevard County Flood Insurance Rate Map, Panel 360 (Map number 12009C0360G) dated March 17, 2014 (https://MSC.FEMA.gov) and included in Appendix F**.** The proposed South pad is located in the floodplain. Consequently, the public was notified that an action is proposed to occur in a floodplain. A notice was placed in the Florida Today newspaper on July 3, 4, and 5th 2016 which allowed a 30-day period to comment. Comments received are included in Appendix I.

Additionally, DOT has implemented Executive Order (EO) 11988, Floodplain Management, through policies and procedures documented in DOT Order 5650.2, Floodplain Management and Protection. DOT Order 5650.2 defines the natural and beneficial values provided by floodplains to include "natural moderation of floods, water quality maintenance, groundwater recharge, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, and forestry." Since some of the new construction will occur in a floodplain, based on DOT Order 5650.2, the analysis (presented in Section 4.7) shall indicate if the encroachment would be a "significant encroachment," that is, whether it would cause one or more of the following to occur:

- The action would have a considerable probability of loss of human life;
- The action would likely have substantial, encroachment-associated costs or damage, including interrupting aircraft service or loss of a vital transportation facility (e.g., flooding of a runway or taxiway, important navigational aid out of service due to flooding, etc.);
- The action would cause notable adverse impact on natural and beneficial floodplain values.

3.9 GEOLOGY AND SOILS

The ROI for geology and soils covers CCAFS; topography consists of a series of relic dune ridges formed by wind and wave action, indicating that gradual beach deposits occurred throughout time. The geology underlying the site remains as described in the original EA.

The general geology topography and soils underlying the LZ-1 area are marine deposits that typically extend to depths of approximately 10 to 30 ft below the surface. The Caloosahatchee Marl underlies the surficial sands and consists of sandy shell marl that extends to a depth of 70 ft below the surface. The Hawthorn Formation, which consists of sandy limestone and clays, underlies the Caloosahatchee Marl and is the regional confining unit for the Floridan aquifer. A copy of the Brevard County, Florida Soils Map for the area around LZ-1 is included in Appendix G.

3.10 TRANSPORTATION

The transportation ROI consists of CCAFS and the immediate regional area around CCAFS.

Regional Access

The CCAFS area can be accessed from Daytona Beach via U.S. Highway (US) 1 or Interstate 95; Orlando lies approximately 50 miles to the west on State Route (SR) 528; and Miami is approximately 187 miles to the south on US 1 or Interstate 95. The majority of the employees and other related support services providers for CCAFS reside within the unincorporated areas of Brevard County and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge, which are all within 14 miles of the station.

Local Access

The key roads providing access to CCAFS from the surrounding local communities include SR A1A, SR 520, SR 528, SR 401, SR 3, and SR 405. LZ-1 is located on ICBM road which can be reached from the south via Central Control Road, and from the north via Samuel C. Phillips Parkway. There are no changes to this resource area as described in the original EA, which contains additional detail about the location.

Additionally, Port Canaveral affords a substantial amount of ocean-going transportation through its channel south of CCAFS. This traffic includes commercial shipping and cruise lines, commercial and private fishing and pleasure boats. The channel is also used by the US Navy, the US Coast Guard, and recovery vessels that have been associated with rocket launches and vehicle stage recoveries in the past.

Discussions with 45 SW personnel indicate that the roads and supporting structures (culverts, bridges, pavement) were constructed to meet Florida DOT standards. Condition of road ways within CCAFS were most recently assessed in 2013 in a report titled *Roads and Parking Lots Pavement Condition Index Survey Report at Cape*

Canaveral Air Force Station, December 2013 (AMEC, 2013). Most road pavement conditions were indexed as either good or fair. However a section of Samuel C Phillips Pkwy (Section ID 01A) was assigned an index condition of poor. That section extends from approximately LC-41 north to the turn-off to where KSC Pad 39A is.

3.11 UTILITIES

The ROI for utilities is CCAFS. Utility systems were evaluated as to their capability to provide service to CCAFS and to the individual operational launch/landing pad sites such as LZ-1. Sufficiency is based upon review of CCAFS demand, other installation facilities, and incorporated and unincorporated areas of the applicable county. Attributes considered include processing, distribution/storage capacities, and related factors, such as average daily consumption and projected peak demand. Historic and projected utility use was determined from records of purveyors, regulatory compliance reports and the application of generally accepted average growth rates. The utility systems addressed in this analysis include the following facilities and infrastructure elements:

- Water (potable and deluge)
- Wastewater (domestic and industrial)
- Electricity
- Stormwater

During operations at the former LC-13 (LZ-1) from the late 1950s until the late 1970s these services were provided to the facility. There are no changes to this resource area as described in the original EA, which contains additional detail about the location. However as part of the work currently completed at LZ-1, existing utility lines and connections at the site for fire protection water, electrical, and communication lines have been upgraded. The new landing pads in this Proposed Action would connect to these lines.

Natural Resources and Energy Supply

CCAFS, and therefore individual launch complexes, draw required power and water from the City of Cocoa Beach. At this time there are no natural resources or local energy sources available in the area of LZ-1 that would either be used, or be prevented from being used. From an efficiency or sustainability standpoint, Florida Power and Light that breaks down their energy production as follows (for 2014):

1. 68% Natural Gas
2. 23% Nuclear
3. 5% Purchased Power
4. 4% Coal
5. Less than 1 % Oil and Solar.

(Source: http://www.nexteraenergy.com/pdf/annual.pdf). The Proposed Action would not affect natural resources or energy supply. Therefore, this resource area is not evaluated further in this SEA.

3.12 HEALTH AND SAFETY

The ROI for the discussion of human health and safety includes the LZ-1 area, and includes both workers and the general public. Safety issues include injuries or deaths, which are usually the result of one-time accidents. Injuries include impacts on a human resulting from an exposure to toxic concentrations of chemicals/hazardous materials, radiant heat, or overpressures from accidental releases or explosions (such as flying debris), or accidents resulting from working in confined spaces, and that require medical treatment or hospitalization. Health issues result from activities where people may be impacted over a long period of time rather than immediately. The standards applicable to the evaluation of health and safety effects differ for workers and the public; thus, it is useful to consider each separately. Health and safety related guidance and conditions remain as discussed in the original EA and operations at the new landing pads would not change. SpaceX is responsible for protecting worker health and safety in accordance with OSHA regulations. OSHA regulations are found in 29 CFR. During clearing and construction phases, all workers will be subject to OSHA and safety programs. Standard construction methods would be used and all safety regulations and guidelines would be followed.

Range Safety procedures in place would be addressing one, two or three returning first stage boosters. Impact debris corridors for returning launch vehicles would be similar to one established for the launched Falcon 9 and other vehicles as part of the program's safety review using the results of the Falcon 9 debris analysis (USAF 2013). Debris data developed for other vehicles in compliance with AFSPCMAN 91-710 also satisfies FAA requirements. Each of the returning landing vehicles would have significantly less fuel than upon launch. Should any of the returning stages crash-land on the "at-sea" platform (which has occurred), flammable material would ignite immediately and be consumed quickly.

3.13 SOCIOECONOMICS

The ROI for socioeconomics includes CCAFS and Brevard County. Some socioeconomic data has been updated since publication of the 2014 EA. CCAFS is located in eastern Brevard County, Florida which has an estimated population of approximately 543,376 according to the 2010 census of Brevard County. The median household income for 2014 in Brevard County was $48,483 (+/- $859), and the unemployment rate dropped from 11.4 to 6.9 percent since 2011. Space Florida's report titled *Brevard Workforce-Aerospace Work Force Outlook Report Phase III,* dated January 2010 estimated that over 9,000 workers may be affected by the loss of the Shuttle Program. However, as reported by Florida Today in October 2014, unemployment was estimated to be approximately 7.1 percent (Florida Today, 2014), with a predicted increase of 1.9 percent by the year 2017. In general, the economic influence of the aerospace industry has declined somewhat with the termination of the Shuttle program. However, commercial space launch companies such as SpaceX and others have had a positive impact on the economics of Brevard County. Florida has a strong commitment to growing its already prominent aerospace industry which is ranked third among states with employment in the aerospace industry. In 2011, Florida employed 147,365 people in the industry and generated $8.38 billion in earnings (U.S. Census Bureau, 2015; U.S Bureau of Labor Statistics, 2015).

3.14 ENVIRONMENTAL JUSTICE

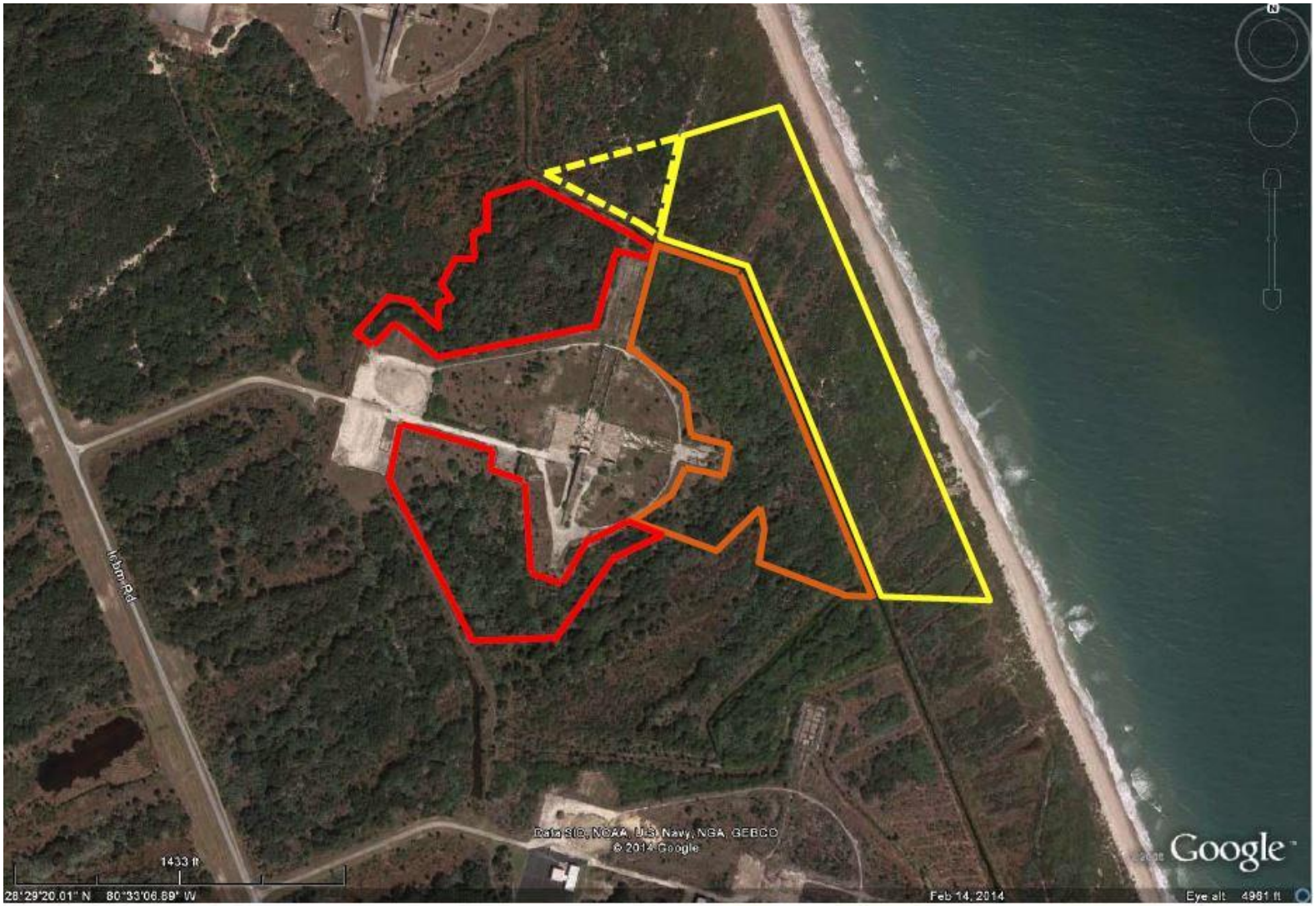
The ROI for Environmental justice includes Brevard County and is defined by the EPA as "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations. Section 989.33 of 32 CFR Section 989, requires that a project proponent comply with EO 12898 to ensure that these types of impacts are considered in EAs and other environmental documents.

The 2010 Census of Population and Housing reports numbers of minority residents are as follows: minority populations included in the census are identified as Black or African American, American Indian and Alaskan Native, Asian, Native Hawaiian/Other Pacific Islander, Hispanic, or Other. Based upon the US Census Bureau 2014 QuickFacts information, Brevard County had a population of 556,885 persons. Of this total, 9.3 percent were Hispanic, 10.7 percent were Black, and 75.8 percent were considered White but not Hispanic, and approximately 1.7 percent were other races (Brevard 2013). The closest population center is Cocoa Beach, which is approximately 7.5 miles south of LZ-1.

3.15 SECTION 4(f) PROPERTIES

Section 4(f) of the U.S. Department of Transportation Act of 1966 (now codified at 49 U.S.C. § 303) protects significant publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historic sites. Section 4(f) provides that the Secretary of Transportation may approve a transportation program or project that requires the use of any publicly owned land from a public park, recreation area, or wildlife or waterfowl refuge of national, state, or local significance, or land from any publicly or privately owned historic site of national, state, or local significance, only if there is no feasible and prudent alternative to the use of such land and the program or project includes all possible planning to minimize harm resulting from the use.

The ROI for this resource area includes CCAFS and the surrounding area that would be affected by operations (i.e., potential operational-related closure and landing noise). No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, or historic sites, exist within the boundaries of CCAFS. There are however public parks and recreation areas, in addition to the Merritt Island Wildlife Refuge and the Canaveral National Seashore, which are adjacent to KSC and CCAFS. The nearest public park, Jetty Park, is located about 7.5 miles south of LZ-1 in the City of Cape Canaveral. Other public parks within an approximate 15-mile radius of the launch site include the following: Kelly Park, KARS Park, Kings Park, and Manatee Cove Park. Additionally, the St. John's National Wildlife Refuge and Tosohatchee State Game Preserve are located west of Interstate 95 in Orange County. The Merritt Island Wildlife Refuge overlaps the northwestern portion of the KSC. All areas of KSC not directly utilized for NASA operations are managed by MINWR and NPS. Cape Canaveral National Seashore is adjacent to the Merritt Island Wildlife Refuge and north of CCAFS.



ROLLER CHOPPED LAND

CLEARED LAND

NEW CLEARING

PLANNED ROLLER CHOPPING

PROPOSED ACTION AFFECTED LANDS

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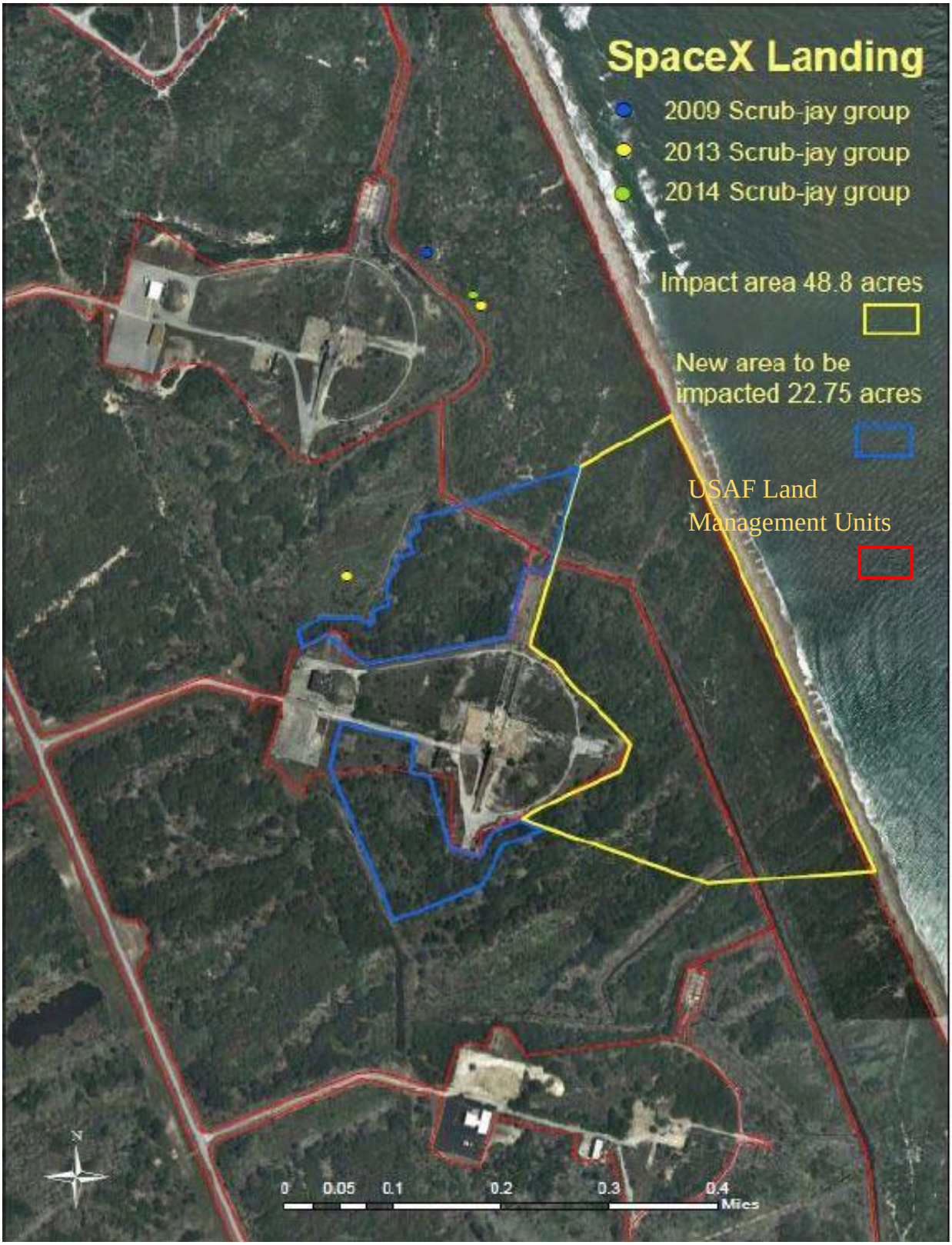
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.

3-1



SCRUB JAY SURVEY

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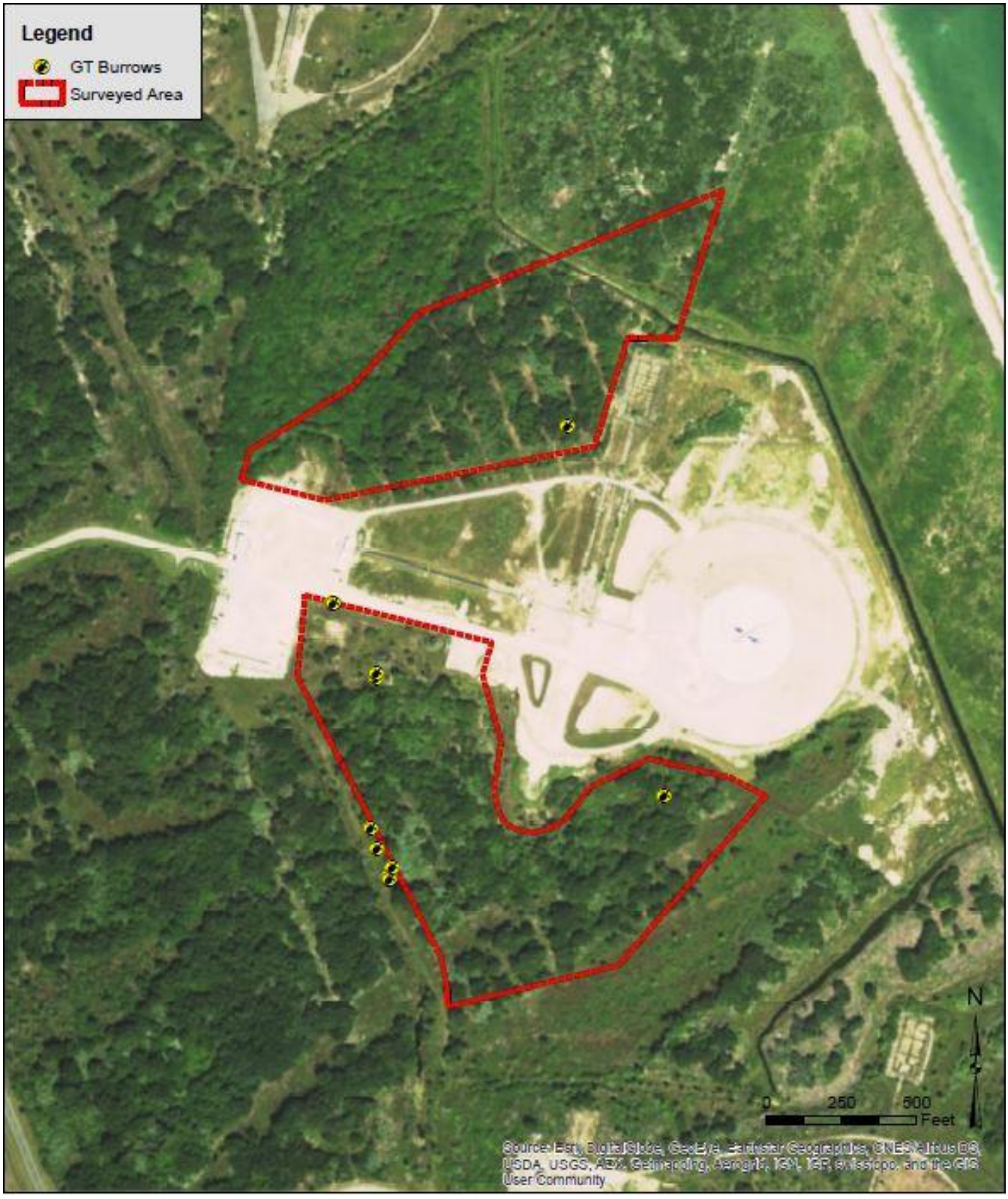
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
3-2



GOPHER TORTOISE SURVEY

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
3-3

U.S. Fish and Wildlife Service
National Wetlands Inventory

LZ-1 Wetlands

October 24, 2016

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

NATIONAL WETLANDS INVENTORY MAP

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.
3-4

4.0 ENVIRONMENTAL CONSEQUENCES

This section focuses on the potential environmental impacts associated with the Proposed Action and the No Action Alternative. Where appropriate, the analysis references the potential environmental consequences associated with LZ-1 that were analyzed in the original EA.

Changes to the natural and human environment that could result from the Proposed Action are evaluated relative to the existing environmental conditions as described in Section 3.0. Three levels of impact may be identified:

- No Impact - No impact is predicted,
- No Significant Impact - An impact is predicted, but the impact does not meet the intensity/context significance criteria for the specified resource, and
- Significant Impact - An impact is predicted that meets the intensity/context significance criteria for the specified resource.

Under NEPA (42 U.S.C. 4321 *et seq.),* significant impacts are those that have potential to significantly affect the quality of the human environment. Human environment is a comprehensive phrase that includes the natural and physical environments and the relationship of people to those environments (40 CFR Section 1508.14). CEQ Regulations specify that in determining the significance of effects, consideration must be given to both "*context*" and "*intensity*" (40 CFR Part 1508.27):

> ***Context*** means that the significance of an action must be analyzed in several contexts, such as society as a whole, to an affected region, to affected interests, or to just the locality. In other words, the context measures how far the effect would be "felt."
>
> The ***intensity*** of an action (i.e., the severity of the impact) regionally and locally may be determined by whether it is beneficial or adverse. Intensity refers to the "punch strength" of the effect within the context involved. The intensity of an action may be determined by:
>
> - Unique characteristics in the area (i.e., wetlands, parklands, ecologically critical areas, cultural resources, and other similar factors);
> - Overall beneficial project effect versus individual adverse effect(s);
> - Public health and safety;
> - Degree of controversy;
> - Degree of unique or unknown risks;
> - Precedent-setting effects for future actions;
> - Cultural or historic resources;
> - Special-status species or habitats;
> - Cumulatively significant effects; and/or
> - Compliance with federal, state, or local environmental laws.

As discussed in Section 3, fifteen environmental resource areas were considered to provide a context for understanding the potential effects of the Proposed Action and as a basis for assessing the significance of potential

impacts. The areas which were reviewed included land use zoning and visual resources; noise; biological resources; historical and cultural resources; air quality; climate; hazardous materials and waste; water resources; geology and soils; transportation; utilities; health and safety; socioeconomics; environmental justice; and Section 4(f) Properties. The level at which an impact is considered significant varies for each environmental resource area. Based on the criteria discussed above, a resource-specific definition of what constitutes a significant impact was prepared for each of the resource areas analyzed in this chapter.

As stated earlier in this SEA, while the original EA is being incorporated by reference, a summary of the impacts to these resource areas identified in that EA is provided in the table below to provide the reader with basic information about those determinations.

Summary Potential Impact Determinations on Resource Areas identified in the original EA for Falcon 9 Landing Operation at LZ-1

SUMMARY OF THE 2014 PROPOSED ACTION

This table is a summary of findings that were presented in the original EA, which is the basis for this current SEA.

The original EA discussed an action that would require clearing approximately 49 acres of vegetation from the land between the LC-13 (LZ-1) operations area to the ditch and then up to the beach dune area. The ditch and the beach dune area would not be cleared. Removed vegetation would be either taken off site to an approved burn or burial area or burnt onsite with appropriate coordination/permissions. Soil relocation and placement is considered to be moderate and may exceed 50,000 cubic yards to support this effort. Removed vegetation may include scrub-jay habitat; therefore a biological assessment was completed, with a subsequent biological opinion from the USFWS.

The Action included constructing an approximately 200 foot by 200 foot square (later changed to round) concrete landing pad at LZ-1. The pad would be designed to support the weight and thrust energy of the Falcon first stage and would comply with all CCAFS and other relevant construction requirements. The main pad would be constructed on previously disturbed land, and it would be surrounded by an approximately 750 foot diameter compressed soil and gravel, flat pervious surface. A concrete pedestal was also placed near-by for the returned stage to be placed on while “safing“ activities are accomplished. Existing power distribution infrastructure which consists of a duct bank that runs from the ICBM road along the LZ-1 entrance road to the former pad support buildings would be refurbished and eventually provide all utilities to the landing pad facility. A Fire extinguishing system would be constructed with three or four remote controlled water cannons mounted on posts above ground to allow for remote firefighting capabilities. An above ground 12,000 gallon water storage tank would be placed on the western site of the LZ-1 area and would be pressurized with nitrogen and provide the water for the fire-fighting equipment. Nitrogen would be supplied to the tank using a mobile trailer. The landing pads would be constructed to control all stormwater runoff from the landing pad. All storm water flowing off the landing pads would be directed to a retention basin or similar infiltration feature according to Federal, State and local storm water run-off regulations.

Falcon first stage would return to LZ-1 at CCAFS for potential reuse rather than splashing down in the Atlantic Ocean. Once the first stage is in position and approaching its landing target, two of the three engines would be shut down to end the boost-back burn. During the boost-back stage a sonic boom occurrence is anticipated. Although propellants would be burned to depletion during flight, there is a potential for approximately 15 gal of LOX and a

maximum of 150 gal of RP-1 to remain in the Falcon first stage upon landing. Final volumes of fuel are included in the FSDP. A small amount of ordnance, such as small explosive bolts and on-board batteries, would also be onboard. The guidance, navigation, and control system of the Falcon vehicle is triplicated such that the system is one-fault tolerant. The system consists of three inertial measurement units, three GPS receivers, three flight computers, and thrust vector control on the first stage.

Land Use Zoning and Visual Resources

The Proposed Action did not convert prime agricultural land, since prime agricultural land does not exist at CCAFS, and was not in conflict with existing uses or values of the project area or other base properties. Activities associated with "re-utilizing" and preparing the land area east of the facility was not contrary to the current land use. Proposed activities would be in conformance with its designated use (for space launch activities) and did not result in significant impacts to land-use zoning. Since the Falcon first stage would land at the site, there may be a short-term visible contrail which would dissipate quickly as wind and air currents affect the trail. Although the visual aspect would be different from a launch and the novelty of a landing event may draw additional attention, the Proposed Action would not generate significant impacts on visual resources. Minimal construction, operation, and landing activities would take place in the designated coastal zone similar to other space operation related activities. Therefore, no impacts to natural shoreline processes and coastal resources would be expected. The Florida Clearinghouse concurred with the no-impact determination.

Noise

Low to moderate levels of noise would be generated by heavy equipment, work vehicles, and other construction equipment during land clearing and construction. Results from the tests and analysis show a 1.5 dBA increase above an assumed baseline ambient noise level of 65dBA would occur approximately 0.5 miles from the rocket landing area, which is not a "noise sensitive area". Data from previous noise studies at SpaceX's Texas facility was used to extrapolate to a 3000 meter altitude approach; that analysis showed a 1.5 dBA increase could occur approximately 1.7 miles from the rocket landing area. The closest sensitive receptor is approximately seven miles away. Therefore, according to FAA 1050.1E (now 1050.1F), a significant noise impact would not occur in a noise sensitive area as a result of the Proposed Action. Based on these determinations, noise effects from landing operations at LZ-1 would be less than other launch actions and would not cause a significant noise impact in sensitive areas, nor would it exceed FAA DNL guidelines.

Launch related sonic boom footprints for the heavy, medium-plus, and medium vehicles have maximum focus boom amplitudes of up to 7.2 psf (for the heavy vehicle) on launch and over the ocean. The carpet boom amplitude diminishes rapidly as the vehicle gains altitude. Most of the boom footprints are below 1 psf at which level no adverse effects would be expected, even over land, from an occasional sonic boom (USAF 1998). At one pound overpressure, no damage to structures would be expected. Overpressures of 1 to 2 pounds are produced by supersonic aircraft flying at normal operating altitudes. Some public reaction could be expected between 1.5 and 2 lb. Rare minor damage may occur with 2 to 5 lb overpressure (NASA, 2014). Recently SpaceX performed a sonic noise study for the Falcon 9 RLV landing at LZ-13, CCAFS that indicated sonic booms may be heard off shore and in areas north and south of the landing pad. The maximum focus boom would be 3psf or less and occur beyond over the ocean 30 miles from the coast. CCAFS and the Daytona Beach area may experience a slight over pressure of up to 1 psf, but generally about 0.4 psf or less. Based on the discussion above, sonic boom effects from landing operations at LC-13 would be less than other launch actions and would not cause a significant noise impact in sensitive areas. Based on the study at that time, sonic boom effects from landing operations at LZ-1 would be less

than other launch actions and would not cause a significant noise impact in sensitive areas or to wildlife.

[NOTE: Since the original EA was published, a later study by the USAF 45 SW found that the actual impact may be greater, but would not cause a significant impact on the human or natural environment. Additionally, actual measurements have been recorded and the current SEA discusses theses aspects in greater detail in Section 4.2.]

Biological Resources

Of the approximate 49 acres requiring clearing, approximately 22.68 acres extends east of the fence line and to the western limits of the onsite ditch. Once vegetation was removed from this area using heavy machinery, much of it was graded using large, heavy tracked bull dozers. Material was either be removed to a suitable off-site area, or burned on location in accordance with USAF regulations as schedule and burn conditions permit. The grading of this area was required. The beach dune area, which is a part of the approximate 48.8 acres extends from the crown of the dune west between 20 feet and 100 feet to a predominately palmetto scrub area. Beach mice typically inhabit the primary and secondary dunes in association with sea oats (*Uniola paniculata*) and other seed producing plants. These dunes, which are comprised of low grassy vegetation and some large patches of sea grapes (*Coccoloba uvifera*) is generally one to two feet tall and covers approximately 5 acres. All of this area, especially at the crown would remain as is. Conversion of vegetative community from scrub to open grass area, and loss of habitat and native vegetation was compensated through the restoration of overgrown scrub-jay habitat located elsewhere (LMU 33) on CCAFS and is addressed in detail in the EA. All vegetation between the ditch or canal and the beach dune area was cleared using wheeled cut and grubbing equipment and in some sensitive areas near the beach dune, by hand. The area was be over-seeded with sea oats or similar grasses which provides opportunity for restoration and future habitat for vegetation and wildlife and would not cause significant impact. Moderate level of noise generated from construction activities was anticipated to act as a warning mechanism for wildlife within the construction site, and helped minimize impacts to animals inhabiting land affected by the Proposed Action.

Mammals

Potential noise related impacts to mammalian species during construction activities may have included disruption of normal activities due to noise and ground disturbances. These impacts were minor and short-term and therefore were not anticipated to cause significant impact to mammalian populations within the vicinity of the project area.

Reptiles and Amphibians

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would potentially cause short-term disturbance to amphibians and reptiles. These impacts were considered short-term and would not cause a significant impact to reptilian and amphibian populations within the vicinity of the project area (USAF 2010). Less than significant impact would occur to migratory birds. The USAF prepared a Biological Assessment (BA) and submitted it to the USFWS in accordance with section 7 consultation. The USFWS issued a subsequent Biological Opinion (BO) stating that the Proposed Action was not likely to jeopardize the continued existence of any Federally listed species. In its BO, the USFWS listed terms and conditions for which USAF complied with. During informal discussions between the USAF and NMFS in January, 2014 about RLV landing events of the Falcon vehicle at CCAFS, the USAF received concurrence from NMFS (both protected species and essential fish habitat) that further consultation for this action is not required from their offices. They concurred that this [action] is a "no effect" for species under their jurisdiction.

Historical and Cultural Resources

During an archeological phase I survey and historical survey accomplished by the 45th SW at the site, while the CRM found three potential archeological sites, all three sites were determined to be ineligible for listing on the HRHP and would not be impacted as discussed in the Florida SHPO letter that was provided. Consequently, no impacts to historic or archeological resources were expected as a result of the Proposed Action.

Air Quality

Temporary increases in local vehicle use and other light/heavy duty construction and land clearing related equipment would be insignificant and would not adversely impact the existing NAAQS standards for CCAFS and the surrounding area. Installation of one small diesel driven electrical generator that would only operate once a month during landing operations would not affect existing NAAQS. Air emissions from launches and landings result in emissions associated with combustion of fuel during takeoff and landing. Emissions were estimated for carbon dioxide (CO2), CO, hydrogen (H2), and water (H2O). Emissions data for NOx, VOCs, and PM for the Merlin engine are nonexistent or very minor; the very efficient combustion conditions that occur during engine operation would tend to minimize the formation of these pollutants. Accordingly, emissions of NOx, VOC, and PM are expected to be minimal. Atmospheric impacts from catastrophic failures would depend on the frequency of such failures. All reasonable and feasible measures would be taken by SpaceX personnel to minimize landing related failures. To minimize the risk of failures, SpaceX would fully comply with the safety requirements set forth in internal and AF regulation. Therefore, landing failures would not be expected to result in significant air quality impacts. (FAA, 2011)

The CAA does not list rocket engine combustion emissions as ODSs, and therefore rocket engine combustion emissions are not subject to limitations on production or use. While not regulated, rocket engine combustion is known to produce gases and particles that reduce stratospheric ozone concentrations locally and globally (WMO, 1991). Launch emissions are considered mobile source emissions and are not required to obtain air permits. Air permits are not required for emissions from the actual landing, as these are mobile sources and are temporary in nature, and therefore not considered to be "significant" or major emissions, neither for criteria nor HAPs pollutants. All of the types of emissions described for the Proposed Action are exempt from air permitting requirements at CCAFS pursuant to FAC Rule 62-210.300(3)(a), Categorical Exemptions.

Most CO emitted by the liquid fuel engines is oxidized to CO2 during afterburning in the exhaust plume. Thus, CO2, a GHG, is the primary emission from the actual landing vehicle. The amount of CO released by the re-landing would be between 60 and 88 percent less than a Falcon 9 launch, since only up to three engines would be re-lit,. This amount is not enough to result in an exceedance of the NAAQS for CO and represents less than 0.02 percent of Brevard Counties CO emissions for 2008 (USEPA Air Emission sources). Brevard County and CCAFS is in attainment, and therefore the General Conformity Rule does not apply. In conclusion, the operational impacts from the Proposed Action on air quality would not be significant. Locally, landing a Falcon first stage using one engine would not increase yearly levels of GHG at CCAFS.

Climate

Climate change was not addressed as a "stand-a-lone" area in the original EA, however aspects of GHG production and impact was discussed within the Air Section. GHG production would not constitute a significant impact.

Hazardous Materials and Waste

Since all applicable Federal, State, county, and USAF rules and regulations continued to be followed for the proper storage, handling, and usage of hazardous materials under the Falcon Launch Vehicle Program, less than significant impacts for hazardous materials management should occur under the Proposed Action. Typically designed "launch deluge water" wastewater is not used by the Proposed Action, a deluge system was not needed nor installed.

Construction activities associated with the Proposed Action generate small quantities of hazardous materials or wastes. All waste generated by the construction contractor was managed in accordance with all Federal, State, local and Installation regulations and directives. Since demolition is not included in this Proposed Action, asbestos and lead-based paint waste was not a consideration. Management of hazardous materials is completed in accordance with 40 CFR 260-279. The Proposed Action does not include buildings; any required equipment or cleaning material would be portable and self-contained. The Proposed Action would therefore not have a significant impact from hazardous materials/hazardous waste management. Control Implementation Plan (LUCIP) which states that prior to any intrusive work; the USAF IRP department must be notified.

Since groundwater contamination exists at the site, any planned construction that would involve contact/digging to groundwater must be coordinated with the IRP office. Since groundwater contamination begins at approximately 18 feet bls, any planned construction did affect the existing groundwater plume. All groundwater monitoring wells around the facility would need to be either protected from damage, or be properly abandoned and replaced so that required quarterly and annual sampling may continue. Any disturbance of soil was coordinated with the IRP office. The Proposed Action would therefore not have a significant impact on the CCAFS IRP program.

Water Resources

Under the Proposed Action, a typical deluge water system is not used, therefore there would not be no wastewater generated by the landing of a Falcon vehicle. A stormwater management system was required for the impervious surface construction at the landing site. The design was developed and an Environmental Resource Permit (ERP) was reviewed and approved by the SJRWMD prior to construction. Any stormwater run-off during construction is managed according to a Stormwater Pollution Prevention Plan (SWPPP) approved by the SJRWMD. Potential impact to surface waters of the Banana River Lagoon or the Atlantic Ocean of a failed landing from spilled fuel, if not consumed by combustion, would be relatively minor and would be much less that a similar event from fully fueled vehicles during normal launches.

Any other waste water would be processed through the existing wastewater collection and treatment systems at CCAFS and would have a negligible impact on system capacity and would not impact surface or groundwater resources. There would be no impact to local and regional water demand would since there would be no substantial increase in use of the potable water supply.

Based on the expected adverse impacts on one of the natural and beneficial floodplain values (i.e., wildlife), the FAA determined the Proposed Action would result in a floodplain encroachment per DOT Order 5650.2. The USAF formally consulted with the USFWS per Section 7 of the Endangered Species Act to minimize potential impacts on Federally protected species. No significant impacts on water resources (including floodplains) are expected. It should be noted for comparison, the 100-year floodplain is also located within the boundary of the following LC's: LC-

11, 12, 14, 36A, 36B, and most of LC-46, as discussed in the reactivation and reuse EA (USAF 2005). The required site plan affords no other practicable alternative that would meet the requirements of the project.

Geology and Soils

Soil in the currently vegetated areas to the east was not impacted by contamination. Prior to and during construction, erosion and sediment control measures such as siltation fences (Best Management Practices) were required and were used to retain sediment on-site and to prevent violations of state water quality standards. There are no unique geologic features in the project area. The Proposed Action would therefore not have a significant impact on geology and soils at LC-13.

Transportation

Minor short-term interruptions to traffic flow or utilities may have, but did not occur during clearing and construction activities. Since landing operations may occur approximately 12 times a year or less, on-base traffic near LZ-1 would not change appreciably. While difficult to calculate, there may be a slight positive impact on traffic since the re-landed vehicle would be transported to a local SpaceX facility, rather than transporting a new Falcon first stage vehicle from Texas to CCAFS. Recovery vessels would also not be required to transit the Port of Canaveral area to retrieve the first stage from the ocean.

Overall launch viewing traffic per year has declined significantly since the Shuttle program was terminated in 2011. Traffic volume has increased for a Falcon launch but has been less than that of a Shuttle launch. There may be a slight increase in viewing traffic for the landing since it would be a novelty. Any increased visitation would cause less than a significant impact on CCAFS and local traffic patterns. The Proposed Action at LC-13 would therefore not have a significant impact on transportation.

Utilities

There would be no utility requirement for the clearing and construction phase. Landing operations would require a minimum amount of potable water, sewer, and electrical power. The Proposed Action's reliance on the water supply would be relatively small; a pressurized 12,000 gallon tanks would be filled via the fire-main system and used to supply water cannon nozzles in the event of a fire. The Proposed Action would therefore not have a significant impact on CCAFS's water supply. The electrical power capabilities for operation at LZ-1 had been designed to support the Atlas launch program. If needed, electrical demand for construction activities would be satisfied by a small propane driven electrical generator. Electrical needs during a landing event would be minimal and would include lights, small pumps, communications equipment and site cameras. Therefore the Proposed Action would not have a significant impact on electrical power demand or supply.

Health and Safety

The operation and management of the landing is managed similar to other vehicle launches; however, the returning first stage vehicle would contain substantially less propellant (RP-1 and LOX) than when it was launched. Expected thrust energies would only be approximately 11 percent of a launch vehicle since only one engine would be firing. The RLV would not contain any second stage material or propellant or payload; clear areas and stand–off distances at sea and at CCAFS would be developed in conjunction with Range Safety and adhered to; any anomalies in a the landing event plan would cause a destruct signal to the vehicle to occur over the ocean. Additionally, as part of the

FAA license application review process, the FAA conducted a safety review of operations.

Payload processing equipment and procedures would not be required. However some remaining ordnance items and propellants require an Explosive Quantity-Distance Site Plan. Hazardous materials such as propellant, ordnance, or chemicals are transported back to a processing facility at CCAFS in accordance with DOT regulations for transport of hazardous substances (Title 49 CFR 100- 199). Hazardous materials such as liquid rocket propellant are transported in specially designed containers to reduce the potential of a mishap should an accident occur. Injuries would not be anticipated if facility personnel follow standard operating and emergency procedures. Therefore landing events would not result in a significant impact to health and safety.

Socioeconomics

During a short but intense period for clearing and construction activities at LZ-1, SpaceX would use their current workforce, but also hired up to 50 additional temporary workers and other local consultants. The addition of these workers at CCAFS does not represent a significant increase in the population or growth rate of the region which was 543,376 people recorded during the 2010 census. During landing operational periods and long-term operations, SpaceX would continue to use their current internal work force. The Proposed Action would not significantly affect the local housing market and would not negatively affect the local economy. Therefore, the Proposed Action would generate no negative socioeconomic impacts on the region and may generate a negligible positive impact due to increased jobs and tourism.

Environmental Justice

The landing of the Falcon first stage at LZ-1 occurs within the boundaries of CCAFS and over the Atlantic Ocean similar to current operations of existing launch vehicles. While minority or low income groups exist in areas of Brevard County, environmental impacts generated by the Proposed Action would not disproportionately affect any particular population group, including minority or low-income populations (USAF 2013).

Section 4(f) Property

There are no Section 4(f) properties located within the boundaries of CCAFS. Therefore, there would be no physical use of a Section 4(f) property via permanent use of land, and there would be no temporary occupancy of a Section 4(f) property. When there is no physical use and no temporary occupancy, but there is the possibility of constructive use, the FAA must determine if the impacts would substantially impair[1] the 4(f) property. Section 4(f) properties located within approximately a 15 miles radius of LZ-1 include Merritt Island National Wildlife Refuge, Cape Canaveral National Seashore, Jetty Park, Kelly Park, Kars Park, Kings Park, and Manatee Cove Park. Additionally, the St. John's National Wildlife Refuge and Tosohatchee State Game Preserve are located west of the launch site. Noise levels at these 4(f) properties may increase slightly and temporarily during the landing of the Falcon first stage but, it would only last a few seconds and would only be planned to occur approximately once per month. For decades, the 4(f) properties have been experiencing increased noise levels during launches taking place at CCAFS and adjacent KSC, and sonic boom noises during shuttle landings. Due to the long history of these 4(f) properties experiencing noise from launches at CCAFS and KSC, and because there is only one planned landing per month,

the FAA determined the Proposed Action would not substantially diminish the protected activities, features, or attributes of any of the Section 4(f) properties identified, and thus would not result in substantial impairment of the properties.

4.1 LAND USE ZONING / VISUAL RESOURCES

An impact may be considered significant if the project results in nonconformance with approved land use plans, a decrease in the land's productivity, or an irreconcilable conflict with existing uses or values of the project area or other properties. Proposed changes to visual resources can be assessed in terms of 'visual dominance' and 'visual sensitivity.' Visual dominance describes noticeable physical changes in an area. The magnitude of visual dominance may vary depending on the degree of change in an area. Visual sensitivity is attributed to a particular setting and the desire to maintain the current visual resources in a viewshed. Areas such as coastlines and national parks are usually considered to have high visual sensitivity. When evaluating visual impact, the ability of the general public to view the area where the proposed action or change to the visual resource would occur must also be taken into account.

Proposed Action

The Proposed Action would occur at LZ-1 which has been designated for space launch/landing activities. Operating as a "landing pad" for a launched vehicle would be consistent with both the CCAFS General Plan and its mission. It would also be consistent with past operations at LZ-1. The Proposed Action would not convert prime agricultural land, since prime agricultural land does not exist at CCAFS, and would not conflict with existing uses or values of the project area or other base properties. Activities associated with adding an additional two landing pads and a small Dragon capsule processing building at the facility would not itself be contrary to the current land use. Proposed activities at LZ-1 would be in conformance with its designated use (for space launch/landing activities) and would not result in significant impacts to land-use zoning.

Minimal construction (on approximately 23 acres of newly cleared land), operation, and landing activities at LZ-1 would take place in the designated coastal zone similar to other space operation related activities. Construction and the landing pads and processing building would not be visible to the public. Since two additional Falcon first stages may land at LZ-1, there may be short-term visible contrails which would dissipate quickly as wind and air currents affect the trail. Although the visual aspect would be different from a launch, or from a single landing, and the novelty of a landing event may draw additional attention, the Proposed Action would not generate significant impacts on visual resources. Issuance of a Federal license or permit for an activity in or affecting a coastal zone must be consistent with the CZMA, which is managed by the Florida Department of Community Affairs. CZMA requires Federal agency activities with reasonably foreseeable effects on coastal zones to be consistent with state programs that are approved under Federal coastal management programs. The state agency that implements or coordinates a state's federally approved coastal management program is responsible for Federal consistency reviews. Minimal construction, operation, and landing activities at LZ-1 would take place in the designated coastal zone similar to other space operation related activities. Therefore, no impacts to natural shoreline processes and coastal resources would be expected. A copy of the Draft Final SEA was submitted to the Florida FDEP CLEARINGHOUSE in June 2016 for a consistence review; a copy of their concurrence letter and other agency letters are included in Appendix H.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A, and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be land at LZ-1. Therefore, no additional impacts to approved land use plans or the coastal zone would occur, and there would be no conflict with existing uses or values of the project area or other properties. SpaceX's ability to fully meet the National Space Transportation Policy goals of providing low-cost reliable access to [and from] space would be negatively impacted.

4.2 NOISE

Noise impact criteria are based on land use compatibility guidelines and on factors related to the duration and magnitude of noise level changes. Annoyance effects are the primary consideration for most noise impact assessments on humans. Noise impacts on wildlife are discussed in Section 4.3, Biological Resources. In accordance with FAA Order 1050.1F, a significant noise impact would occur if the action would increase noise by DNL1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dB to 65 dB.

Proposed Action

The Proposed Action would not be expected to have significant noise impacts at or around LZ-1, and would not have significant impact from sonic booms in or around CCAFS and Central Florida. The noise impact data and analyses in the original EA, and those presented in this SEA are used to support these conclusions as summarized below.

Clearing and Construction Noise

There are no sensitive receptors (*e.g.,* schools, hospitals) in the vicinity of LZ-1. Low to moderate levels of noise would be generated by heavy equipment, work vehicles, and other construction equipment during land clearing and construction. The relative isolation of LZ-1 reduces the potential for noise to affect adjacent communities. The closest residential areas to CCAFS are about 7.5 miles to the south, in the cities of Cape Canaveral and Cocoa Beach. Residential areas and resorts along the beach would expect to have low overall noise levels, normally about 45 to 55 dBA. Clearing and construction noise would not be an impact on CCAFS or nearby communities.

Operational Engine Noise

Operational noise during landing events would occur from engine noise and sonic booms generated as the returning boosters descend and land. Noise from operations at the capsule processing building and facility is expected to be minimal. There are no homes within a 7.5 mile radius of LZ-1 where each of the (up to) three Falcon 9 first stage boosters would land.

Noise levels at the launch site are directly correlated to the thrust of the space launch vehicle at lift-off. The thrust for the Falcon 9 is approximately 1.4 million pounds force (Mlbf). As discussed in Section 2, the Falcon Heavy consists of three Falcon 9 first stage boosters. Based on the existing baseline noise levels at CCAFS from current launches, and the modeled launch noise for the Falcon 9, the 2013 SEA (USAF 2013) which concluded that noise levels under

the Falcon 9 launch would not exceed the FAA's noise significance threshold for the closest noise sensitive areas, which are the residential areas of Cape Canaveral approximately 7.5 miles away (USAF 2013).

Each of the (up to) three Falcon returning first stage boosters would land at LZ-1 with one to three Merlin engines operating, or one third of the total thrust energy. Since noise is a function of acoustical energy, the expected noise profile from a landing vehicle at LZ-1 would be less than noise from a launch by a direct proportion, perhaps up to 67% less. The analysis discussed in the original EA remains valid for this SEA, since the same first stage booster vehicles would be landing; but there may be two or three landing within a period of several minutes. A revised summary of the noise methodology study developed for the FAA DNL discussion is included in Appendix C**.** Based on the discussion above and in the 2014 EA, noise effects from landing operations at LZ-1 would be less than launch actions and would not cause a significant noise impact. Antidotal evidence and comments from the general public have not mentioned engine noise as a concern.

For periodic static test firings of the Dragon, the combined total thrust for the Dragon capsule which would be approximately 131,000 lbs of force, or less than 13 percent of the Falcon 9 (Block 1). The noise then is expected to be much less since the total thrust at launch is expected to be approximately 131,200 lbs-f at 100% throttle as noted in the Dragon Pad Abort EA (USAF 2014), and because test firings will be less than 2 seconds.

Sonic Booms

The original EA discussed the occurrence of a possible maximum sonic boom of 3 psf that would occur over the ocean, approximately 30 miles from the coast during a first stage booster landing event, as predicted by an earlier noise study. A copy of SpaceX's sonic noise study, developed by Wyle Labs, for the Falcon 9 RLV landing at LZ-1, CCAFS was included in the 2014 EA. However, since that time the USAF produced an additional sonic boom study; a copy of a summary of that study is included in Appendix B. Figure 4-1 presents the expected sonic boom footprint for a Falcon 9 RLV flying back to LZ-1 from an approximate trajectory of between 040 degrees and 060 degrees. Note that recorded measurements are plotted with an offset of +1.6 miles to the distances, to approximate that the actual boom source is from the offshore vehicle (which the sub-missile position is roughly 1.6 miles NE of LZ-1).

SpaceX has also measured sonic boom events from their recent landing events. The January 17, 2016 Falcon 9 Flight 19/Jason-3 registered a pressure value of 2.3 psf at the droneship for that mission. The acoustics of the droneship were closely analyzed in support of this measurement and there was a high confidence in the results. SpaceX also measured pressure for the sonic boom produced on Flight 25 Thiacomm-8 which landed on the drone ship on May 27, 2016 and registered 2.2 PSF. On December 21, 2015 Falcon9 Flight 21/Orbcomm launched from LC-40 and landed at LZ-1. The value measured at LC-40 was 2.5 psf. Appendix D contains these data, and data from the July 18, 2016 Falcon9 CRS-9 landing.

Overpressures of 1 to 2 psf are produced by supersonic aircraft flying at normal operating altitudes. Some public reaction could be expected between 1.5 and 2 psf. Rare, minor damage may occur with 2 to 5 psf of overpressure (NASA, 2014). Following both the December 2015 and the July 2016 landing at LZ-1, surveys of the area and CCAFS indicated that no evidence of structural damage (broken windows or cracked walls), or biological impacts were identified or found. However, news organizations in the coastal area, and in the central Florida reported that sonic boom noise was heard up to 60 miles away. Figure 4-2 is taken from Appendix B and indicates that sonic

boom events may be heard as far away as 38 miles with certain atmospheric conditions; sonic booms beyond that area would be caused by unusual weather (wind and temperature) condition. According to Air Force modeling, a loud sonic boom could be expected from the current SpaceX Falcon9 flyback design trajectories, peaking at approximately 5-7 PSF in the near-field (on CCAFS property) and reaching dozens of miles beyond with over 0.5 PSF. These peak "modeled" values (5-7 PSF) exceed the historical sonic boom vehicles (Space Shuttle, Concorde, Apollo capsule, etc.; typically below 2 PSF), however as shown in the CRS-9 landing data in Appendix C, the highest value actually measured was only 5.48 at LZ-1 during the July 18, 2016 landing event. At a distance of 10.13 miles the measurement was 1.45 PSF, which is less than the generally accepted potential damage threshold of about 2 psf.

With up to three first stage boosters returning, the same sonic boom effects would be expected, but would occur once for each returning stage, several seconds apart. Two sonic boom events may occur for each returning stage, for a total of up to six for the returning three booster stages may be generated. In situations where multiple launch vehicles are returning to CCAFS simultaneously (e.g. the Falcon Heavy side boosters returning to CCAFS) it is possible that the pressure waves from the two (or three) vehicles could interact and cause localized regions of increased sonic boom overpressures, down track. These local interactions would change the signature of the pressure waves in small regions on the ground affected by the coalesced waves; however, those small areas are not expected to significantly increase the overpressure magnitudes. Elsewhere, a dual, or triple-vehicle fly back would result in similar overpressure signatures and magnitudes to that of a single vehicle re-entry but with two sets of booms - one set for each vehicle (e.g. 6 sonic booms would possibly be audible when the Falcon Heavy side boosters return: 2 for each booster).

Mitigation and Best Management Practices

Following the two recent landing events, it appears that the largest impact would be associated with potential sonic booms; not with the intensity, but with the unexpected suddenness of the event. As mentioned before there is no evidence that the over pressures of up to 5.48 PSF at CCAFS (CRS-9 landing July 18, 2016) caused any structural or biological damage or impact. However the noise caused by the over pressures between that value and 1.45 at 10 miles, and possibly 0.5 PSF at 60 miles startled a large number of people. Therefore, SpaceX has developed a notification plan to educate the public, and announce when a landing event would take place. The plan would involve issuing statements to news outlets and law enforcement so that if and when heard, the public would understand what has occurred. It should be noted that many in the central Florida area mentioned that the recent sonic booms reminded them of the times when the shuttle returned to the KSC area, which they mentioned was a good sound and a good sign. While the overall impact of sonic booms is less than significant, implementing these BMPs and mitigation plans would help to reduce the impact of a sonic boom event even further.

No Action Alternative

Under the No Action Alternative the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A, and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages, would be able to land at LZ-1. Therefore no additional impacts from construction or operational noise would occur.

4.3 BIOLOGICAL RESOURCES

An impact to biological resources may be considered significant if the USFWS or the NMFS determines that the action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species, or would result in the destruction or adverse modification of federally designated critical habitat. Also, a biological resource impact may be considered significant if the action would substantially diminish a regionally or locally important plant or animal species, interfere substantially with wildlife movement or reproductive behavior, and/or result in a substantial infusion of exotic plant or animal species.

Any federal action that may affect federally listed species or designated critical habitat requires consultation with the USFWS under Section 7 of the ESA of 1973 (as amended). Also, the Marine Mammal Protection Act of 1972 prohibits the taking of marine mammals, including harassing them, and may require consultation with the NMFS. The NMFS is also responsible for evaluating potential impacts to Essential Fish Habitat (EFH) and enforcing the provisions of the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (50 CFR 600.905 et seq.).

4.3.1 Vegetation

Construction

The Proposed Action would result in the clearing of approximately 21 acres of vegetation (and roller-chopping two acres) for a total of 23 acres. Construction activities would necessitate the clearing of both native and invasive vegetation. The cleared acreage is needed for the two landing pads, associated tractor pathways, and storm water management systems. The additional two acres is required based on vehicle navigation radar fidelity needs. The Proposed Action would clear and remove all vegetation located in the north landing area and the south landing area of the existing LZ-1 complex. Vegetation within the ditch (located on the northern side of the north pad) would not be removed; vegetation east of the ditch would be roller-chopped. Since some of the 21 acres of vegetation planned to be removed is invasive species, clearing and building landing pads, roads, and storm water retention areas would include a potential minor beneficial effect to native vegetation in the area that competes with the invasive species.

Once vegetation is removed from the 21 acres using heavy machinery, much of the land would be graded using large, heavy tracked bull dozers. Material would either be removed to a suitable off-site area, or burned on location in accordance with USAF regulations as schedule and burn conditions permit. The grading of this area would be required.

Conversion of vegetative community from scrub (scrub-jay habitat) to open grass area, and loss of habitat and native vegetation would be compensated through the restoration of overgrown scrub-jay habitat located elsewhere on CCAFS. This is addressed in section 4.3.3 below. All vegetation east of the ditch (approximately 2 acres) would be cleared using wheeled cut and grubbing equipment, and would not cause a significant impact. Land within the 21 acres of cleared land that would not be part of the concrete landing pad or apron would be sodded or seeded and designed to be used for storm water management. Overall, construction would not result in significant impacts on vegetation.

Landing Operations

Operational impacts to habitats and vegetation in the vicinity of other launch pads on KSC and CCAFS have been well documented. These impacts include outright destruction of plants in the path of exhaust plumes followed by regrowth during the same growing season, and damage to leaves. But mortality of plants or changes in community composition have not been documented. Occasionally, brush fires occur immediately after a launch, but these are quickly contained and confined to ruderal vegetation that recovers rapidly (NASA 2013). Impacts from landings are expected to be much less than launch events since the thrusts and energies (heat) are much less, and cleared area around each pad is sufficiently large enough that any heat is dissipated quickly. Following the Falcon 9 first stage landing on December 21, 2015, and on July 18, 2016 there was no apparent impacts to surrounding vegetation.

4.3.2 Wildlife and Migratory Birds

Construction

Clearing and construction activities would occur over a relatively short period of time. As noted above, approximately 21 acres of vegetation (habitat) would be removed.

Wildlife present in the area could also be affected by construction noise. Wildlife response to noise can be physiological or behavioral. Physiological responses can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Behavioral responses to man-made noise include attraction, tolerance, and aversion. Each has the potential for negative and positive effects, which vary among species and among individuals of a particular species due to temperament, sex, age, and prior experience with noise. In addition to construction related noise impact, clearing would eliminate potential habitat for wildlife. It is anticipated that the moderate level of noise generated from construction activities would act as a warning mechanism for wildlife within the construction site, and should help minimize impacts to animals inhabiting land affected by the Proposed Action.

Mammals

Potential noise related impacts to mammalian species during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be minor and short-term and, therefore, would not cause significant impact to mammalian populations within the vicinity of the project area.

Reptiles and Amphibians

Reptile and amphibian hearing is poorly studied. However, reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would potentially cause short-term disturbance to amphibians and reptiles. These impacts would be short-term and would not cause a significant impact to reptilian and amphibian populations within the vicinity of the project area (USAF 2014).

Migratory Birds

Potential impacts to birds resulting from construction and human generated noise include disruption in foraging, roosting, and courtship activities. If construction was scheduled to occur during the avian breeding season,

construction would occur in accordance with the MBTA to avoid impacts to nesting migratory birds. Biological surveys would occur prior to commencing construction and bird nests would be marked. In compliance with the MBTA, construction workers would not directly or indirectly disturb the nest or adjacent areas until a biologist determines the nest is no longer in use. Any impacts to migratory birds would be short-term and only affect individuals at or near the construction site; thus, construction would not cause a significant impact to migratory bird populations. Monitoring during construction activities would identify any potential disturbances of nests so measures could be implemented to avoid adverse effects.

Landing Operations

Landing operations would not be expected to significantly impact biological resources around LZ-1, including terrestrial wildlife, marine species, and protected species. The Proposed Action would begin when the Falcon first stage boosters separate from the second stage and begin their descent and "fly-back" to LZ-1 for landing. Rather than launching with a full load of fuel and payload, and the energy and engine noise that accompanies the thrust of nine Merlin engines per booster stage, the returning vehicles would descend with less weight, less fuel, no payload, and with up to 33 percent of total thrust energy and therefore much less noise energy.

The ROI for the final phase of the actual landing events occurs in and is defined by as the vehicles cross the ocean and beach at LZ-1 for landing, or land on the droneship in the open ocean. The impact of landing on a droneship would be less than significant. Noise from launches and sonic booms was identified as a potential concern for wildlife during the NEPA documentation process for the Space Shuttle Program, however, no impacts were observed by NASA. Even the maximum number of launches anticipated in the Proposed Action [for the Falcon Heavy or similar vehicle] (24 per year from both pads) would result in only interrupting normal behavior twice per month. Most operational impacts are anticipated to be from noise and vibration and the very low potential to sea turtles and marine mammals from potential orbital and reentry debris. Operations of facilities would not have impacts, but the potential consequences from orbital and reentry debris after launch would be slight and it is highly unlikely that a right whale would be directly hit by debris (NASA 2013). Wildlife in the ROI would be exposed to noise generated by the engines of each returning stage and sonic booms generated during vehicle descent. While Figure 4-1 shows the anticipated area of noise impact, a later study performed by USAF 45 SW SELR predicted a sonic boom event during landing of between 3 and 5 psf on CCAFS property, and between 2 and 3 psf outside CCAFS property.

SpaceX took pressure measurements for Falcon 9 Flight 19 on the west coast, and measured a pressure value of 2.3 psf at the droneship for that mission. The acoustics of the droneship were closely analyzed in support of this measurement and there was a high confidence in the results. SpaceX also measured pressure for the sonic boom produced on Flight 21/Orbcomm; which launched from LC-40 and landed at LZ-1. The value measured at LC-40 was 2.5 psf. Sonic booms would be heard over land and are expected to be minor in magnitude (less than 2.8 psf). SpaceX and USAF noted that after the landing in December, and the landing in July 2016, no windows were reported to have been broken. Wild animals exposed to sudden intense noise can panic and injure themselves or their young; however, this is usually the result of the noise in association with the appearance of something perceived by the animals as a pursuit threat, such as a low-flying aircraft. RLV noise is not expected to cause more than a temporary startle-response because a "pursuit threat" would not actually be present. Any loss or injury as a result of this startle response would be incidental and not a population-wide effect. No animal mortality or significant impact on wildlife

habitat has been documented during previous launches at CCAFS, including launches of the Falcon 9, Atlas, Titan, and Delta (USAF 2013).

The effects of a sonic boom on whales or other open ocean species are not known. However the marine species in the ocean's surface waters are present in low densities. While spring and fall northern right whales migration would see periodic groups of migrating whales that follow the coastline and rarely are more than 5 miles off shore; the sonic boom footprint lies over 30 miles from CCAFS. Because these sonic booms are infrequent the sonic booms associated with landings are not expected to negatively affect the survival of any marine species (USAF 2014). The maximum Pmax anticipated over 200 miles from the coast would only be between two and three psf; therefore the effect on ocean species is expected to be less than a normal launch and therefore not significant.

4.3.3 Threatened and Endangered (T&E) Species of Concern

Federal and state threatened and endangered wildlife species that occur or have the potential to occur within the project ROI are shown below in Table 4-1. Potential project related impacts to these species are also listed in this table and are further discussed below. Construction activities have the potential to result in the take of some special status wildlife species from activities such as disturbance, excavation, crushing or burial. The USAF prepared a BA and submitted it to the USFWS in accordance with ESA section 7 consultations. The USAF determined that the proposed project "may affect and is likely to adversely affect" the Florida scrub-jay and eastern indigo snake. The USFWS concurred with that determination. The USAF also determined that the proposed project "may affect, but is not likely to adversely affect" the loggerhead, green, leatherback, hawksbill, and Kemp's Ridley sea turtles; the American alligator; the red knot, and the piping plover. The USFWS concurred with this determination. The USFWS issued an amended BO dated February 12, 2016 stating that the Proposed Action is not likely to jeopardize the continued existence of any federally listed species. Therefore, the Proposed Action would not result in significant impacts on threatened and endangered species. In its BO, the USFWS listed terms and conditions for which USAF must comply. APPENDIX D contains a copy of the BO, and a copy of the BA.

Table 4-1 Potential Impacts to Federal and State Protected Wildlife Species that Occur or Have Potential to Occur within the ROI

Common Name *Scientific Name*	**Status**		**Occurrence**	**Potential Impacts**
	USFWS (Federal)	**FWC (State)**		
American Alligator [2] *Alligator mississippiensis*	T[1]	T[1]	Documented	Disruption due to noise
American Wood Stork *Mycteria americana*	T	T	Potential	Loss of breeding habitat. Disruption due to noise.
Eastern Indigo Snake *Drymarchon corais couperi*	T	T	Potential	Crushing by equipment Loss of habitat Disruption due to noise
Florida Mouse *Podomys floridanus*	----	SSC[3]	Potential	Crushing by equipment Loss of habitat

				Disruption due to noise
Florida Pine Snake *Pituophis melanoleucus mugitus*	----	SSC	Potential	Crushing by equipment Loss of habitat Disruption due to noise
Florida Scrub-Jay *Aphelocoma coerulescens*	T	T	Documented	Loss of potential habitat Disruption due to noise
Gopher Tortoise *Gopherus polyphemus*	----	T	Documented	Crushing by equipment Disruption due to noise
Gopher frog *Lithobates capito*	----	SSC	Potential	Crushing by equipment Loss of habitat Disruption due to noise
Green Sea Turtle *Chelonia mydas*	T	E[4]	Documented	Disruption and disorientation of nesting and hatching turtles due to light
Hawksbill Sea Turtle *Eretmochelys imbricata*	E	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light
Kemp's Ridley Sea Turtle *Lepidochelys kempii*	E	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light
Leatherback Sea Turtle *Dermochelys coriacea*	E	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light
Loggerhead Sea Turtle *Caretta Caretta*	T	T	Documented	Disruption and disorientation of nesting and hatching turtles due to light
Northern Right Whale *Eubalaena glacialis*	E	E	Documented	Disruption of breeding habitat
Piping Plover *Charadrius melodus*	T	T	Potential	Loss of breeding habitat. Disruption due to noise.
Red Knot *Calidris canutus*	T	----	Potential	Loss of breeding habitat. Disruption due to noise.
Southeastern Beach Mouse *Peromyscus polionotus niveiventris*	T	T	unlikely	Crushing by equipment
West Indian Manatee *Trichechus manatus*	T	SSC	Documented	Collisions with boating or barge traffic in Port of Canaveral area.

[1] T – Threatened [3] SSC – Species of Special Concern [4] Endangered

[2] The American Alligator is protected due to its similarity of appearance to the American Crocodile

During informal discussions between the USAF and NMFS in January, 2014 about RLV landing events of the Falcon vehicle at CCAFS, the USAF received concurrence from NMFS (regarding protected species and essential fish habitat) that further consultation for this action is not required from their offices. They concurred that this [action]

would have "no effect" on federally listed species under their jurisdiction. Since the Proposed Action is essentially the same with respect to species under NMFS jurisdiction, the USAF determined the Proposed Action would have no effect on federally listed species under NMFS jurisdiction. Similarly, the Proposed Action would have no effect on essential fish habitat.

4.3.3.1 Florida Scrub-Jay

Direct Effect

The federally threatened Florida scrub-jay inhabits areas north of the Proposed Action site and its vicinity. Construction activities would result in the direct permanent loss of approximately 23 acres of scrub-jay habitat. A take may occur as the result of loss of habitat. The probability and level of incidental take is dependent upon the number of Florida scrub-jays within the region; their ability to disperse; and the amount and distribution of available suitable habitat. It is possible that as construction proceeds, they would move away from the construction site; however, USFWS anticipates that a "take" would occur, but the taking would not jeopardize the continued existence of the species.

Indirect Effect

Indirect effects are caused by or result from the Proposed Action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. Indirect effects to Florida scrub-jays would occur in two ways: (1) operation of LZ-1 would add activity adjacent to occupied habitat, possibly resulting in scrub-jays being struck by vehicles and (2) proposed habitat restoration and management activities are expected to enhance scrub-jay dispersal when complete. Dreschel *et al*. (1990), Fitzpatrick *et al*. (1991), and Mumme *et al.* (2000) referenced within the BO provide the best scientific and commercial data on the likelihood of incidental take as the result of scrub-jays being killed by vehicles. The only scientific documentation of road-kill mortality in Florida scrub-jays are from scrub-jays living in a territory immediately adjacent to a road, not from dispersing some unknown distance across a road to a new territory.

Mitigation Measures

Mitigation for direct and indirect impacts to the scrub-jay would help lessen or compensate for impacts caused by the Proposed Action. Clearing would be restricted to outside nesting season; therefore, mortality associated with actual clearing activities is not expected to occur. Approximately 46 acres of potential scrub-jay and eastern indigo snake habitat at CCAFS would be restored over a five-year period. In accordance with the ESA, the USFWS issued a BO for this Proposed Action in February 2016, which included an "Incidental Take Statement". Reasonable and prudent measures and terms and conditions are listed in the BO (see Appendix D). The USAF must comply with these measures. Additionally, the ability for prescribed fire to be applied as a means to manage scrub-jay habitat was considered by the USAF during this SEA. The Proposed Action would not hinder the ability of land managers to apply prescribed fire, therefore would not have indirect effects on Florida scrub-jays by reducing habitat quality.

The USAF proposes to restore unoccupied scrub-jay habitat at a ratio of 2:1 (every acre lost would require compensation in the amount of two acres). The proposed areas to be restored would be located in Land Management Unit (LMU 33). A combination of mechanical treatment and prescribed burning would be used to restore habitat. In addition to the creation of habitat, CCAFS would avoid construction in scrub-jay occupied areas

during the nesting season from March 1 through June 30; ensure that, prior to clearing of scrub-jay habitat, there is suitable habitat within 1200 feet; that the USFWS would be notified of any unauthorized taking of scrub-jays identified during construction; and that CCAFS would conduct routine scrub-jay monitoring and submit reports describing the actions taken to implement the terms and conditions outlined in the BO. Appendix D contains an overview of where both clearing and restoration activities would take place.

If a dead scrub-jay is found at the project site, it would be salvaged in accordance with proper protocols and the USFWS would be notified.

4.3.3.2 Southeastern Beach Mouse

Since the area being cleared is not beach mouse habitat, the Proposed Action would have no effect on the southeastern beach mouse.

4.3.3.3 Eastern Indigo Snake

Direct Effect

Clearing and construction activities have the potential to result in incidental take of some individuals of eastern indigo snake from disturbance and possible mortality during project activities. A take may occur as the result of this habitat loss, although adjacent habitat is available. Eastern indigo snakes would also be vulnerable to mortality as a result of injuries sustained during activities such as vegetation clearing and grading.

The probability and level of incidental take is dependent upon the number of eastern indigo snakes within the region; their ability to disperse; and the amount and distribution of available suitable habitat. It is possible that as construction proceeds, they would move away from the construction site; however, the USFWS anticipates that "take" would occur. Incidental take in the form of mortality to eastern indigo snakes would be avoided or minimized through preconstruction surveys and relocation of any individuals present within the boundaries of the work area. Prior to any land disturbance activities, a survey would be required to identify locations of gopher tortoise burrows within the project area. This survey would include a burrow count and habitat characterization and would be conducted in accordance with FWC guidelines. Any eastern indigo snakes encountered during gopher tortoise burrow excavation would be safely relocated outside the project area. The USFWS determined the Proposed Action would not jeopardize the continued existence of the species. Therefore, the Proposed Action would not result in significant impacts on the eastern indigo snake.

Indirect Effect

It is expected that indirect effects could occur from increased traffic at LZ-1 due to the operation of the landing pad adjacent to occupied habitat, possibly resulting in indigo snakes being struck by vehicles. Since a portion of their suitable habitat would be impacted by the Proposed Action, indigo snakes could be run over by vehicles as they disperse and cross roads.

Mitigation Measures

Mitigation for direct and indirect impacts to the eastern indigo snake would help lessen or compensate for impacts caused by the Proposed Action. Generally, those mitigation measures include the following:

The 45 SW Indigo Snake Protection/Education Plan would be presented to the project manager, construction manager and personnel. An educational sign would be displayed at the site informing personnel of the snake's appearance, its protected status, and who to contact if any are spotted in the area. If any indigo snakes are encountered during clearing activities, they would be allowed to safely leave the area on their own. Furthermore, any indigo snakes encountered during gopher tortoise burrow excavation, if required, would be safely moved out of the project area to areas approved by the USFWS. An eastern indigo snake monitoring report would be submitted in the event that any indigo snakes are observed. If a dead indigo is found at the project site, it would be salvaged in accordance with proper protocols and the USFWS would be notified. Approximately 46 acres of potential scrub-jay and eastern indigo snake habitat at CCAFS would be restored over a five-year period. Only individuals with permits would attempt to capture the eastern indigo snakes. If an indigo snake is held in captivity, it would be released as soon as possible in release sites approved by the USFWS on the CCAFS.

4.3.3.4 Marine Turtles

Direct Effect

The proposed clearing and construction of new facilities would not be expected to impact the beach where sea turtles nest. However, the additional exterior lighting proposed for the new facilities has the potential to be visible from the beach. Disorientation of adult or hatchling sea turtles could result in a take on the beach. Lighting visible from the beach can cause adult and hatchling sea turtles to move landward, rather than seaward, which increases the chances of mortality. The USFWS concurred with the USAF's "may affect" determination for the loggerhead, green, leatherback, hawksbill, and Kemps Ridley sea turtles provided a USFWS-approved Light Management Plan is prepared for operations at LZ-1. The USFWS anticipates that there may be an additional "take", but it would not appreciably add to past takes and would not exceed the 3% threshold established for nesting and hatchling sea turtles under the 2008 BO. They therefore have established that take threshold for this project. The USFWS determined the Proposed Action would not jeopardize the continued existence federally listed sea turtles. Therefore, the Proposed Action would not result in significant impacts on the loggerhead, green, leatherback, hawksbill, and Kemps Ridley sea turtles.

Indirect Effect

No indirect effects on sea turtles are expected.

Mitigation Measures

To prevent or minimize impacts to sea turtles from new or temporary facility lighting, all exterior lighting proposed for this project would be in accordance with the 45th SW Instruction 32-7001, *Exterior Lighting Management* dated January 25, 2008. Additionally, a Light Management Plan would be required for the new facilities. Adherence to"*45th SW Instruction 32-7001, Exterior Lighting Management*" would reduce the potential for disorientation to occur. Strict adherence to the plan would be monitored to ensure disorientation is kept to a minimum. This Plan would be

approved by the USAF and USFWS prior to any facility construction. Clearing of vegetation at the LZ-1 area would not have an impact to nesting or hatchling sea turtles; therefore, no mitigation is required for those activities.

4.3.3.5 Gopher Tortoise

Direct Effect

A tortoise survey in 2015 indicated that there were 10 burrows in the area, one in the north area and nine in the south area. Although the proposed clearing and construction of new facilities would eliminate current burrows, another tortoise burrow survey, and tortoise trapping and burrow excavation process would occur. Construction activities have the potential to cause harm to gopher tortoises during ground clearance, grading, and moving equipment. The proposed clearing would result in the loss of approximately 23 acres of potential gopher tortoise habitat.

Mitigation Measures

To minimize impacts to gopher tortoises, pre-construction surveys would be implemented per FWC guidelines, 90 days or less prior to construction, to locate tortoises within the project area; the FWC would be notified. Tortoises found during pre-construction surveys and trappings or burrow excavations, would be relocated to nearby viable habitat within CCAFS areas. The tortoise surveys would include a burrow count and habitat characterization and would be conducted in accordance with FWC guidelines. A monitoring report would be submitted in the event that any gopher tortoises are relocated. If a dead gopher tortoise is found at the project site, it would be salvaged in accordance with proper protocols and notification would be made to the FWC. Gopher tortoises would be relocated in accordance with Gopher Tortoise Relocation Permit WR04151c.

4.3.3.6 American Alligator

Proposed Action

Construction and land clearing activities near the man-made ditch/canal east of the northern landing area have the potential to cause harm to the alligator. The proposed clearing would result in the potential harassment of alligators; no loss of habitat is expected. The USFWS concurred with the USAF's "may affect, not likely to adversely affect" determination. Therefore, the Proposed Action would not result in significant impacts on the American alligator.

Mitigation Measures

Mitigation measures for potential impacts on alligators are not proposed. However, construction personnel would be alerted to the potential of alligator presence.

4.3.3.7 Piping Plover and the Red Knot

Construction activities would not come within 500 feet of coast and beach areas, so there would be no effect to the piping plover or red knot habitat. Noise associated with landings may startle many species within the CCAFS area. Actual noise impact to wildlife is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, the Atlas, Titan, and Delta launches have been documented to not cause any animal mortality or significant impact to wildlife on CCAFS (USAF 1998).

Direct Effect

Direct effects are expected to occur in the form of noise related to the landing operation. It is expected that these effects may elicit a, "startle" response. However, these effects are predicted to be very short in duration and are not expected to cause lasting negative consequences.

Indirect Effect

No indirect effects are expected.

Mitigation Measures

No habitat is expected to be impacted as a result of the proposed action. Noise effects would be minimal and only cause a "startle" effect. Due to these factors, mitigation would not be required.

No Action Alternative

Under the No Action Alternative, land and vegetation clearing would not occur and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land on or near LZ-1. The Dragon capsule facility would not be built. Therefore, there would be no additional impacts to biological resources including vegetation, wildlife and the scrub-jay, eastern indigo snake, marine turtles, gopher tortoises, alligators, piping plover, and red knots or other marine mammals. The limited benefit of removing a relatively large amount of invasive species such as Brazilian pepper would also not occur.

4.4 HISTORICAL AND CULTURAL RESOURCES

Impacts on cultural resources would be considered significant if they resulted in the disturbance or loss of value or data that qualify a site for listing in the National Register of Historic Places (NRHP); if there was substantial disturbance or loss of data from newly discovered properties or features prior to their recordation, evaluation, and possible treatment; or if the project substantially changed the natural environment or access to it such that the practice of traditional cultural or religious activities was restricted.

Proposed Action

LZ-1 is not considered a historic complex, and there are no identified historic properties located within the LZ-1 boundary or in the immediate vicinity. During an archeological phase I survey and historical survey accomplished by the 45th SW at the site, no potential sites were found. Significant traditional cultural properties (TCPs) are subject to the same regulations as other types of historic properties and are afforded the same protection. Traditional resources associated with the Ais could include archaeological sites, burial sites, mounds, ceremonial areas, caves, hillocks, water sources, plant habitat or gathering areas, or any other natural area important to this culture for religious or heritage reasons. By their nature, traditional resource sites often overlap with (or are components of) archaeological sites. As such, the National Register listed or eligible sites (as well as any archaeologically sensitive areas) could also be considered traditional sites or could contain traditional resource elements. There are no remaining Ais Indians. They are represented by the Seminole and Miccosukee Tribes of Indians of Florida. While burial sites are sacred sites they have not been declared TCPs on CCAFS, but are afforded protection under NAGPRA and ARPA. During a site visit to CCAFS in 2011, the Seminole Tribe of Florida and the Seminole Nation of Oklahoma indicated verbally that they have no TCPs on CCAFS property. In 2015, the tribes were invited to review, but did not provide

comments on, the 45 SW Integrated Cultural Resources Management Plan in which no TCPs are identified.

The SHPO concurs that there would be no impact to historical or cultural resources from the Proposed Action (see Appendix E for SHPO correspondence).

No Action Alternative

Under the No Action Alternative the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages, would be able to land. The Dragon capsule facility would not be built. Therefore no impacts to historical or cultural resources would occur.

4.5 AIR QUALITY

This section describes the potential effects to air quality resulting from implementation of the Proposed Action and the No Action Alternative. A significant impact on air quality would occur if the action would cause pollutant concentrations to exceed one or more of the National Ambient Air Quality Standards (NAAQS) or state air quality standards within Brevard County. This exceedance would occur if calculated long and short-term impacts from the direct and indirect emission sources were significant when compared with the federal and state standards for CCAFS and Brevard County, and both lower and upper atmospheres.

Proposed Action

The Proposed Action includes clearing activities, construction activities, and the landing of up to two additional Falcon 9 first stage vehicles. Land clearing activities would pose a short term increase in the amount of various regulated air pollutants in the immediate area of LZ-1. However, these temporary construction and land clearing related fugitive emissions increases would not be substantial enough to cause a resulting change to the NAAQS attainment status. CCAFS is in an air "attainment" area; therefore, no air conformity determination is required. Particulates and fugitive dust from these activities can be adequately controlled through periodic controlled water spraying and other planning activities normally performed during construction projects. Any potential air emissions associated with the planned land clearing and construction would be conducted in the same way that current activities are conducted elsewhere on CCAFS in order to protect construction workers and other station personnel.

Temporary increases in local vehicle use and other light/heavy duty construction and land clearing related equipment would be insignificant and would not adversely impact the existing NAAQS for CCAFS and the surrounding area. Installation of two electrical generators (one for each pad) that would only operate once a month during landing operations would not affect existing NAAQS.

Falcon Vehicle Emissions

Air emissions from landings—carbon dioxide (CO_2), CO, hydrogen (H_2), water (H_2O), NOx, VOC, and PM—are expected to be minimal, as discussed in the original EA. While the original EA addresses a Falcon 9 first stage, a Falcon heavy first stage is the same engine configuration and therefore emissions output, with the exception that there are three first stage boosters, rather than one. The CAA does not list rocket engine combustion emissions as ozone depleting substances (ODS), and therefore rocket engine combustion emissions are not subject to limitations

on production or use. As described in the original EA, all of the types of emissions resulting from the Proposed Action are exempt from air permitting requirements at CCAFS. These types of categorically excluded emissions units or activities are considered to produce "insignificant" emissions pursuant to FAC Rule 62-213.430(6).

The amount of CO emissions that would result from landing a Falcon booster would be between 60 and 88 percent less than a Falcon 9 or a Falcon heavy launch, since only three engines would be re-lit during landing (for each returning first stage). This amount is not enough to result in an exceedance of the NAAQS for CO and represents less than 0.02 percent of Brevard County's CO emissions for 2015 (USEPA Air Emission sources 2015). Brevard County, including CCAFS, is in attainment, and therefore the General Conformity Rule does not apply. Therefore, the operational impacts from the Proposed Action on air quality would not be significant.

Dragon Capsule Testing

Loading of hypergolic propellants would be performed at the LZ-1 facility in a manner similar to previous operations with the Dragon capsule at LC-40. Each loading or unloading operation would be independent, sequential and conducted using a closed-loop system. During the operation, all propellant liquid and vapors are contained (USAF 2014). Although both NTO and hydrazine are classified as hazardous air pollutants (HAPs), the NESHAP regulations under Title III of the CAA have not yet established control standards. The packed bed scrubber systems usually used are considered Best Available Control Technology (BACT) and would be considered acceptable when NESHAPs regulations are promulgated. SpaceX would comply with applicable state and federal regulations.

Inadvertent releases of toxic air contaminants are unlikely but possible as a result of accidents during Dragon capsule system testing. The highest possible contaminant release scenario would result from the unlikely event of a spillage of the entire quantity of liquid propellants. Lesser releases could result from fires or explosions that would consume significant amounts of the propellants. SpaceX safety procedures that are in place ensure that there is minimal risk for these events to occur. In addition, spill response planning procedures are in place to minimize spill size and duration, as well as possible exposures to harmful air contaminants (USAF 2014)

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no significant impacts to air quality would occur. However, there would be a slight increase in emissions for stage recovery and/or actions associated with transporting new first stage boosters to CCAFS.

4.6 CLIMATE

This section describes the potential effects to climate resulting from either implementation of the Proposed Action or the No-Action Alternative. This section also addresses the impact of climate change issues may have on the Proposed Action and No Action Alternative. The 2016 CEQ specifically asks agencies to consider;

1) The potential effects of a proposed action on climate change as indicated by its Green House Gas (GHG) emissions; and
2) The implications of climate change for the environmental effects of a Proposed Action.

Some of the impact on climate is presumed to be caused by increases in GHG. However, there are no significance thresholds for aviation or commercial space launch GHG emissions, nor has the FAA identified specific factors to consider in making a significance determination for GHG emissions. There are currently no accepted methods of determining significance applicable to aviation or commercial space launch projects given the small percentage of emissions they contribute. Therefore, it is difficult to assess what would be a significant impact on the climate. Conversely, based on a global climate affect, it is difficult to also assess what significant impact climate may have upon the Proposed Action at CCAFS.

Since the late 2000s there have been changes in GHG regulations which are required to be addressed. GHG are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Some scientific evidence indicates a trend of increasing global temperature over the past century which may be due to an increase in GHG emissions from human activities. The climate change that may be associated with this global warming may produce negative economic and social consequences across the globe.

Climate change effects on the Proposed Action were also considered in the analysis of the project. Effects considered per the 2016 CEQ guidance include increasing sea level, drought, high intensity precipitation events, increased fire risk, or ecological change. Climate change impacts are variable, therefore the effects listed were considered on regional and local lens: the Southeastern United States and CCAFS respectively. Sea level rise was taken into further analysis due to its predictability and impact on the region and potential effects on the project area. According to the 2014 "Climate Change Impacts in the United States: The Third National Climate Assessment," this region is especially vulnerable to sea level rise which is expected to accelerate through 2100 (Carter, et al., 2014). Vulnerability was relative measure defined by the "coastal system's susceptibility to change with its natural ability to adapt to changing environmental conditions" (Carter, et al., 2014). While there is strong predictability based on current scientific understanding that sea level will continue to rise throughout the 21st century and centuries to come, the 2013 "Fifth Assessment Report of the Intergovernmental Panel on Climate Change" concludes uncertainties remain regarding the magnitude and regional distribution of sea level rise (Church, et al., 2013).

SpaceX recognizes the regional and local vulnerability to sea level rise based on the coastal location of the Proposed Action. Adaptation mechanisms discussed in the Third National Climate Assessment were considered to mitigate impacts associated with climate change: protect, accommodate, or retreat (Cater, et al., 2014). Since LZ-1 area main pad has begun operations accepting returning, landing vehicles, and adaptations for altered climate conditions are

considered SpaceX removed the "retreat" adaptation from further consideration when assessing this Proposed Action.

The Proposed Action

The GHG emissions associated with the estimated emissions for the launch of a Falcon 9 is compared to U.S. GHG emissions shown in Table 4-5 below. If one simply multiplies the values of CO2 emitted by a single booster by three (3), the estimated CO_2 emissions from probable annual operations of landing the Falcon Heavy at CCAFS are still less than a millionth of 1 percent of the total GHG emissions generated by the U.S. in 2010 and less than a millionth of 1 percent of the total CO2 emissions generated worldwide (European Commission–Joint Research Centre 2012). Therefore, the emissions of GHGs from the Falcon Heavy landing event would be much less than that of a launch event and would not cause any appreciable addition of GHG gases into the atmosphere. At present, no methodology exists that would enable estimating the specific impacts (if any) that this increment change in GHG gases would produce locally or globally. Locally, landing a Falcon first stage using one engine would not increase yearly levels of GHG at CCAFS.

Table 4-5: Estimated Carbon Dioxide (CO_2) Emissions Comparison

Annual Emissions Source	**Metric Tons CO2e per Year**
Global Total CO_2 Emissions	3,400 x 10^7
U.S. 2010 Total GHG Emissions	6,821.8x 10^6
2013 CCAF GHG Emissions (Total)	72,547
12 Falcon 9 launches (Falcon Heavy)	4,645
12 Falcon RLV landings (approx. 11% of launch)	511 3 boosters landings (1,533)
Falcon 9 GHG Percent of Global GHG Percent of US GHG Percent of CCAFS GHG	.000000114 .000000567 1% 3 booster landings (2%)

Source: (USAF 2014)

Constructing two landing pads at LZ-1 would have a negligible effect on GHG on a global or on a regional basis, and therefore on the climate. As shown above in Table 4-5, landing up to three first stage boosters would have an extremely small impact on total GHG. Therefore, the impact to the region or global climate would not be significant.

Climate effects on the Proposed Action would also be insignificant. SpaceX factored global climate change and water level rise into the design of the landing pads and Dragon capsule processing facility. Landing pads are several feet higher than existing terrain, and the processing facility floors would be several feet above the 100 year flood stage. There would be no facilities constructed that would be designed for habitation which could be affected by flooding. Therefore, the impact (by potential seawater rise) to the Proposed Action cause by climate change would not be significant. Also as discussed in the original EA, GHG emissions and possible effect on climate change is insignificant and essentially not measurable compared to totals at CCAFS (less than 1%), the Proposed Action would therefore not have an impact on air quality or climate change. Finally, while difficult to measure, reusing a first stage booster would reduce potential emissions compared to manufacturing and shipping a new booster to the launch site.

No Action Alternative

Under the No Action Alternative, the additional landing pads would not be built and the Falcon family of rockets would continue to be launched from LC-40 (and from LC-39A) and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no additional impacts to, or by the climate would occur.

4.7 HAZARDOUS MATERIALS/HAZARDOUS WASTE

A project may result in a significant impact regarding hazardous materials/hazardous waste if it increases the potential for adverse exposure to hazardous materials/waste or increases the likelihood of a hazardous materials release to the environment. Impacts would also be considered significant if they resulted in major noncompliance issues with applicable regulatory guidelines or increased the amounts of hazardous waste beyond available management capacities.

Proposed Action

All hazardous materials would continue to be handled and disposed of per the requirements established by OSHA (Hazardous Materials), RCRA and per the Hazardous Materials Contingency Plan developed for the Falcon Launch Vehicle Program. Approximately 2,160 pounds or less of RP-1 fuel would remain on-board each returning vehicle. After removing the legs, the vehicles would be transported shortly after landing to another facility, most probably LC-40, for processing activities including maintenance and cleaning. Since all applicable federal, state, county, and USAF rules and regulations would continue to be followed for the proper storage, handling, and usage of hazardous materials under the Falcon Launch Vehicle Program, less than significant impacts for hazardous materials management should occur under the Proposed Action.

Construction activities associated with the Proposed Action may require or generate small quantities of hazardous materials or wastes. All waste generated by the construction contractor would be managed in accordance with all Federal, State, local and Installation regulations and directives. Since demolition is not included in this Proposed Action, asbestos and lead-based paint waste would not be a consideration. Management of hazardous materials would be completed in accordance with 40 CFR 260-279. The Proposed Action does not include buildings; any required equipment or cleaning material would be portable and self-contained.

Construction and operation of the proposed dragon processing building would be managed in the same fashion of other processing facilities at CCAFS. Fuel volumes and subsequent safety arcs would be approved by USAF safety prior to construction beginning. SpaceX has implemented proper handling procedures for payloads containing hypergolic fuels at LC-40. Since all applicable federal, state, and local regulations would continue to be followed for the proper storage, handling, and usage of hazardous materials under the their Falcon Launch Vehicle Program, no significant impacts due to hazardous materials management should occur under the Proposed Action. Materials that would be used during processing and preparing the Dragon capsule for testing would be the same as a routine payload spacecraft for the Falcon 9 Block 1. Facilities at the LZ-1 Dragon capsule processing facility would be designed and built to be permitted to process hypergolic propellants similar to LC-40 and would continue operating under those permit requirements for hypergolic propellants and waste products. The Proposed Action would therefore not result in significant impacts from hazardous materials/hazardous waste management.

IRP Program

The LZ-1 area is also known as SWMU C038 since there has been recorded site contamination and several removal actions that have taken place since the late 1970's. Soil remediation activities have taken place, however groundwater contamination still exists (E3, 2013a). The Land Use Control Implementation Plan (LUCIP) found in the 2014 EA states that prior to any intrusive work; the USAF IRP department must be notified.

Since groundwater contamination exists at the site, any planned construction that would involve contact/digging to groundwater must be coordinated with the IRP office. Since groundwater contamination begins at approximately 18 feet below land surface (bls), any planned construction is not expected to affect the existing groundwater plume; the need to dewater is not expected. All groundwater monitoring wells around the facility would need to be either protected from damage, or be properly abandoned and replaced so that required quarterly and annual sampling may continue.

Dust exposure could be minimized through engineering controls (dust control measures). Incidental ingestion could be reduced through dust control and the practice of proper personal decontamination procedures. Any disturbance of soil should be coordinated with the IRP office. The Proposed Action would therefore not have a significant impact on the CCAFS IRP program.

Solid Waste Management

Impacts on solid waste would be considered significant if they resulted in noncompliance with applicable regulatory guidelines or increased the amounts generated beyond available waste management capacities. The Proposed Action is expected to generate much less solid waste than a launch of a Falcon 9 vehicle. Examples of solid waste may include cardboard packaging, wood, rag material, plastic and aluminum bottles and cans. Solid waste resulting from the landing of the Falcon 9 first stage on December 21, 2015 resulted in minimal solid waste. The Proposed Action at LZ-1 would therefore not have a significant impact on CCAF's solid waste management. Current plans are to conduct approximately one landing (of three booster stages) per month, therefore the Proposed Action would generate less than significant impacts on solid waste.

No Action Alternative

Under the No Action Alternative the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore no additional impacts from hazardous materials or hazardous waste management would occur.

4.8 WATER RESOURCES

A project may have a significant impact on water resources if it substantially affects the chemical, biological, and physical quality of a water body, such as an ocean, stream, lake, or bay; causes substantial flooding or exposes people to reasonably foreseeable hydrologic hazards such as flooding; substantially affects surface or groundwater

quality or quantity; or exceeds the existing potable water or wastewater system capacities for CCAFS. This section describes the potential effects to surface water and groundwater (including hydrology and water quality), wetlands, and floodplains resulting from either implementation of the Proposed Action or the No Action Alternative.

Proposed Action

The Proposed Action includes clearing and construction activities and would not impact water resources around LZ-1 or CCAFS. Construction of the landing pads would require a stormwater management system to address the impervious surface which may be added at site. Impervious surfaces for pedestals which may be added to the pad areas would be accounted for within the over-all design. The design would be developed and a modification to ERP permit # 140524 would be reviewed and approved by the SJRWMD. Any stormwater run-off during construction would be managed according to a Stormwater Pollution Prevention Plan (SWPPP) approved by the SJRWMD. Under the Proposed Action, a typical deluge water system would not be used, therefore there would not be no wastewater generated by the landing of up to two additional Falcon booster vehicles. Firefighting water from the water cannons could be generated but would generally be contained within the landing pads. Potential impact to surface waters of the Banana River Lagoon or the Atlantic Ocean of a failed landing from spilled fuel, if not consumed by combustion, would be relatively minor compared with a similar event from fully fueled vehicles during a launch.

Potable water would be supplied by the existing water distribution systems at CCAFS and would have a negligible impact on system capacity or surface and groundwater resources. Portable toilets would continue to be placed on site during construction and landing operations. Any other waste-water would be processed through the existing wastewater collection and treatment systems at CCAFS and would have a negligible impact on system capacity and would not impact surface or groundwater resources. There would be no impact to local and regional water demand since there would be no substantial increase in use of the potable water supply.

Wetlands and 100-year Floodplains

Proposed Action

Wetlands have been surveyed and delineated generally west of the northern pad area, and south of the southern pad area project site; construction or land management activities would avoid wetland areas. Additionally, a 25-foot buffer zone has been designed and delineated in place, as required by the SJRWMD, to ensure separation of construction and operations activities from the wetlands. This buffer would be in place to protect the wetland from potential direct or secondary impacts.

The 100-year floodplain surrounds the area south of the main pad and where the southern pad would be constructed as shown on the map in Appendix F. Because the Proposed Action is subject to whether the project would be a significant floodplain encroachment in accordance with Executive Order 11988 and DOT Order 5650.2 or not, the action was assessed by considering each of the following three scenarios, which are followed by the finding:

1. Would the action have a considerable probability of loss of human life?

   Construction and operation of the proposed landing site would not result in considerable probability of loss of human life. The landing pad and road way would not include buildings; the pad would be elevated at least

ten feet above 100 year flood levels. The proposed site would also not prohibit people from entering or exiting the area should a flood event occur.

2. Would the action likely have substantial, encroachment-associated costs or damage, including interrupting aircraft service or loss of a vital transportation facility (e.g., flooding of a runway or taxiway, important navigational aid out of service due to flooding, etc.)?

   The proposed site would be constructed within a large contiguous floodplain that spans the coast of Florida. Construction would result in clearing approximately 11 acres (the south pad area) of vegetation within the floodplain. This is a small area compared to amount of floodplain in the vicinity of CCAFS. The Proposed Action would not result in new areas being subject to 100-year floods, nor would it result in existing areas subject to 100-year floods becoming more prone to floods.

3. Would the action cause a notable adverse impact on natural and beneficial floodplain values.

   Based on the analysis in Section 4.3 (Biological Resources), and an understanding that the Proposed Action calls for limited cutting and grubbing of all vegetation in the floodplain, construction impacts to the natural and beneficial floodplain values wildlife (including federally threatened or endangered species) has been addressed by the USFWS required BA and BO and found not to be significant.

Based on the expected adverse impacts on one of the natural and beneficial floodplain values (i.e., wildlife), the Proposed Action would result in a floodplain encroachment per DOT Order 5650.2. With the mitigation identified in the USFWS's BO, no significant impacts on wildlife within the floodplain are expected. It should be noted that the boundary of launch complexes LC-12, LC-14, LC-36 and most of LC-46 are also located within the 100-year floodplain as discussed in the reactivation and reuse EA (USAF 2005). The required site plans for the landing pads affords no other practicable alternative that would meet the requirements of the project. The public was made aware of this floodplain encroachment through SpaceX's public notice in the Florida Today newspaper by a notice published on July 3, 4, and 5, 2016. Seven comments for additional information were received and are shown in Appendix I. Since the area is limited, and there are no structures being placed at the south pad, the Proposed Action is not expected to impact area wetlands or near-by floodplains.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no additional impacts to water resources would occur.

4.9 GEOLOGY AND SOILS

A project may result in a significant geologic impact if it increases the likelihood of, or results in exposure to foundation instability, land subsidence, or other severe geologic hazards. It may also be considered a significant geologic impact if it results in the loss of the use of soil for agriculture or habitat, loss of aesthetic value from a unique

landform, loss of mineral resources, or causes severe erosion or sedimentation.

Proposed Action

No unique geologic features of exceptional interest or mineral resources occur within the project area. Soil in the currently vegetated areas to the south was not impacted by contamination, and only a minor impact is found to the north. Prior to and during construction, erosion and sediment control measures such as siltation fences (Best Management Practices) are required to retain sediment on-site and to prevent violations of state water quality standards. There are no unique geologic features in the project area. The Proposed Action would therefore not have a significant impact on geology and soils at LZ-1.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no additional impacts to geology and soils would occur.

4.10 TRANSPORTATION

This section discusses the projected traffic conditions along roadways which may be affected by the construction at LZ-1 and the landing operations of a Falcon first stage vehicle. A project would have a significant impact on transportation if it caused an exceedance of the capacity of roadways or impacted structural sections of roadways.

Proposed Action

Minor short-term interruptions to traffic flow or utilities may occur during clearing and construction activities. Since landing operations would occur approximately 12 times a year, on-base traffic near LZ-1 would not change appreciably. While difficult to calculate, there may be a slight positive impact on traffic since the re-landed vehicles would be transported to a local SpaceX facility, rather than transporting a new Falcon first stage vehicles from Texas to CCAFS. Continuing to operate LZ-1 as a landing facility for one or up to three returning first stage vehicles is not expected change operation of the CCAFS roadways during a launch, and landing event that would occur approximately 10 minutes later. Operating the Dragon capsule processing facility is also not expected to require the closure of ICBM road. Operation of roadways outside of CCAFS would not be impacted.

Overall launch viewing traffic per year has declined substantially since the Shuttle Program was terminated in 2011. Traffic volume has increased for a Falcon launch but has been less than that of a Shuttle launch. There may be a slight increase in viewing traffic for the landings since it would be a novelty. Any increased visitation would cause less than a significant impact on CCAFS and local traffic patterns. The Proposed Action at LZ-1 would therefore not have a significant impact on transportation.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The

Dragon capsule facility would not be built. Recovery vessels would continue to transit from local ports. As a new first stage would need to be transported from Texas to CCAFS, a negligible negative impact on transportation would occur as a result of the implementation of the No Action Alternative.

4.11 UTILITIES

This section describes the potential effects to the water supply system and the electrical supply system by implementing the Proposed Action or the No Action Alternative. The action may have a significant impact on these resources if it substantially affects capacity of the systems to maintain existing services.

Proposed Action

There would be no utility requirement for the clearing and construction phase. Landing operations would require a minimum amount of potable or fire-main water and electrical power.

Water Supply

The current potable and non-potable water supply which could be available to LZ-1 was originally designed to support Atlas launches. Since the Proposed Action involves landing up to three booster stages, typical launch deluge water would not be used. The Proposed Action's reliance on the water supply would be relatively small; two pressurized 12,000 gallon tanks (one for each new pad) would be filled via the fire-main system and used to supply water cannon nozzles in the event of a fire. The Proposed Action would therefore not have a significant impact on CCAFS water supply.

Electrical Power

The electrical power capabilities for operation at LZ-1 were designed to support the Atlas launch program. If needed, electrical demand for construction activities would be satisfied by small propane or diesel driven electrical generators. Electrical needs during landing events would be minimal and would include lights, small pumps, communications equipment and site cameras. Electrical power requirements would be provided by tie-ins to existing power cables; the additional power would not be a significant impact on current levels. Therefore, the Proposed Action would not have a significant impact on electrical power demand or supply.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no additional impacts to utilities would occur.

4.12 HEALTH AND SAFETY

An impact would be considered significant if it created a devastating public health hazard or involved the use, production, or disposal of materials that pose a substantial hazard to the population of the affected area.

Proposed Action

Clearing and Construction

Safety hazards are inherently associated with construction activities, including heavy equipment operation. All appropriate regulations, including OSHA Regulation 29 CFR 1926, *Safety and Health Regulations for Construction*, and local USAF health and safety regulations would be followed and SpaceX procedures would be followed during project activities to minimize potential minor impacts. Clearing and construction activities for the additional landing pads and the Dragon capsule processing facility would therefore not have a significant impact on health and safety. SpaceX would have a safety representative who would ensure that proper safety procedures are followed.

Landing Operations

CCAFS range safety regulations ensure that the general public, launch area personnel, and affected land area are provided an acceptable level of safety, and that all aspects of pre-launch and launch operations adhere to public laws (USAF 2013). The Range Safety organizations at CCAFS have used models to predict launch hazards to the public and on-site personnel prior to every launch. These models calculate the risk of injury resulting from toxic gases, debris, and blast overpressure both from nominal launches and launch failures. Launches are postponed if predicted risk of injury exceeds acceptable limits. The allowable collective public risk limit in use at CCAFS is extremely low (30×10^{-6}). Range safety organizations review, approve, monitor, and impose safety holds, when necessary, on all pre-launch and launch operations.

A landing event at LZ-1 by the Falcon Heavy booster stages would follow a nominal launch from KSC Pad 39A. The operation and management of the landing would be managed similar to other vehicle launches; however, the returning first stage vehicles would contain substantially less propellant (RP-1 and LOX) than when they were launched. Expected thrust energies would only be up to 33 percent of a launch vehicle since up to three engines would be firing on each of the booster stages. The returning vehicles would not contain any second stage material, propellants, or payload. Clear areas and stand–off distances at sea and at CCAFS would be developed in conjunction with Range Safety and adhered to; any anomalies in the landing event plan would cause a destruct signal to the vehicle to occur over the ocean. Additionally, as part of the FAA license application review process, the FAA would conduct a safety review of operations prior to the issuance of an FAA license.

Payload processing equipment and procedures would not be required. However, some remaining ordnance items and propellants would require an Explosive Quantity-Distance Site Plan. Hazardous materials such as propellant, ordnance, or chemicals would be transported back to a processing facility at CCAFS in accordance with DOT regulations for transport of hazardous substances (Title 49 CFR 100- 199). Hazardous materials such as liquid rocket propellant are transported in specially designed containers to reduce the potential of a mishap should an accident occur. Injuries would not be anticipated if facility personnel follow standard operating and emergency procedures. Therefore, landing events would not result in a significant impact to health and safety.

Dragon Capsule Processing Facility Operations

Processing of the Dragon capsule would involve the handling of toxic and hazardous propellants including MMH, and

NTO. MMH is a strong irritant and may damage eyes and cause respiratory tract damage. Exposure to high vapor concentrations can cause convulsions and possibly death. Repeated exposures to lower concentrations may cause toxic damage to liver and kidneys as well as anemia. The EPA classifies MMH as probable human carcinogens. It is flammable and could spontaneously ignite when exposed to an oxidizer. NTO is a corrosive oxidizing agent, contact with the skin and eyes can result in severe burns. Inhalation of vapors can damage the respiratory system. NTO would ignite when combined with fuels and may promote ignition of other combustible materials. Fires involving NTO burn vigorously and produce toxic fumes. Current SpaceX operations would not change current Dragon capsule processing, health or safety (USAF 2014).

Health and safety impacts to personnel involved in the propellant loading and unloading operations in the processing facility would be minimized by adherence to OSHA and U. S. Air Force Occupational Safety and Health (AFOSH) regulations, just as they are currently used for similar operations at LC-40. These regulations require use of appropriate protective clothing and breathing protection. Toxic vapor detectors are used in the facilities to monitor for leaks and unsafe atmospheres.

Spills, fires, and explosions would be possible outcomes from accidents during Dragon capsule processing. A violent fire or an explosion could produce severe injuries or even death. A catastrophic accident of this type during payload processing would be extremely unlikely. Most propellant spills would be contained within the processing facility with no health impacts to personnel. The most likely consequences of a severe accident during processing would be some level of damage to the spacecraft and the immediate liquid propellant transfer area. Facility design would limit damage to the spacecraft and the transfer area.

Injuries would not be anticipated if facility personnel follow emergency procedures. If human error (e.g., not following procedures, not wearing protective clothing, or not donning breathing equipment) occurs at the time of the accident, exposure of personnel to toxic propellant vapors may result. This would give some level of short-term adverse health impact and an incremental increase in the chance of the exposed individual developing cancer.

Extremely small quantities of toxic propellant vapors would be emitted from payload processing facilities during propellant loading operations. These small emissions would not impact the health of the public or on-site personnel. The operations plan for the facility would provide additional protection by identifying the safety areas to be cleared of unprotected personnel during propellant operations. Therefore, Dragon capsule processing operations would not result in a significant impact to health and safety.

The processing facility design would be influenced by the presence of limited and local fuel storage areas, ordnance storage and, for short durations. The design would be developed to locate explosive hazards so as to minimize the impacts to inhabited buildings on CCAFS when the Dragon capsule is fueled and ready for testing. Similar to all other hazardous operations at CCAFS, the Proposed Action would account for public safety distances. Best management practices and mitigation measures to minimize any potential risks in the ICBM Road area are being addressed in the AF Explosive Siting Process. Due to explosive safety concerns, Dragon capsule operations could not be performed concurrently with landing procedures at the north pad; all other safety measures would be implemented in the design and operation of the site. SpaceX currently estimates road closures would not be required for Dragon capsule processing.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no additional impacts to health and safety impacts would occur.

4.13 SOCIOECONOMICS

Socioeconomic impacts would be considered significant if they substantially altered the location and distribution of the local population, caused the population to exceed historic growth rates, decreased jobs so as to substantially raise the regional unemployment rates or reduce income generation, substantially affected the local housing market and vacancy rates, or resulted in the need for new social services and support facilities.

Proposed Action

During a short but intense period for clearing and construction activities at LZ-1, SpaceX would use their current workforce, but would also bring onboard up to 50 additional temporary workers and other local consultants. The addition of these workers at CCAFS does not represent a significant increase in the population or growth rate of the region which was 568,088 people according to a 2015 estimate (www.census.com/quickfacts). During landing operational periods and long-term operations, SpaceX would continue to use their current internal work force. The Proposed Action would not significantly affect the local housing market and would not negatively affect the local economy. Therefore, the Proposed Action would generate no negative socioeconomic impacts on the region and may generate a negligible positive impact due to increased jobs and tourism.

No Action Alternative

Under the No Action Alternative the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. A negligible negative impact on socioeconomics would occur as a result of the implementation of the No Action Alternative since jobs would not be created during the construction period.

4.14 ENVIRONMENTAL JUSTICE

A significant impact to environmental justice would occur if:

- There was a significant adverse impact to the natural or physical environment or to health that affected a minority or low -income population or children;
- There was a significant adverse environmental impact on minority or low-income populations or children that appreciably exceeded those on the general population or other comparison group;
- The risk or rate of environmental hazard exposure by a minority or low-income population was significant and exceeded those by the general population or other comparison group; or
- A health or environmental effect occurred in a minority or low-income population affected by

cumulative or multiple adverse exposures from environmental hazards.

Proposed Action

The landing of up to three Falcon Heavy booster stages at LZ-1 would occur within the boundaries of CCAFS and over the Atlantic Ocean similar to current operations of existing launch vehicles. While minority or low income groups exist in areas of Brevard County, environmental impacts generated by the Proposed Action would not disproportionately affect any particular population group, including minority or low-income populations.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage, or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. Therefore, no impact on Environmental Justice would occur as a result of the implementation of the No Action Alternative.

4.15 SECTION 4(f) PROPERTIES

Impacts to Section 4(f) properties would be significant if the action involves more than a minimal physical use of a Section 4(f) resource or constitutes a "constructive use" based on an FAA determination that the project would substantially impair the Section 4(f) resource. Resources that are protected by Section 4(f) are publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance; and publicly or privately owned land from an historic site of national, state, or local significance. Substantial impairment occurs when the activities, features, or attributes of the resource that contribute to its significance or enjoyment are substantially diminished.

Proposed Action

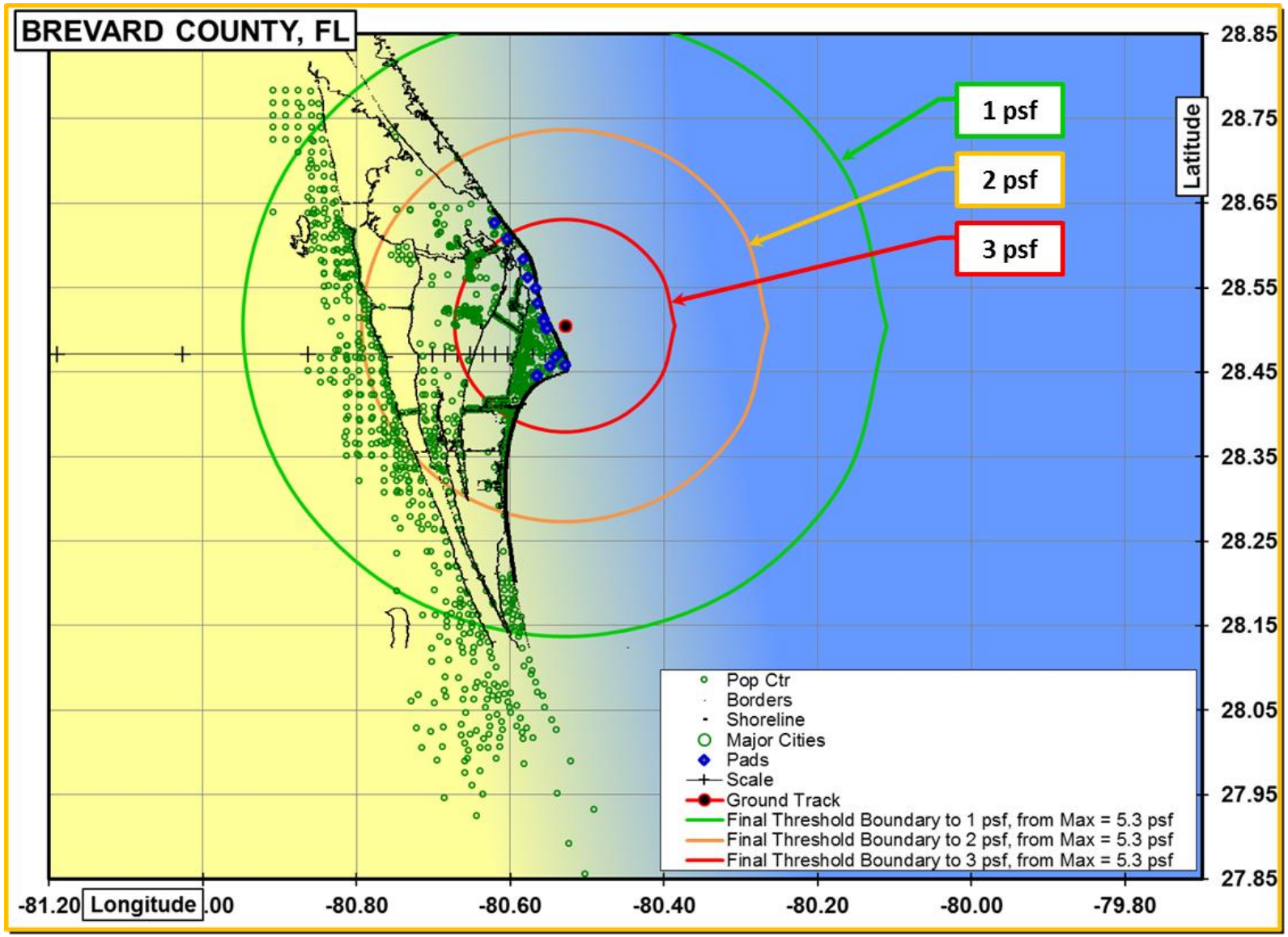
As discussed in the original EA, there are no Section 4(f) properties located within the boundaries of CCAFS. Therefore, there would be no physical use of a Section 4(f) property via permanent use of land, and there would be no temporary occupancy of a Section 4(f) property. When there is no physical use and no temporary occupancy, but there is the possibility of constructive use, the FAA must determine if the impacts would substantially impair the 4(f) property. Section 4(f) properties located within approximately a 15-mile radius of LZ-13 include Merritt Island National Wildlife Refuge, Cape Canaveral National Seashore, Jetty Park, Kelly Park, Kars Park, Kings Park, and Manatee Cove Park. Additionally, the St. John's National Wildlife Refuge and Tosohatchee State Game Preserve are located west of the launch site. Noise levels at these 4(f) properties may increase slightly and temporarily during the landing of up to three Falcon Heavy booster stages, but the noise would only last during several second intervals, occurring approximately once per month.

For decades, the 4(f) properties have been experiencing increased noise levels during launches taking place at CCAFS and adjacent KSC, and sonic boom noises during shuttle landings. Due to the long history of these 4(f) properties experiencing noise from launches at CCAFS and KSC, the FAA has determined the Proposed Action would not substantially diminish the protected activities, features, or attributes of any of the Section 4(f) properties identified, and thus would not result in substantial impairment of the properties. Therefore, the Proposed Action would

not be considered a constructive use of these Section 4(f) properties and would not invoke Section 4(f) of the DOT Act.

No Action Alternative

Under the No Action Alternative, the additional two landing pads would not be built, and the landing of up to three Falcon Heavy stages would not occur. The Falcon family of rockets would continue to be launched from LC-40 and LC-39A and only the Falcon 9 first stage or one of three Falcon Heavy booster stages would be able to land. The Dragon capsule facility would not be built. The No Action Alternative would not be considered a constructive use of Section 4(f) properties and would not invoke Section 4(f) of the DOT Act.



LANDING VEHICLE MODELED SONIC BOOM CONTOUR

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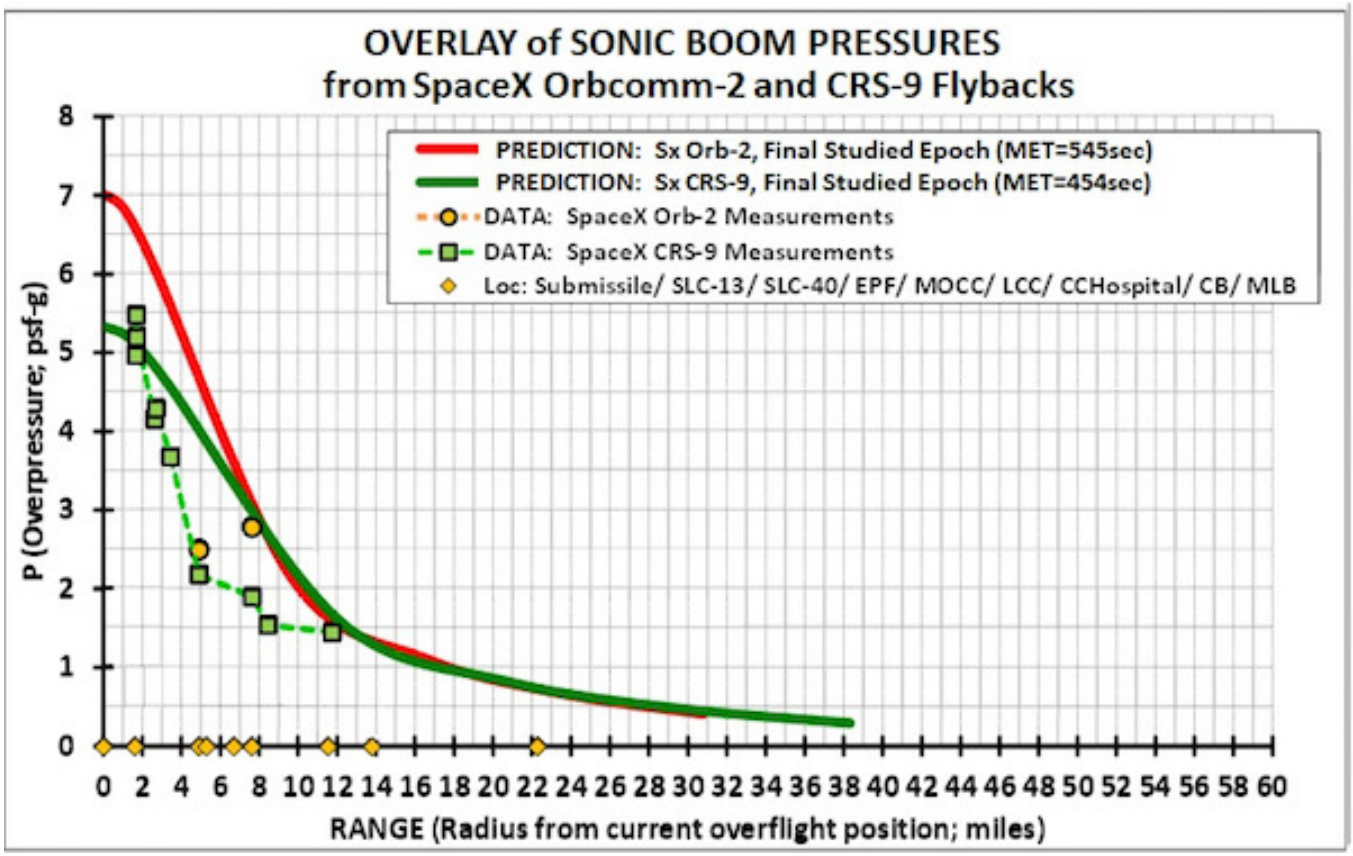
SUPPLEMENTASL ENVIRONMENTAL ASSESSMENT
LANDING ZONE 1 (LZ-1)
CAPE CANAVERAL AIR FORCE STATION

Figure No.

4-1

Taken From USAF Sonic Boom Study and Summary (Appendix D of the SEA)



5.0 CUMULATIVE IMPACTS

According to 40 CFR § 1508.7, cumulative impacts are defined as "…the incremental impact of the actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions." Within the realm of space vehicle operations, this SEA addresses only the landing of RLVs and construction of two new landing pads at LZ-1. Cumulative impacts include impacts from space vehicle operations at CCAFS and other past, present, and reasonably foreseeable future activities that could affect the resources impacted by the Proposed Action. Reasonably foreseeable future activities include construction projects occurring at CCAFS and surrounding areas that would meaningfully interact in time and space with the Proposed Action such that potential cumulative impacts could result.

The Cumulative impacts discussion as presented in the original EA remains substantially valid. Rather than restating all foreseeable future actions, only significant changes or additions are noted within this SEA.

5.1 REASONABLY FORESEEABLE FUTURE ACTIONS

Current and future actions include vehicle launches, RLV landings, and substantial land clearing and construction. Documents that were reviewed for reasonably foreseeable actions at CCAFS and KSC included the following. Of these, the last document listed has been added since the original EA.

- NASA Final Environmental Assessment for Suborbital Processing, Launch, and Recovery Operations, August 24, 2012
- NASA KSC Master Plan, 2012-2032
- Final Environmental Assessment for Multi-Use of Launch Complexes 39A and 39B, John F. Kennedy Space Center, FL, June 25, 2013
- FAA Aerospace Forecast Fiscal Years 2011–2031, 2013
- FAA Final Supplemental Environmental Assessment to the September 2008 Environmental Assessment for Space Florida Launch Site Operator License, July 2010
- FAA Draft Environmental Impact Statement (in development) for the Shiloh Commercial Launch Complex
- Space Florida Cape Canaveral Spaceport (CCS) Complex Master Plan 2013
- KSC Master Plan, 2012-2032
- CCAFS General Plan (Limited 1-page summary since it is not yet releasable)
- Port of Canaveral "State of the Port" 2014
- NASA Environmental Impact Statement (EIS) for the International Space Research Park (ISRP) at Kennedy Space Center, June 2004.

- Recent Public Announcements by Blue Origin and Moon Express
- USAF 45 SW Integrated Natural Resources Management Plan and Integrated Cultural Resources Management Plan

Future developments that may occur at complexes near the Proposed Action were investigated. It was recently announced that Moon Express has finished negotiations to license LC-17 and LC-18 from the USAF at CCAFS. Moon Express reportedly will use the two complexes to develop and test its lunar lander and test flight operations. In addition, Blue Origin is planning to redevelop LC-11 and LC-36 for use as an engine test stand and an Orbital Launch Site respectively. The company plans to launch heavy-lift class orbital vehicles from a planned launch complex that would include several buildings.

Generally, each of the documents listed above promotes future space related operations success by emphasizing reuse or modernization of existing facilities at CCAFS and KSC, in addition to development and construction of new facilities. The following paragraphs briefly discuss general future plans.

5.1.1 CCAFS Future Actions

A new CCAFS General Plan is being developed. The summary states that future development would be guided by sustainability. In order to accomplish this, 50-year Long Term Development Plans (LTDPs) were created for each installation. The LTDPs are the 45 SW's vision for future development. They provide land use options that support the mission of the Wing, its partners and future government and commercial space operations. The LTDPs are rooted in the 45 SW's Strategic Plans and illustrate how increases in launch tempo and associated support activities can occur sustainably, and compatible with the efficient use of land and energy, the conservation of natural resources and the safe operation of launch vehicles and processing facilities. Future facilities and launch complexes would be developed as to minimize any potential impact or compatibility with current facilities and the environment.

The short-term forecast for CCAFS and KSC launches during the next several years are shown below in Table 5-1. Space launch forecasts for KSC and CCAFS launch pads are difficult to determine at this point. Advertised "goals" for both SpaceX and Blue Origin were up to 12 per year for each vehicle. Specific data for the Atlas and the Delta vehicles were unavailable. Additionally according to NASA's multi use of pads 39A and 39B at KSC, NASA would have the capability to accept various launch vehicles including, but not limited to, Atlas V, Delta IV, Delta IV Heavy, Liberty, Falcon 9 and 9 v1.1, Falcon Heavy, Antares, RSLV-S, Athena IIc, Xaero, and the Space Launch System (SLS). While no time frame was provided, an assumption was made that each of those pads would eventually be able to launch one vehicle per month, or a total of 24 per year. From local news articles the space company Blue Origin is planning to develop LC-36 into a launch facility in concert with Space Florida for their family of space vehicles; they plan to begin launching vehicles in 2018. Specific data for the Atlas and the Delta vehicles were unavailable. While firm data is not available beyond 2018, it is assumed that space launches would continue, and would increase in frequency.

TABLE 5-1 Future planned Vehicle Launches at KSC and CCAFS (Estimates)						
Year	Launch Vehicles (number of Launches)					TOTAL
	Falcon 9 (LC-40)	Falcon Heavy (Pad 39A KSC)	Atlas V (LC-40)	Delta IV (LC-37)	BLUE ORIGIN (LC-36)	
2016	5		8	4	0	16
2017	10	1	5	5	0	21
2018	10	1			4	15
2019	10	1			8	19
2020	5	1			10	16
2021		1			12	13
2025					12	12
Total Launches	40	5	13	9	46	

Sources: SpaceX and www.spacelaunch.com, www.spacecoastlaunches.com

NOTES: Launch Forecasts are not firm. SpaceX's website lists 6 future Falcon Heavy missions and 40 future Falcon 9 missions, but does not specify a date that has been assigned for the launches. FloridaToday.com that said "up to 30 launches this year," with 12 being from ULA and the rest from SpaceX. http://www.spaceflightinsider.com/launch-schedule/]). Blue Origin: USAF 45 SW News article September 2015, Orlando Sentinal.

While current data and active scheduled missions are relatively low, the projected annual launch rate from CCAFS for the Atlas launch family ranges from 11 to 13, and the projected annual launch rate from CCAFS for the Delta launch family ranges from 11 to 13 from 2014 to 2020.

5.1.2 KSC Redevelopment Plans

Based upon the *Final Environmental Assessment for Suborbital Processing, Launch, and Recovery Operations; August 24, 2012* the following Proposed Actions are in planning for the KSC area. First to increased flight operations at the Shuttle Landing Facility (SLF), second to include horizontal take-off (launch) and landing (HTOL) of suborbital rocket powered vehicles from the SLF, and third to develop a site to process, launch, and land Vertical Take-off and Landing (VTOL) vehicles conducting suborbital flights.

Increased flight operations at the SLF would involve construction of new facilities at the south-field and mid-field sites and increased flight operations at the SLF in the following broad categories: commercial spaceflight program and mission support aviation, aviation test operations including unpiloted aerial vehicles (UAV), airborne research and technology development and demonstration, parabolic flight missions, testing and evaluation of experimental spacecraft, ground based research and training, and development and demonstration of future supersonic passenger flight vehicles. To take full advantage of the capabilities of the SLF, new construction would occur at both the south-field and mid-field sites.

The HTOL of suborbital rocket powered vehicles is proposed to occur at a single location, the SLF. The HTOL site would support medium thrust rockets. The HTOL vehicles would take off horizontally using rocket powered engines of no greater than 26,689 Newtons (N) (6,000 pounds-force [lbs-f]) of thrust, and would use a steep ascent trajectory. Multiple users with their own vehicles could be utilizing the site for these operations. The VTOL site would support reusable vehicles in the small to medium classes with thrusts of up to 13,345 N (3,000 lb-f). Such vehicles could fly

up to 105km (65 mi) in altitude, return to launch site, and land in a powered mode. Their rocket engines would be processed and the vehicle would either be prepared for another flight or removed from the launch area. The site improvements for this proposed facility would include a launch and landing concrete pad, two surface systems regolith test beds, parking areas for trucks, fuel tankers, trailers and cars, power hook-ups, LOX loading area, LOX tanker truck parking, and a GHe loading/unloading area. The VTOL is anticipated to be a multi-user facility supporting the integration and launch of two or more vehicle systems using a single launch pad. It is anticipated that the combined average annual launch rate would exceed 100 launches per year. The VTOL site location would be selected from one of three alternatives. After the Space Shuttle Program ended in 2011, activity level and operations at the SLF greatly decreased. Many facilities, including those addressed in this EA, would either be maintained at a reduced level, maintained in long-term storage mode, or disassembled.

In 2004 NASA developed an EIS, with the Florida Space Authority (FSA) acting as a cooperating Agency, which addressed the environmental impacts associated with the proposed development of the International Space Research Park (ISRP) now identified as Exploration Park. Development of the ISRP is intended to bring new research and development (R&D) uses to KSC in Brevard County, Florida. NASA has entered into an agreement with the State of Florida, through the FSA, to jointly study the development of up to 160 ha (400 acres) of land on KSC as a research park. KSC comprises 56,500 ha (139, 490 ac) of land controlled by NASA within Brevard and Volusia Counties. The study area analyzed included KSC, Brevard County, and the five adjoining counties (Indian River, Orange, Osceola, Seminole, and Volusia Counties). Exploration Park would support the collaborative missions of NASA and the FSA, by providing for complementary research and development (R&D) objectives, NASA mission enhancement, public-private partnership opportunities, and space commercialization and development. As a center for R&D, the ISRP would bring together a dynamic mix of industry, academia, and government researchers to focus their combined strengths in areas of R&D critical to the long-term success of the NASA and its partners.

The Preferred Alternative proposed the development of the ISRP on approximately 140 ha (345 ac) of KSC property. This development and related construction activities would occur on land located immediately south of the KSC Visitors Complex along the recently constructed Space Commerce Way. About 130 ha (321 ac) of the development would occur on the west side of Space Commerce Way (Phases A-E). The site is dominated by citrus groves and includes remnant wetlands and disturbed habitats.

Since 2004 construction for Phase F on an approximate 10 ha (24 ac) parcel east of Space Commerce Way, adjacent to and west of the Space Life Science Laboratory (SLSL) was approved, but has not been developed as of the time of this writing.

Also in October, 2015 NASA revisited the EIS and issued a REC and together with Space Florida[1] agreed to develop some of the land for lease or use by Blue Origin for a manufacturing facility. That project location is Exploration Park Phase 2 and consists of 139 acres located on the west side of Space Commerce Way and would include site preparation, construction, and operation of a manufacturing and processing facility that would support development of reusable launch vehicles utilizing rocket-powered Vertical Take-off and Vertical Landing (VTVL) systems. Of the approximately 139 acres, 71 acres would be developed, 54.3 would be proposed wetland mitigation area, and 13.78 acres would be undeveloped area. The project's conceptual site design would contain an approximately 380,000 square foot (sf) manufacturing building, a 36,000 sf adjacent support Ground Service Equipment (GSE) building, a connecting anodizing building, a fire pump house and water storage tank, parking areas, connecting roadways, and stormwater management ponds. Land is reserved for a separate payload processing building, which

[1] Space Florida is the current aerospace economic development agency of the State of Florida. The agency was created by consolidating three existing space entities into a single new organization via the Space Florida Act, enacted in May 2006 by the Florida Legislature. The predecessor entities were the Florida Space Authority, Florida Space Research Institute and Florida Aerospace Finance Corporation.

may be designed and constructed in the future (3-5 years). Land for a training center and parking has also been reserved in the southeast corner of the project site (currently labeled as visitor center parcel).

5.1.3 KSC Pad 39A, 39B Redevelopment

The *Final Environmental Assessment for Multi-Use of Launch Complexes 39A and 39B, John F. Kennedy Space Center, FL, June 25, 2013,* document was reviewed for future planned development and because it addresses the future use of LC-39A for the SpaceX Falcon Heavy launch vehicle. The Proposed Action includes the following. First to construction of a Horizontal Integration Facility (HIF) at one or more of five potential locations, Second, to provide RP-1 Storage at individual locations or at a common location, and third to allow multiple user launch capabilities at LC 39A and LC 39B. Flight operations at LC 39A and LC 39B by multiple users would require construction of new RP-1 storage and transfer facilities. Options for these facilities include either individual storage locations at each launch pad or at a centrally located common storage facility. Delivery of RP-1 by railcar is being considered and, therefore, railroad connections to chosen storage location(s) would be necessary to provide a mode of transport for incoming fuel supplies. These railroad connections would be constructed within existing roadways. A HIF is proposed to provide housing for launch vehicle preparation prior to launch. Five location options for the HIF were reviewed. Launch vehicles include Atlas V, Delta IV, Delta IV Heavy, Liberty, Falcon 9, Falcon Heavy, Antares, RSLV-S, Athena IIc, Xaero and the SLS. The potential for up to two launches per month by NASA and/or commercial users would provide the ability to continue space exploration.

The construction of new facilities and associated infrastructure, modifications of existing facilities and infrastructure, and proposed launch procedures and activities would be consistent with existing KSC activities and pose no new types of impacts. The maximum number of launches would be no more than two per month in any combination of users for the Proposed Action. Additional current actions at KSC include the Ground Systems Development and Operations (GSDO) leading the center's transformation from a historically government-only launch complex to a spaceport with activity involving government and commercial vehicles alike. The program's primary objective is to prepare the center to process and launch the next-generation vehicles and spacecraft designed to achieve NASA's goals for space exploration. To achieve this transformation, program personnel are developing the necessary ground systems while refurbishing and upgrading infrastructure and facilities to meet tomorrow's demands. This modernization effort keeps flexibility in mind, in order to accommodate a multitude of government, commercial and other customers. KSC future actions include the launch of suborbital vehicles from the SLF and LC 39A locations. This would expand KSC's spaceport capabilities to include the processing, launch, and recovery of horizontally and vertically launched suborbital rocket powered vehicles. The Finding of No Significant Impact (FONSI) for this action was published in December 2013. Based on the findings of that FONSI, SpaceX began construction of their HIF, and refurbishment of the launch pad in 2014. The new facility is expected to be completed in 2016, with the first launch of a Falcon Heavy vehicle in late 2016 or early 2017.

5.1.4 Shiloh Launch Complex

Space Florida proposes to develop a non-Federal launch site that is State-controlled and State-managed. Space Florida's goal is to provide launch site options other than Federal installations/ranges. Under the Proposed Action, Space Florida would construct and operate a commercial space launch site (known as the Shiloh Launch Complex) consisting of two vertical launch facilities and two off-site operations support areas. This facility is located

immediately north of KSC property, includes approximately 150 acres and straddles the Volusia County and Brevard County boarder. The Shiloh Launch Complex would accommodate up to 24 launches per year (12 launches per vertical launch facility), as well as up to 24 static fire engine tests or wet dress rehearsals per year (12 static fire engine tests or wet dress rehearsals per vertical launch facility). The vehicles to be launched include liquid fueled, medium- to heavy-lift class orbital and suborbital vertical launch vehicles. The FAA is the lead Federal agency for preparing an Environmental Impact Statement (EIS) in accordance with NEPA. The U.S. Army Corps of Engineers, NASA, U.S. Fish and Wildlife Service, National Park Service, and the Florida Department of State, Division of Historical Resources, State Historic Preservation Office are cooperating agencies. The FAA published a Notice of Intent (NOI) on December 26, 2013, held scoping meetings in the local area on February 11th and 12, 2014. A summary of those meetings were published in 2014. A draft of the EIS is not yet available for review.

5.1.5 Cape Canaveral Spaceport

Based upon Space Florida's *Cape Canaveral Spaceport Complex Master Plan* developed in 2013, the following paragraphs describe plans for future activities. The Cape Canaveral Spaceport (CCS) primarily consists of Kennedy Space Center (KSC) and the Cape Canaveral Air Force Station (CCAFS), as geographically defined by section 331.304 of the Florida Statutes. Section 331.360(3) of the Florida Statutes requires Space Florida to "develop a spaceport master plan for the expansion and modernization of space transportation facilities within spaceport territories "to meet current and future commercial, national, and state space transportation requirements." The Master Plan provides information and analysis to guide Space Florida in its efforts to face the market, grow the space industry, and attract commercial space, technology, and life science related businesses through expansion and modernization of facilities infrastructure at the CCS. During the past 10 years, Florida has invested over $500 million in financing and infrastructure at the CCS in support of commercial, national and state space transportation requirements. Those funds, in part provided efforts for a FAA Launch Site Operator License for LC-46. This would allow Space Florida to offer the site for launches of solid- and liquid-propellant launch vehicles to launch operators for several types of vertical launch vehicles, including 139 Athena-1 and Athena-2, Minotaur, Taurus, Falcon 1, Alliant Techsystems small launch vehicles and launches of Minuteman-derivative booster vehicles. Space Florida proposes to support a maximum of 24 annual launches from LC-46, including 12 solid propellant launches and 12 liquid propellant launches. The proposed launch vehicles and their payloads would be launched into low earth orbit or geostationary orbit. All vehicles are expected to carry payloads, including satellites (FAA, 2008). Much of the future plans involve re-development and re-use of legacy facilities at both KSC and CCAFS. Space Florida is also discussing adding a rail component to the transportation plans, which parallels current efforts by the Port of Canaveral for a connecting rail line.

5.1.6 Port Canaveral

The Port is located on the coastal barrier island along the East Coast of Central Florida and abuts the Atlantic Ocean on the east, the City of Cape Canaveral on the south, the Banana River on the west, and CCAFS on the north. It is composed of two sections – the Harbor and the Barge Canal. The Canaveral Harbor is a man-made, deepwater Port located on the barrier island north of the City of Cape Canaveral. The Port also controls the land on Merritt Island known as the Barge Canal, which includes the man-made canal connecting the Indian and Banana Rivers and State Road 528 also known as the Beachline. The Port's authority for Master Plan is provided for in the Port's Charter and by Florida Statute, which requires each deepwater Port in Florida to have a master plan. In addition, state law requires each deepwater Port that has spoil disposal responsibility to provide for or identify disposal sites for dredged

materials in the future land use to ensure proper long-term management of dredged materials. The Port has played a major role in addressing the regional transportation needs. In addition to the maritime transportation facilities of the Port, SR 528, also known as the Beachline, is constructed on property made available by the Port. The Port also constructed a flyover on SR 401 to improve traffic flow among cruise terminal, Port, and Canaveral Air Force Station traffic. The Port has conducted regular traffic analysis to ensure the free flow of traffic within the Port. As a result of these studies, the Port has widened a portion of George King Boulevard and has plans to widen the remainder of the road in the future. The Port is working with the Cities of Cocoa Beach and Cape Canaveral to develop an aquifer storage and recovery system to temporarily store reclaimed water to be used for irrigation purposes. The Port is also designing a pump out system for waste from gaming ships to address the dumping of such wastes off-shore. The Port has also implemented a comprehensive program of environmental protection including manatees, sea turtles, right whales, dunes, and addressing beach erosion. A summary of the Port's future development plans includes but is not limited to the following areas.

- Complete Cruise Terminal #1 (Completed in 2015)
- New 10 Year Royal Caribbean Contract with two 5-year Options – *Explorer of the Seas*
- New 3-year NCL contract – Home Port Ship Fall 2015 (completed)
- New Carnival Ships – *Sunshine* – *Liberty*
- 3 Disney Home Port Ships; adding – *Magic* Spring - *Wonder* Fall
- Add Holland America – Celebrity – Princess – Cunard – Regent
- Develop new Cruse Terminal #3 (In Progress)
- Develop Backup areas of 20 acres for container areas and an expanded 35 acres for autos and other commodities (In progress)
- Morton Salt signed a 10-year lease expansion including 2 added acres and expanded plant, facilities and warehouse
- Increase current 17,000+ jobs to 50,000
- Connecting via Rail to Inland Ports, include rail line via NASA property (In discussion)
- Beeline (528) Widening-8 lanes Orlando to I-95, 6 lanes to the Port
- Cruise will grow from 4 million to 5 million passenger movements in 2016 and to 6 million by 2018
- Cargo growth will triple to over 12 million tons in the next 3 years

Many of these actions involve federal agencies and will require NEPA coordination and documentation.

5.2 CUMULATIVE IMPACT ANALYSIS ON RESOURCE AREAS

The following resource areas briefly discuss the cumulative impacts associated with the Proposed Action interacting with relevant past, present, and reasonably foreseeable future actions. As described in Section 4, no direct impacts were identified for historical and cultural resources, geology and soils, health and safety, environmental justice, and 4(f) properties. When considered with other past, present, and foreseeable future actions, the Proposed Action would therefore not contribute to any cumulative impacts associated with these resource categories and are therefore not considered further in this analysis.

The actions listed in Table 5.1 as well as other projects described above, considered in conjunction with the Proposed Action, formed the basis for the cumulative impacts analysis. This section analyzes the interaction of the Proposed Action with the actions described in the section preface and evaluates the potential cumulative impacts from these interactions. With the exception of land use, air quality, noise, socioeconomics, and transportation the ROI for each resource area discussed below is limited to CCAFS and KSC. The ROIs for land use, air quality, noise, socioeconomics, and transportation extend beyond CCAFS and KSC and are consistent with the ROIs presented in the past EA for LC-13 reuse (USAF 2005), Falcon 9 v1.1 operations at LC-40 (USAF 2013), operations at KSC 39A and 39B (NASA 2013), and the 2014 EA.

Land Use/Visual Resources

The Proposed Action would not result in any significant impacts to land use compatibility since CCAFS and KSC currently allow space vehicle operations. Operating as a "landing pad" for a launched vehicle would be consistent with both the CCAFS General Plan and its mission. It would also be consistent with past operations at LZ-1and does not limit use of surrounding launch complexes even if there would be minor operational constraints during launches. Furthermore, the Proposed Action would not generate impacts on visual resources within the flight range other than a possible short-lived visible engine re-light and vehicle contrail.

Cumulative impacts on land use from increased launch vehicle and landing operations at KSC and CCAFS would be minimal. These impacts would be a result of increased quantities and types of commodities used and stored at the KSC's shuttle landing facility or other existing facilities, as well as potential additional land use category designations. New safety setbacks may also be established as necessary, but these would be determined during the individual projects' licensing process with the FAA. Development of the Vertical Take Off and Landing (VTOL) site at KSC is expected to have a moderate effect on land use due to the undisturbed/undeveloped nature of the area. Currently, the land at KSC is set aside primarily for conservation, being managed by the Merritt Island Natural Wildlife Refuge (MINWR) for wildlife and habitat diversity. However, relatively few natural areas on KSC are being converted to operational use. Mitigation for impacts to these sites could be accomplished through habitat restoration in other degraded areas of KSC, which similar to CCAFS, has ongoing efforts installation-wide to improve habitat for managed species. Additionally, since the Proposed Action at LZ-1 is being constructed on developed land and in natural habitat that would be mitigated, the overall cumulative impact to natural areas is negligible to minor. As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on land use and visual resources is considered negligible and less than significant. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact to the overall negligible and less than significant effect on land use and visual resources.

Noise

A short-term, small increase in the noise level received in the community from the proposed landing of up to three Falcon first stage booster vehicles may occur; the event would be within 10 or 15 minutes of a launch and would therefore be a relatively short-term impact. Sonic booms for a returning vehicle would occur since the vehicles would transition from supersonic speeds to sub-sonic speeds. USAF studies accomplished to support the December 21, 2015 landing indicated over pressure would range from about 7psf over the landing pad area to about .5 psf at extended ranges and surrounding areas. A copy of a USAF study summary can be found in Appendix C. Actual measurements by SpaceX recorded a maximum value of 5.48 psf near the landing pad for the July 18, 2016 landing

(Appendix D), which would not be considered a significant impact. The noise associated with small lift type RLVs landings addressed in NASA's 2013 EA is also considered insignificant. Noise associated with the construction, operation, and launch/landing activities associated with the VTOL are common to each site. Differences in overall impact are associated with the magnitude in changes in land use and proximity to non-direct launch workplaces. Minimal impacts to the current noise environment would be observed at current launch complex sites. The nearest communities are not expected to experience a significant adverse impact. Construction related noise would be local, short term, and would be managed using OSHA guidance.

As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions from noise is considered not significant. Additionally, two simultaneous launches in the ROI would never occur. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact to the overall minor and less than significant impact from noise.

Biological Resources

The landing event would not be expected to have a significant impact on terrestrial vegetation and wildlife, marine species, or protected species. An anomaly on the landing pads such as an explosion could injure or kill wildlife found adjacent to the launch pad or within debris impact areas. However, payloads would not be involved and the fuel load would be substantially less than a typical launch. An improbable mishap from downrange would occur over the open ocean and would not likely jeopardize any wildlife, given the relatively low density of species within the surface waters of these open ocean areas (USAF, 1998). Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area.

Potential cumulative adverse impacts would occur for the Florida scrub-jay and eastern indigo snake. When evaluated with other projects occurring or proposed on CCAFS KSC or the Port of Canaveral area, the proposed removal of approximately 23 acres of occupied/potential habitat would result in a reduction of available breeding habitat, as well as a reduction in the availability of scrub habitat for restoration. However, the restoration of approximately 46 acres of habitat within LMU 33 (mitigation for the Proposed Action) would result in habitat that could support additional scrub-jay territories. The current INRMP goal is for CCAFS to support 200 breeding pairs of jays. Cumulative impacts on the gopher tortoise are not anticipated with the Proposed Action. Gopher tortoises observed within any area to be impacted by ground disturbance would be excavated and relocated to an onsite recipient area approved and managed by the USAF. Cumulative Impacts on beach mice are not anticipated for the Proposed Action. Cumulative impacts on sea turtles have the potential to occur. The new facilities would result in more exterior lighting than is currently present at LZ-1. Adherence to the Light Management Plan and Air Force lighting policies would help reduce these impacts. Amber LED lighting would be used to minimize potential adverse impacts on nesting turtles and/or their young. Cumulative impacts on American alligator, Piping Plover, and Red Knot are not expected to occur with the Proposed Action. There are no activities proposed within the onsite ditch or the shoreline.

The overall cumulative effect of other past, present, and reasonably foreseeable future actions (reuse of existing facilities) on biological resources would not be significant. When considered with other past, present, and foreseeable future actions, it is anticipated that operations would not contribute a significant incremental impact to the overall effect on biological resources.

Mitigation actions discussed in Section 4 and the BO shown in Appendix D would be accomplished to minimize the effect on threatened and endangered species due to construction activities. Impacts from other construction related actions would not be significant. The numbers of listed species that occur within areas which may be reused are low, and loss of the habitats at sites would not contribute to the decline of any protected species populations. Limited acreage of scrub lost would be small and could be mitigated through restoration of degraded scrub habitat elsewhere on KSC and CCAFS. Further return landings on land and not in the ocean as traditionally done would be a benefit from a cumulative standpoint for each landing event. As a result, the overall cumulative effect when considered with other past, present, and foreseeable future actions, it is anticipated that the Proposed Action would not contribute a significant incremental impact to the overall effect on biological resources.

Air Quality

CCAFS, KSC and Brevard County are in an "Attainment" area and the operational emissions for the proposed Falcon landing represent an extremely small percentage of the Brevard County regional emissions and would not cause an exceedance of any NAAQS, therefore would not cause a significant impact on air quality.

The public in and around the landing sites is also unlikely to be exposed to concentrations of any vehicle emissions that exceed the allowable public exposure limits adopted by the range safety organizations. Potential emissions resulting from RLV landings would be small in comparison to launches of the Falcon 9, Falcon Heavy, Delta, Atlas, Titan, Saturn V rockets, and the Space Shuttle. Therefore, operations would have minimal cumulative impacts. Carbon emissions from transportation associated with the RLV site locations are expected to be less than what is emitted as a result of the energy used for facilities or building and transporting new rocket stages, rather than reusing them.

As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on air quality is considered minor and not significant. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact on air quality.

Climate

The construction and additional landing operations at LZ-1 would not be expected to have a significant impact on the climate, locally or globally. The discussion about GHG production in Section 4 indicates that the construction and landing operation contributions to potential increase globally is extremely small, essentially less than can be measured. The potential effect on the Proposed Action by global climate change may only be seen in potential ocean level rise, which would not affect the landing pad structures

As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on climate is considered minor and not significant. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact on climate.

Water Resources including Wetlands and Floodplains

Falcon Heavy landing events would not have a significant impact on wetlands and floodplains. Other new construction at CCAFS and KSC is expected to be limited and would occur at a relatively slow pace. Any direct impact to wetlands would require compensatory mitigation in the form of wetland creation or payments worked out with the SJRWMD and with the USACE. Cumulative loss of floodplain function and values in the area due to additional development (from several projects) in the floodplain. Although floodplains are generally avoided, if construction is justified then specifications would adhere to floodplain standards and requirements.

Construction of new facilities in the surrounding (non-federal) area supporting Port of Canaveral development or Shiloh may occur sooner and may have impacts which would be defined in respective NEPA documentation. With the implementation of normal BMP controls in the form of a stormwater management system, development of the future sites would have a minor cumulative effect on hydrology and water quality. Regionally, vegetated lands are increasingly being covered by impermeable surfaces (buildings, roads, parking lots), which increases runoff and limits replenishment of groundwater. Although stormwater management has been implemented for construction efforts since the 1990s, these retention and detention ponds are sometimes not able to accommodate large amounts of water associated with heavy rainfall, resulting in some excess runoff flowing into canals and wetlands. However, because extreme rainfall events are rare, these quantities are generally small, and can be absorbed by water management systems.

The cumulative effects on surface water quality in local waterways from the development would be minor. Surface water discharges from the selected site would be managed according to requirements of the SJRWMD conditions for issuance of Environmental Resource Permits. Water quality impacts would be minimized by the design, operation, and maintenance of a stormwater management system that would meet or exceed all requirements of the SJRWMD (SJRWMD Rule 40C-42.026(4)). Stormwater analyses would be conducted to determine the amount of land necessary to provide adequate treatment and storage capacity, for both pre- and post-developed conditions. The resulting stormwater storage and treatment areas would help filter much of the suspended solids out of the water percolating into the ground. In addition, the biological and chemical processes that take place in stormwater detention/retention ponds would reduce the amount of contaminants found in runoff, and fewer pollutants would make their way into the water table. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on water resources is considered less than significant. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact on water resources.

Hazardous Materials/Hazardous Waste

Operations supporting the Falcon landings would use a small amount of products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, propellants, and chemicals. Hazardous material associated with payload components or residual fuels would not exist. Continued implementation of existing handling and management procedures for hazardous materials, hazardous wastes, and solid wastes generated would limit the potential for impacts. Numerous types of hazardous materials are used to support the missions and general maintenance operations at CCAFS and KSC. Management of hazardous materials is the responsibility of each individual or organization and is regulated under RCRA (40 CFR 260-280) and Rule 62-730. Although releases of hazardous materials and wastes can occur in the environment, it is not expected that there would be substantial

cumulative contamination issues as a result of the Proposed Action. Safeguards are in place to minimize the release of toxic chemicals in the environment, and rapid emergency response plans would ensure that accidental spills would be cleaned up quickly.

Land clearing and construction practices for foreseeable future actions discussed in section 5.1.2 are not expected to introduce hazardous materials and hazardous wastes into the environment. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions from hazardous materials and waste are considered minor and less than significant. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a negligible incremental impact from hazardous materials and waste.

Utilities and Transportation

There would be a low demand for additional electrical power for the Proposed Action and therefore the direct impact would be negligible. Water supply requirements would be minimal, less than the need during a launch sequence. Current and future actions would require a water supply in order to successfully function. Water for CCAFS and KSC is acquired from the City of Cocoa's municipal potable water distribution system under a long-term agreement which has a 37 million gallons per day (MGD) capacity. The City's contract is with the U.S. Government and includes KSC, CCAFS and Patrick Air Force Base. A total of 6.5 MGD is allocated for all three facilities. Historically, total consumption of water from the city for all three facilities has averaged only 3.7 MGD.

From a transportation standpoint, as Port Canaveral continues its growth plans, additional shipping and follow-on passenger and cargo transportation needs will increase. More cruise ships are scheduled for arrivals and departures, as well as cargo shipping. The Proposed Action would reduce the potential need for ocean-going vessels associated with a first-stage recovery operation to transit the Port water-ways. Additionally, every re-landed first stage vehicle at LZ-1 would eliminate the need for over-the-road transportation of a new first-stage delivery from Texas. Therefore, there would be a positive effect on the cumulative impact of the sea port use and heavy over-the-road transport. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on utilities and transportation are considered negligible and less than significant in the context of supply. Transportation would be a slightly positive effect.

Socioeconomics

The Proposed Action would not significantly affect the local housing market. The Proposed Action would generate no negative socioeconomic impacts on the region and may generate a small one-time positive impact during construction activities. The Spaceport (KSC and CCAFS) is Brevard County's major employer. The presence of these employers causes a chain of economic reactions throughout the local region and nearby counties. These employment opportunities and resultant local economic contributions (housing, services, and recreation) cumulatively have a positive influence on socioeconomics, through contributions to the local economy. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on socioeconomics is considered beneficial and not significant. When considered with other past, present, and foreseeable future actions, it is anticipated that the Proposed Action would contribute a noticeable incremental minor beneficial impact on socioeconomics.

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The Florida State Clearinghouse reviews NEPA documents for projects planned at CCAFS pursuant to Gubernatorial Executive Order 95-359; the Coastal Zone Management Act; 16 U.S.C. SS 1451-1464 as amended; and NEPA, 42 U.S.C. §4321, §§4331–4335, and §§4341–4347. The State of Florida Clearinghouse sends copies of the draft SEA to applicable regulatory agencies for review and submits any comments to be addressed in the final SEA. Therefore, this SEA was submitted for Clearinghouse review in June 2016; concurrence letter and comments are located in Appendix H. This SEA's process is also required to follow, and has been following, regulatory coordination, approval, and permits with other agencies other than the USAF and FAA. These regulatory coordination, approval, and permits include:

- Consultation with the USFWS pursuant to the federal ESA and the MBTA.
- Informal Consultation with the NMFS Magnuson-Stevens Fishery Conservation and Management Act MSFCMA, the MMPA, and ESA.
- Coordination with DOT to renew and/or maintain transportation permits.
- Consultation with Florida SHPO
- SJRWMD ERP
- FDEP Pre-Construction Permit
- USACE CWA Section 404 permit & tribal consolations

The USAF invites public participation in decision-making on new proposals through the NEPA process. Public participation with respect to decision-making on the Proposed Action is guided by 32 CFR 989.24. Copies of the Draft SEA and FONSI/FONPA will be made available to the public in local public libraries and the local 45 SW Public Affairs Office. A scoping notice was published in the local newspaper on July 3-5, 2016 for a 30-day comment period. Comments were received from seven individuals, two of which were from news organizations; all comments are included in Appendix I and have been considered in the development of the SEA. In summary, all of the emails requested more information when available; two of the seven expressed positive support for SpaceX plans. One of the news organizations asked several specific questions related schedule, facility location, and potential challenges during this process. Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. Copies of the Draft SEA and FONSI/FONPA will be made available to the public in local public libraries and the 45 SW Public Affairs Office at Patrick Air Force Base. A Notice of Availability (NOA) will also be published in the local newspaper announcing the availability of the documents. Agencies, organizations, and members of the public with a potential interest in the Proposed Action are urged to participate. A record of agency coordination and public involvement associated with the documents will become part of the official file and will be considered in the final version of the SEA and in the decision making process.

7.0 LIST OF PREPARERS

NAME	TITLE-RESPONSIBILITY	EDUCATION	YEARS EXP.
John Kaiser PMP	Project Manager: Document Preparation and Review	B.S. Engineering, Physical Science	29
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Steve Volpe, PG	Soils and Geology, assist in Wetlands and Gopher Tortoise survey, Document Development	B.S. Conservation 2008; M.S. Ecology 2010	13
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Matthew Humphrey, EI	Water Resources, Storm water, Geology, Document Development	BS Civil Engineering	3

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16 U.S.C. 668-669c. Bald and Golden Eagle Protection Act.

16 U.S.C. 1453 Coastal Zone Management Act.

16 U.S.C. 3501 et seq. Coastal Barrier Resources Act.

32 CFR.989.24- USAF EIAP requirements

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Appendix A
2014 FONSI/FONPA for LZ-1 Original EA

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
FINDING OF NO PRACTICABLE ALTERNATIVE (FONPA)

Environmental Assessment (EA) for the
Space Exploration Technologies Vertical Landing of the Falcon Vehicle and Construction at Launch Complex 13
Cape Canaveral Air Force Station (CCAFS), FL

INTRODUCTION

Pursuant to Council on Environmental Quality (CEQ) regulations, the provisions of the National Environmental Policy Act (NEPA) of 1969, 40 Code of Federal Regulations (CFR) Parts 1500-1508, and *Environmental Impact Analysis Process* (32 CFR Part 989), the U.S. Air Force (USAF) adopts the EA prepared by Space Exploration Technologies Corporation (SpaceX) to address the potential environmental consequences associated with the proposed action at Launch Complex-13 (LC-13), CCAFS, FL. That EA is attached and incorporated by reference. The EA analyzed impacts associated with clearing land, construction of landing pads, and operations that support landing a Falcon 9 first stage vehicle. The USAF has determined that the EA is current, satisfactorily meets 32 CFR Part 989 requirements, and adequately addresses impacts associated with conducting landing operations of the Falcon first stage at LC-13 at CCAFS.

In accordance with 32 CFR Part 989.9, the USAF released the draft EA for public review along with a draft FONSI and FONPA for actions affecting USAF property. These documents were made available to the affected public for a 30-day review/comment period commencing on November 6, 2014. The affected public was notified by advertisements placed in a locally viewed newspaper. The documents were also made available by placing them on file in two local public libraries, the 45 SW Public Affairs Office, and the Patrick Air Force Base public website. No public or agency comments were received during this period.

Proposed Actions Occurring on USAF Property

The Proposed Action would include constructing an approximately 200 foot by 200 foot concrete landing pad at LC-13 to support the landing and weight of a Falcon first stage vehicle. The main pad would be constructed on previously disturbed land, and it would be surrounded by an approximately 750 foot diameter compressed soil and gravel, flat pervious surface. Four additional, 150 foot diameter concrete "contingency" pads would also be constructed. The purpose of these pads would be to accept the safe landing of a vehicle should last-second navigation and landing diversion be required. The two western-most pads would be constructed on previously disturbed land. The two eastern-most pads would be constructed in previously undisturbed land; two access roads would also be constructed to those pads for crane movement following a landing. Supporting infrastructure for water, electrical, communications, and nitrogen would also be constructed.

The Proposed Action would require clearing existing vegetation from the land between the LC-13 operations area to the ditch to the east, and to the western area of the Atlantic Ocean beach dune. Site grading would be required between LC-13 and the ditch in order to provide a flat compacted area to construct the two eastern-most landing pads, connecting roads, and the eastern half of the main pad and surrounding compacted soil.

Following a normal launch from LC-40 or LC-39A, the Falcon first stage would "fly-back" to LC-13 and land for potential reuse, rather than splashing down in the Atlantic Ocean. Once the first

stage is in position and approaching its landing target, two of three "restarted" engines would be shut down to end the boost-back burn. The landing legs on the first stage would then deploy in preparation for a final single engine burn that would slow the first stage to a velocity of zero before landing at the landing pad at LC-13. Following safing activities, a crane would place the vehicle on a specially designed flat-bed truck for transport to a processing facility. SpaceX anticipates conducting up to 12 landings per year.

ENVIRONMENTAL CONSEQUENCES

The EA addressed impacts associated with the No Action Alternative and the Proposed Action. Other alternatives were considered but not carried forward for analysis. Complexes at KSC were considered, however, no sites were readily available or within reasonable distances from the launch and stage refurbishment location. Several complexes at CCAFS were also considered including LC-1, LC-36A and B, LC-46 (both of which are currently used by Space Florida), LC-2, LC-12, and LC-47 but since implementation of those alternatives did not meet the project selection criteria; they were also not carried forward for analysis.

Effects to land use, noise, biological resources, cultural resources, air quality, hazardous materials/waste, water resources, geology/soils, transportation, utilities, health and safety, socioeconomics, 4(f) properties, and secondary impacts were assessed and presented in Chapter 4 of the EA. The analysis revealed negligible to moderate effects on those resources from direct launch operations. Likewise, cumulatively the effects to these resources would be negligible to minor as described in Chapter 5.

Since construction east of LC-13 may affect Federally-listed species or their critical habitats, consultation with the USFWS under Section 7 of the ESA of 1973 was required. In accordance with Section 7 consultation, the USAF completed a Biological Assessment for the USFWS's review which assessed construction and landing activities and their potential to result in the take of some special status wildlife species from activities such as disturbance, excavation, crushing or burial. The USAF determined that the proposed project may affect and is likely to adversely affect Florida scrub-jay, southeastern beach mouse, and the eastern indigo snake. The USFWS concurred with that determination. The USAF also determined that the proposed project may affect, but is not likely to adversely affect the loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles, the American Alligator, and the Piping Plover. The USFWS concurred with this determination. The USFWS issued its Biological Opinion (BO) in September 2014 stating that the Proposed Action is not likely to jeopardize the continued existence of any Federally listed species. In its BO, the USFWS listed terms and conditions for which USAF must comply.

Mitigation for direct and indirect impacts to the scrub-jay would help lessen or compensate for impacts caused by the Proposed Action. Provided the following mitigation measures are implemented, the Proposed Action would not substantially impact the scrub-jay population at CCAFS. Clearing would be restricted to outside nesting season; therefore, mortality associated with actual clearing activities is not expected to occur. Approximately 100 acres of potential scrub-jay, southeastern beach mouse and eastern indigo snake habitat at CCAFS would be restored over a five-year period. In its BO, the USFWS issued an "Incidental Take Statement" for this Action. The USAF proposes to restore unoccupied scrub-jay habitat at a ratio of 2:1 (one acre impacted would be compensated by two acres). The proposed areas to be restored would be located in Land Management Unit (LMU 33). This habitat restoration would also serve to mitigate any direct or indirect impacts to the southeastern beach mouse and the eastern indigo snake.

No significant environmental impacts were identified that would require the preparation of an Environmental Impact Statement (EIS). Minor to moderate impacts resulting from implementation of the Proposed Action were identified and addressed in the EA.

FINDING OF NO PRACTICABLE ALTERNATIVE

Executive Order (EO) 11988, *Floodplain Management*, dated May 24, 1977, requires Federal agencies to evaluate the potential effects of actions it may take in a floodplain to avoid adversely impacting floodplains wherever possible, to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management, including the restoration and preservation of such land areas as natural undeveloped floodplains, and to prescribe procedures to implement the policies and procedures of this EO. Guidance for implementation of the EO has been provided by the U.S. Water Resources Council in its Floodplain Management Guidelines dated February 10, 1978 (see 40 CFR 6030). Due to the location of LC-13 and the operational and safety requirements for location of the landing pads and "clear" area, portions of the proposed landing site would be constructed within a large contiguous floodplain. Construction would result in clearing less than 50 acres of vegetation within the floodplain. While this is a small area, these construction activities (namely clearing and grubbing vegetation) would nonetheless result in unavoidable encroachment and impacts to floodplain wildlife species.

The USAF formally consulted with the USFWS per Section 7 of the Endangered Species Act to minimize potential impacts on federally protected floodplain species. No significant impacts to water resources are anticipated. The USAF also conducted formal consultation with the Florida State Historic Preservation Office for potential effects to Section 106 resources at the site and with the Florida Clearinghouse for Coastal Zone Management construction. Both agencies concurred with the findings of no adverse effect to cultural or coastal zone resources.

Pursuant to Executive Order 11988, the authority delegated by SAFO 780-1 and 32 CFR part 989 and taking the submitted information into account, I find that there is no practicable alternative to this action that would avoid floodplain encroachment during construction activities and the proposed action includes all practicable measures to minimize harm to the environment.

Finding of No Significant Impact

In accordance with the Council on Environmental Quality Regulations implementing the National Environmental Policy Act of 1969 (Public law 91-190, 42 U.S.C. §§4321-4347), as amended, and 32 CFR 989, 15 Jul 1999, and amended 28 Mar 2001, an assessment of the identified environmental effects has been prepared for the proposed action at LC-13 at CCAFS. I find that the action will have no significant impact on the quality of the human or natural environments; thus, an EIS is not warranted. This decision has been made after taking into account all submitted information and considering a full range of practicable alternatives that will meet project requirements and that are within the legal authority of USAF.

Scott M. Anderson

SCOTT M. ANDERSON
SES, DAF
Director of Logistics, Installations
and Mission Support

JAN 0 8 2015

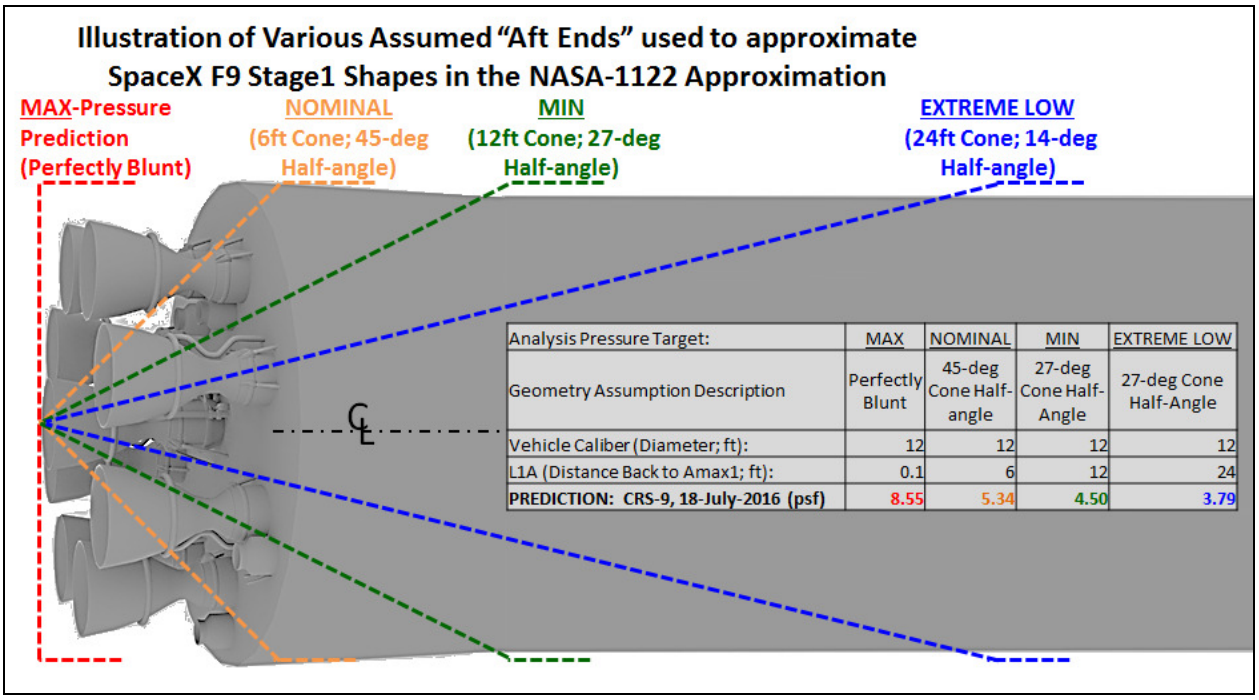
Date

Appendix B
SpaceX F9R Acoustic Test Study and Sonic Boom Model

The 45th SW/SELR group has provided unofficial analysis results using "as-flown" trajectory data for both CRS-9 and Orbcomm-2 missions. Below are the assumptions that went into the analysis and results provided on August 16th, 2016.

45 SW/SELR ASSUMPTIONS:

a. For the CRS-9 landing - as with the prior prediction for SpaceX Flyback (Orbcomm-2, December 2015) – an approximation of the "NASA-1122" (or "Carlson") Method was used, from NASA Technical Report #1122, of 1978 (modified for ease of use and calculation on modern computers).
b. The body length of Stage1 is ~156ft (modestly longer than the year-old ~135ft), to better represent the upgraded v1.2 stage, with legs folded.
c. The flyback trajectories used for this review were updated, actual "as flown" telemetries for these flights, provided by SpaceX on 9-Aug-2016 (although both were similar to the pre-flight deliveries).
d. Beyond the "near field" (~0 to 5 miles or so, in this case, where sonic boom should be relatively unaffected by meteorological conditions), there is the "mid" and "far field" (~10 and 20+ miles, respectively), where atmospheric conditions would be expected to begin having an increased effect. A "standard atmosphere" refraction attenuation (caused by cooler air at altitude, slowing and bending the wave from the Earth's surface) is imposed over this far-field, at a magnitude that is more attenuating than the original (Aug 2015) Orbcomm-2 prediction (which assumed no refraction). The CRS-9 event was observed to exceed the predicted audible/startling range of ~0.3-0.5psf by about 10 miles (~38 miles South, vs. the predicted ~28 miles South). The current standard atmospheric refraction attenuation assumptions then have been calibrated to produce near ~0.5psf overpressure at about 38 miles (as observed), for the CRS-9 flyback, and is believed to behave reasonably hereafter. Note: An additional ~20 miles of westerly sonic boom (reaching ~58 miles west to Kissimmee, FL) was observed for the CRS-9, but – based on the downloaded wind conditions at the time of flyback (~10 knots between 0-25,000ft, roughly from the East) – this additional ~20 miles of sonic boom footprint (58 vs. 38 miles) is believed to have been driven by the ambient wind, rather than intrinsic to the vehicle, so no further adjustments to the standard atmosphere refraction attenuation are assumed.
e. As shown in Figure (1), below: Historically, a range of "bluntness" for the Falcon-9 nozzle body has been exercised within the NASA-1122 approximation, to study the possible range of severity in sonic boom generation (with the more blunt an object, generally the more severe the sonic boom generation). Due to the complexity of the aft end of the Falcon-9 (with multiple canted nozzle cones, folded legs, etc) – an exact bluntness value (assessed as "LA1"; the length downstream to the larger body area) is not certain. However, the body is clearly not a "supersonic shape" (with boom-minimizing features such as delta-wing shapes or pointed forward nose spikes) – nor is the nozzlebody a homogenously-blunt flat face. For this reason, a mid-range assumption was made; a "nominal; 6ft cone, 45-deg half-angle", as shown.

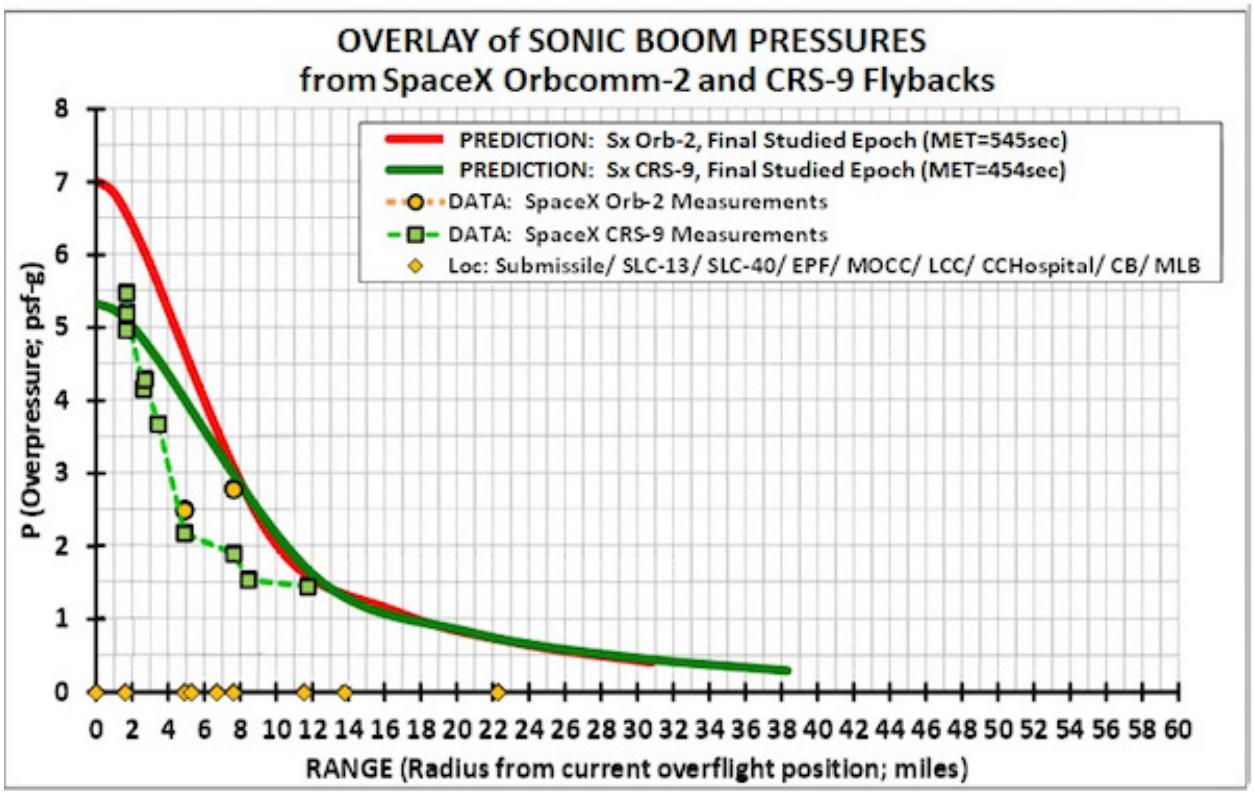


Analysis Pressure Target:	MAX	NOMINAL	MIN	EXTREME LOW
Geometry Assumption Description	Perfectly Blunt	45-deg Cone Half-angle	27-deg Cone Half-Angle	27-deg Cone Half-Angle
Vehicle Caliber (Diameter; ft):	12	12	12	12
L1A (Distance Back to Amax1; ft):	0.1	6	12	24
PREDICTION: CRS-9, 18-July-2016 (psf)	8.55	5.34	4.50	3.79

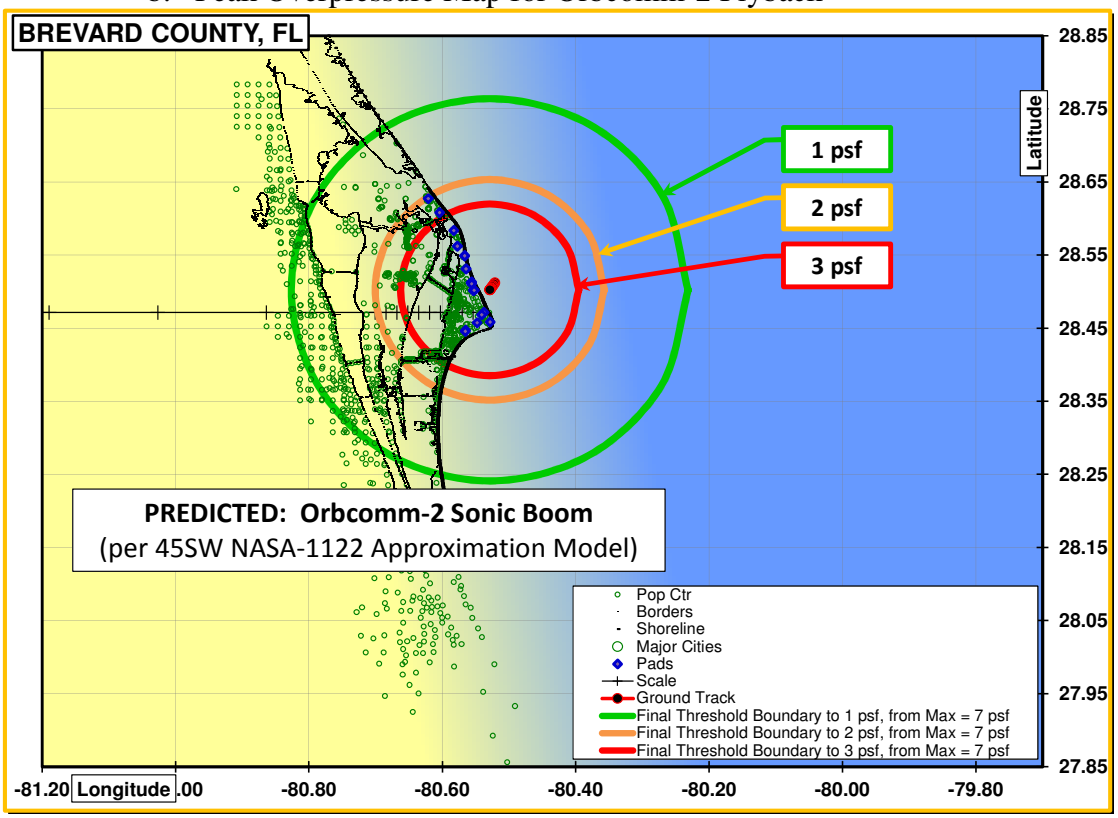
FIGURE 1: Illustration of Historical "Bluntness" Assumption Options for Falcon-9

45 SW/SELR RESULTS: The sonic boom pressure overlays for Orbcomm-2 and CRS-9 are below.

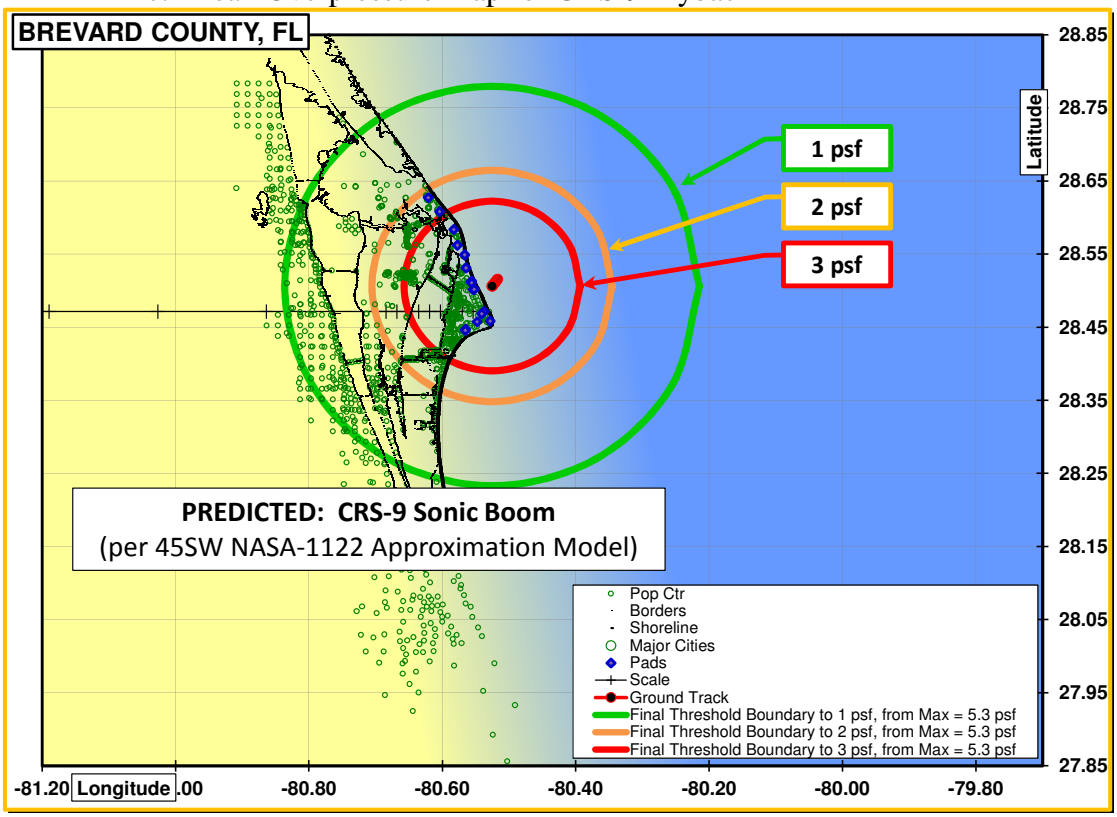
a. Peak Overpressures vs. Range (Radius from Submissile)



b. Peak Overpressure Map for Orbcomm-2 Flyback



c. Peak Overpressure Map for CRS-9 Flyback



45 SW/SELR CONCLUSION: . A significant and startling sonic boom is expected from the current SpaceX Falcon9 flyback design – peaking at ~5-7psf in the near-field, i.e. on federal property, and reaching dozens of miles beyond, i.e. off base, with over ~0.5psf. On federal property peak values (~5-7psf) far-exceed historical sonic boom values (Space Shuttle landing, Concorde, Apollo capsule, etc.; typically below ~3psf) – and thus the SpaceX Falcon9 landing at CCAFS is apparently producing the strongest sonic boom experienced for the history of Cape Canaveral operations, but remain within historical values off base when compared to Space Shuttle landings at KSC.

For a soft copy of *45SW/SELR Sonic Boom Prediction Reviews for SpaceX Flybacks Orbcomm-2 and CRS-9* please contact:

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Appendix C
FAA DNL Memo and
Noise Capture Results from SpaceX Droneship and LZ-1 Landings

MEMORANDUM **August 28, 2015**

TO: Federal Aviation Administration, Office of Commercial Space Transportation

FROM: Space Exploration Technologies

SUBJECT: Falcon Landing SEA - Noise Assessment Methodology

Space Exploration Technologies (SpaceX) is actively working on introducing reusability into their vehicle program. In 2014 an Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.); as implemented by CEQ regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508); and 32 CFR Part 989. The EA analyzed potential impacts related landing a single core of a Falcon vehicle at Cape Canaveral Air Force Station (CCAFS) and included an analysis of potential noise impacts. A finding of No Significant Impact was issued for the Proposed Action in January 2015.

A Supplemental Environmental Assessment (SEA) is currently being prepared. The SEA expands the original December 2014 EA to include additional land clearing and construction of two additional landing pads at Launch Complex 1 in order to allow the three first stage boosters of a Falcon Heavy to land at the complex.

In accordance with Federal Aviation Administration (FAA) Order 1050.1E, a significant noise impact would occur if the Proposed Action would cause noise sensitive areas to experience an increase in noise of day/night average sound level (DNL) 1.5 dBA or more at or above DNL 65 dBA noise exposure when compared to the No Action Alternative during the same time frame. “Noise sensitive” is generally defined as an area where noise interferes with the area’s typical activities or its uses.

As such, the SEA must demonstrate that the Proposed Action would not cause noise sensitive areas to experience an increase in noise of DNL 1.5 dBA or more at or above DNL 65 dBA noise exposure when compared to the No Action Alternative during the same time frame. The closest “noise sensitive area” to the location continues to be the city of Cape Canaveral which is about seven miles to the south-southwest. Additionally, all three returning stages hold the same characteristics as did the Falcon 9 first stage booster assessed in the EA.

In order to achieve this SpaceX will utilize the data and analyzes presented in the original EA. This effort included:

- A comparison of expected noise levels to previously modelled Falcon 9 V1.1 noise data.
- A comparison of expected noise levels to previously modelled Grasshopper vehicle

noise data

- Use of the same Sonic noise study for the expected landing trajectory
- Use of the previous collection of real-time F9-R noise data in order to facilitate a comparison to CCAFS landing operations.

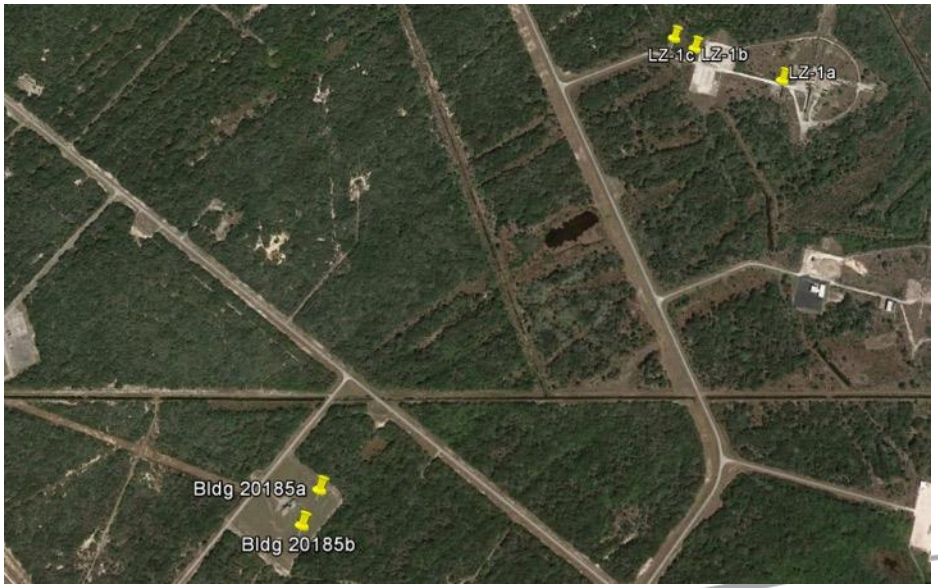
Scaling the data outlined above will allow the comparison of expected noise levels from the Falcon Heavy first-stage boosters on sensitive receptors (City of Cape Canaveral), allowing SpaceX to demonstrate compliance with FAA Order 1050.1E.

Measurements taken prior to CRS-9

- F9-21/Orbcomm-2 (12/21/2015)
  - 2.5 PSF measured at SLC-40 (5.7 mi from LZ-1)
- F9-19/Jason-3 (1/17/2016)
  - 2.3 PSF measured at JRTI
- F9-25/Thaicomm-8 (5/27/2016)
  - 2.2 PSF measured at OCISLY

Sonic Boom Measurements: CRS-9 (7/18/2016)

Location	Distance from LZ-1 (miles)	Measurement (psf)
LZ-1 (a)	0.07	4.97
LZ-1 (b)	0.22	5.48
LZ-1 (c)	0.25	5.20
Bldg 20185a	1.05	4.16
Bldg 20185b	1.11	4.29
Hangar AO	2.3	3.68
LC-40	5.52	2.18
LCC	5.97	1.90
LC-39A	9.29	1.54
Offsite	10.13	1.45



Observations from CRS-9

- Similar to Orbcomm-2
  - No damage to any SpaceX facilities or vehicles on base, including LZ-1.
  - No broken/cracked glass reported at the landing zone or at any SpaceX facilities
  - No malfunctioning equipment at the landing zone or at any SpaceX facilities
  - No noted or reported or observed impacts to any species in the landing zone or at any SpaceX facilities

- Reports of sonic boom being heard in Orlando
- Reports of 911 calls made at the time of the boom

Appendix D
USFWS February 12, 2016 Amended Biological Opinion and copy of BA

United States Department of the Interior
U. S. FISH AND WILDLIFE SERVICE
7915 BAYMEADOWS WAY, SUITE 200
JACKSONVILLE, FLORIDA 32256-7517

IN REPLY REFER TO:
FWS Log. No. 04EF1000-2014-F-0259

February 12, 2016

Mr. Michael Blaylock, Chief, Environmental Conservation
Department of the Air Force, 45th Space Wing
45 CES/CEIE
1224 Jupiter Street
Patrick AFB, Florida 32925-3343
(Attention: Angy Chambers)

RE: Additional Requests for Re-initiation of Section 7 Consultation: SpaceX Vertical Landing at Launch Complex 13 (Landing Complex 1), Cape Canaveral Air Force Station, Florida

Dear Mr. Blaylock:

Our office has reviewed the 45th Space Wing's (45 SW) correspondence dated July 23, 2015. The 45 SW again has requested re-initiation of section 7 consultation as a result of significant modifications by SpaceX to the original proposed site plan. These modifications involve the removal of four contingency landing pads due to improved radar landing accuracy, and the construction of two additional large landing pads for the purpose of supporting the landing of the Falcon Heavy three first stage vehicles. The changes will result in an increase in temporary site lighting during vehicle reentry and recovery due to the first stage rockets, water cannons, and portable pad lighting. In addition, construction of the two new pads will result in the clearing of an additional 23 acres of potential Florida scrub-jay habitat. Impacts to scrub-jay habitat from the original site design were addressed in our Biological Opinion (BO) dated September 17, 2014, and to nesting and hatchling sea turtles in an amended BO dated November 4, 2015. The latter included a reasonable and prudent measure to revise the site light management plan, which has been completed (Revision 7).

As a result of the further modifications, we are providing this second amendment to the September 17, 2014 BO and its November 4, 2015 amendment. This amendment addresses the impacts of the additional site lighting and the minimization measures needed for nesting and hatchling loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*) and hawksbill (*Eretmochelys imbricata*) sea turtles, and land clearing impacts and minimization measures for the Florida scrub-jay. We submit the following in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*).

The U.S. Fish and Wildlife Service (Service) provided the 45 SW a Biological Opinion in November 2008 (2008 BO) that covered the effects of lighting on nesting and hatchling sea turtles for the previously-mentioned species at both Cape Canaveral Air Force Station (CCAFS) and

Patrick Air Force Base (PAFB). The information in the 2008 BO relative to Status of the Species, Environmental Baseline, Effects of the Action, Cumulative Effects, and Conclusion (no jeopardy) remains generally current with two exceptions. The Service on September 22, 2011 designated nine distinct population segments (DPS) of the loggerhead sea turtle (76 FR 58868) and updated their status. Loggerhead sea turtles nesting at CCAFS and PAFB are part of the Northwest Atlantic DPS. The listing status of that DPS remained as threatened, so the DPS designation and status update for these turtles will not change the conclusion, RPMs and T&Cs of the 2008 BO. In addition, the Service published a final rule on July 10, 2014 (79 FR 39756) designating critical habitat for the Northwest loggerhead DPS. Due to the habitat protection and conservation measures in place at both CCAFS and PAFB that are reflected in the 45 SW's Integrated Natural Resource Management Plan and various individual active BOs, the 45 SW was exempt from this critical habitat designation. The exemption means that the absence of a critical habitat assessment in the 2008 BO remains valid.

Incidental Take Statement

Amount or extent of take anticipated

Sea turtles

The Service anticipates that nesting and hatchling sea turtles present within an action area that includes the beach approximately 2.5 miles northwest and southeast of Launch Complex-13/Landing Complex-1 during first stage rocket booster landing and the post-landing processing operations, may be taken from the additional lighting associated with those actions. The incidental take is expected in the form of direct and indirect harm to nesting and hatchling sea turtles resulting from misorientation or disorientation by the operational lighting that results in post nesting and hatching turtle movement in directions other than immediately towards open marine waters. Direct harm includes mortality from predation, desiccation, adverse physical impacts with pedestrians, vehicles, and equipment on or contiguous to the beach, and entrapment within vegetation and other natural landscape features, and within man-made structures, holes, ruts, etc. Indirect harm includes a reduced survivorship probability in post hatchling turtles due to yolk depletion resulting from lighting misorientation or disorientation that increases hatchling time spent on a beach before reaching open marine waters.

The 2008 BO established an annual level of take of sea turtles for all lighting present on CCAFS and PAFB at that time of 3% of all hatchlings at each installation, as well as a 3% take of adult females nesting at each installation due to disorientation/misorientation caused by lighting. Since that BO has been in effect, the levels of take at CCAFS has ranged from 0.26% to 2.53%. The high range represented the 2015 take figure that included six nests on the adjacent Kennedy Space Center Beach, and attributed to Launch Complex 41, its Vehicle Integration Facility, and Launch Complex 37. This situation is under investigation, and any lighting/monitoring issues identified are expected to be corrected prior to the beginning of the 2016 major sea turtle nesting season. Based on this and the preponderance of past annual disorientation being well under the 3% threshold, we anticipate that the additional take from the proposed project will not appreciably add to those figures, and will not exceed the 3% threshold established for nesting and hatchling sea turtles at each installation under the 2008 BO. We therefore are applying that take threshold to the project.

Scrub-jays

The Service anticipates the loss of approximately 23 acres of potential scrub-jay habitat.

Effects of the take

In this amended BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the five species of sea turtles and the Florida scrub-jay, or the destruction or adverse modification of any designated critical sea turtle nesting habitat.

Reasonable and prudent measures

The incidental take statement provides nondiscretionary measures that are necessary and appropriate to minimize the impact of incidental take. The Service's view is that the following reasonable and prudent measures (RPM) are necessary and appropriate to minimize impacts of incidental take of the five species of nesting and hatchling sea turtles and Florida scrub-jay, from some of the additional operational lighting and land clearing, respectively, associated with the proposed modified action. These measures have been developed in coordination with the 45 SW.

- Adherence to the reasonable and prudent measures included in the November 2008 BO on light management activities at CCAFS and PAFB, except as noted in the below
- Additional revision of the approved a site-specific LMP (Revision 7) in accordance with the USFWS's 2008 Programmatic BO, the September 2014 site-specific BO, the 45 SW Lighting Instruction, and to the maximum practical extent the Florida Fish and Wildlife Conservation Commissions' Sea Turtle Light Management Guidelines. This revision shall reflect the site modification and lighting changes
- LMP compliance inspection, monitoring, and enforcement by the site operator, SpaceX, and personnel from the 45 SW Civil Engineering Squadron/Civil Engineering Installation Environmental (CES/CEIE)
- Restoration of approximately 46 acres of potential scrub-jay habitat within Land Management Unit 33

Replacements of reasonable and prudent measures

- Replace RPM #1 with the following : "Assess the habitat scheduled for clearing for scrub-jay presence, including nests, prior to any clearing activities"
- Replace RPM #2 with the following: "Compensate for the amount of occupied and potential, unoccupied scrub-jay habitat permanently lost as a result of land clearing activities, with the enhancement/restoration and perpetual management of scrub-jay habitat within Land Management Unit (LMU) 33
- Replace RPM #4 with the following: "Monitor scrub-jay status within the enhancement/restoration area"

Terms and conditions

In order to be exempt from the prohibitions of section 9 of the Act, the 45 SW must comply with the following terms and conditions (T&C) that implement the reasonable and prudent measures

described above, and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

- Application of the terms and conditions included in the November 2008 BO on light management activities at CCAFS and PAFB.
- Full implementation of the additionally revised, site-specific LMP.
- The site operator shall provide the 45 SW CES/CEIE Office within 72-hours of completion of site construction a written, signed, and dated statement verifying that the constructed lighting is/is not in compliance with the LMP. Any lighting not in compliance shall be noted on the statement, and a date given for making such lighting compliant. The date will afford CES/CEIE personnel time to inspect the site and confirm lighting compliance. The site may not become operational until all constructed lighting complies with the LMP.
- The site operator and 45 SW CES/CEIE personnel shall conduct a joint site inspection not later than 48 hours prior to a scheduled launch and landing to confirm that the proposed portable lighting is of the correct type, and in the physical positions, direction, and angle stipulated in the LMP. Lighting not compliant with the LMP must be made compliant prior to commencement of the launch/landing/processing operation.
- Personnel from the 45 SW CES/CEIE will make at least one unannounced nighttime. inspection of the site per year to confirm continued lighting compliance with the LMP.
- Scrub-jay habitat restoration shall be in accordance with the 45 SW Scrub-Jay Habitat Management Plan.

<u>Replacements of terms and conditions</u>

- Replace T&C #1 with the following: "Use established guidelines and protocols to survey for nesting scrub-jays, and avoid construction during the nesting season that extends from March 1 through June 30, if applicable"
- Replace T&C #3 with the following: "Use the most current version of the 'State of Florida Scrub Management Guidelines for Peninsular Florida' http:/myfwc.com/media/130823/IssuesScrubMgmtGuidelines for PeninsularFlorida.pdf as the primary source to enhance/restore/perpetually manage suitable scrub-jay habitat at a ratio of two acres enhanced/restored/managed to one acre cleared (2:1). The initial enhancement/restoration work shall be completed within one year following completion of the LC-13/LC-1 land-clearing activity. The site manager shall develop a habitat enhancement/restoration assessment plan, and submit it to the U.S. Fish and Wildlife Service for approval prior to any habitat enhancement/restoration. The plan shall include photographs, and be based on scientifically accepted, standard habitat assessment methodology".
- Replace T&C #4 with the following: Use established guidelines and protocols to annually monitor and assess the status of scrub-jays within the enhanced/restored habitat, and to adaptively manage the habitat. The resulting information shall be included within the annual Interagency Integrated Natural Resource Management Plan review".

The Service has determined that the proposed action will not result in a level of incidental take of potential scrub-jay habitat exceeding 23 acres, or of nesting and hatchling sea turtles from disorientation and misorientation by site lighting that will result in the 45 SW's exceeding its 3 percent annual allowable threshold for take from lighting at both installations. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If during the course of the action this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of formal consultation and a review of the reasonable and prudent measures provided (see **Reinitiation Notice** below).

Reinitiation Notice

This concludes our amendment to the formal consultation on the action outlined in the reinitiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where the discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in the opinion; and/or (4) a new species is listed or critical habitat designated that may be affected by the action. In the instance where the amount or extent of incidental take is exceeded, and to avoid or minimize the potential for additional unauthorized take, we strongly recommend the 45 SW contact our office within 24 hours to again reinitiate formal consultation. As part of that contact, the 45 SW must provide us the amount or extent of unauthorized take, and known or possible cause(s) of the taking. If as a result it is determined that further taking is imminent prior to completion of the additional consultation , the 45 SW should strongly consider ceasing the action in order to limit any liability it may have under Section 9 of the Act.

If you have any questions regarding this response, please contact Mr. John Milio of my staff at the address on the letterhead, by email, john_milio@fws.gov, or by calling (904)-731-3098.

Sincerely,

Jay B. Herrington
Field Supervisor

cc:
FWC, Tallahassee, Florida (Ron Mezich)

Biological Assessment Revision
for the
SpaceX LC-13 Vertical Landing Pad
Construction and Operation
at
Cape Canaveral Air Force Station
Florida

Prepared For

45th Space Wing
Patrick Air Force Base, Florida

Prepared By

G.E.A.R.
Gator Engineering & Aquifer Restoration, Inc.
185 MIDDLE STREET, SUITE 1351
Lake Mary, FL 32746

August, 2015

Table of Contents

LIST OF FIGURES

SUMMARY

In August 2014 the US Air Force 45th Space Wing submitted a Biological Assessment (BA) to the U.S. Fish and Wildlife Service (USFWS) for the ***SpaceX LC-13 Vertical Landing Pad Construction and Operation at Cape Canaveral Air Force Station, Florida***. On September 17, 2014 the USFWS issued the corresponding ***Biological Opinion (BO) FWS Log No. 41910-2014-F-0259.*** These documents were required in accordance with the Endangered Species Act, Formal Section 7 Consultation guidance to support the related Environmental Assessment (EA) for the same project. Space Exploration Technologies Corporation (SpaceX), in cooperation with the United States Air Force (USAF) as Lead Agency, and the Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) as Co-operating Agencies, prepared the EA and submitted it for USAF review and approval. The Finding of No Significant Impact (FONSI) was signed by the USAF on January 8, 2015, and the USAF signed the Environmental Baseline Survey (EBS) on January 14, 2015 which officially began SpaceX licensed use of this area for landing operations. The EA evaluated potential environmental impacts resulting from activities associated with conducting vertical landings of the Falcon first stage vehicle at Launch Complex (LC) 13 at Cape Canaveral Air Force Station (CCAFS), in Brevard County, Florida.

Additionally, on January 30, 2015 the St John River Water Management District (SJRWMD) issued Environmental Resource Permit (ERP), **permit # 140524-1** for the original construction site plan and operation at LC 13, and issued **permit # 140524-2** on April 22, 2015 for a revised site plan which eliminated the four (4) contingency pads.

All aspects of the original BA and conditions of the BO have been or are in the process of being implemented, however since the period of time when those documents were developed and issued, two changes or modifications have been implemented, and one **additional** action is proposed, which requires the original BA to be revised. This revised BA therefore addresses the following combined three changes;

1. Launch Complex 13 has been re-designated Landing Complex 1 (LC-1)
2. The original site plan calling for one (1) large main pad and four (4) smaller “contingency” pads now only includes the main pad; due to improved landing radar accuracy the 4 contingency pads are no longer needed.
3. The total developed area would increase by an **additional** approximately 22.8 acres of cleared (or roller-chopped) land for two (2) additional landing pads. This is planned so that the new total of three (3) landing pads could support the landing of the Falcon Heavy three (3) first stage vehicles.

The format for this revised Biological Assessment is essentially identical to the original Assessment, with the exception that Sections 1 and 2 have an additional sub-section describing the new proposed action, and the eight (8) sub-sections in Sections 3, 4, 5, and 6, have an **additional** paragraph added. Those paragraphs contain information related to the additional approximately 22.8 acres (rounded up to 23 acres) of land that will be impacted by this project. Sections 1 and 2 of this revised document update the original proposed action to describe the minor (reduced impact) changes in site landing pad design, and describe the planned actions for the additional 23 acres.

SpaceX has developed the Falcon 9 (containing a single first-stage booster) and the Falcon Heavy (containing three first-stage boosters) vertical launch vehicles with the goal of reusing the first-stage booster vehicles. Since 2007, SpaceX has successfully launched the Falcon 9 from LC-40 at CCAFS. SpaceX also plans to launch the Falcon Heavy, a three-stage heavy-lift vehicle, from Kennedy Space Center's launch pad 39A in late 2015. SpaceX has designed the first-stage boosters of their Falcon rocket vehicles to be completely reusable by enabling up to the three stages to return or "boost-back" to land at Launch Complex (LC) 13, which was re-designated as Landing Complex 1 (LC-1). In January 2015, SpaceX obtain a five-year license from the USAF to operate their landing activities at LC-1.

CCAFS occupies approximately 15,800 acres (25 square miles) of land on Florida's Cape Canaveral barrier island as shown on Figure 1. Cape Canaveral is on the east coast of Brevard County Florida, approximately 155 miles south of Jacksonville, 210 miles north of Miami, and 60 miles east of Orlando. It is approximately 4.5 miles wide at its widest point. CCAFS has 81 miles of paved roads connecting various launch support facilities with the centralized Industrial Area. The northern boundary of CCAFS adjoins the Kennedy Space Center (KSC) boundary on the Merritt Island barrier island. The Banana River Lagoon separates CCAFS from KSC to the west. The Port of Cape Canaveral adjoins CCAFS to the south. CCAFS's eastern boundary is the Atlantic Ocean. The base is accessible primarily from U.S. Highway 528 to the south and from KSC to the west and north. A total of 33 Launch Complexes have been constructed and used at CCAFS.

The site that has been designated for the landings is located in and around the area formerly known as LC-13 (see Figure 2) but now designated as Landing Complex 1. LC-1 is located in the east-central portion of CCAFS between LC-12 to the south and LC-14 to the north. Throughout the many years of operation at the complex, various versions of the Atlas rocket were launched. Since the USAF's first launch in 1958 of an

Atlas B rocket, the complex has supported 51 rocket launches from its pad. The last launch from this complex was an Atlas vehicle in April 1978. The USAF demolished the Mobile Service Tower and its associated infrastructure in 2005 and demolished the block house in 2012. The purpose of the Proposed Action is to provide a Reusable Launch Vehicle (RLV) landing area by constructing three landing pads and associated supporting infrastructure for landing operations of the Falcon 9 or Falcon Heavy vehicles in order to reuse the first stages for future launches. This purpose continues to support SpaceX's over-all missions for NASA and the USAF. Table 4-1 presents a summary of potential impacts to the additional approximately 23 acres of land needed for the additional two landing pads.

Table 4-1 Potential Impacts to Federal and State Protected Wildlife Species that Occur or Have Potential to Occur within the Proposed Action Area

Common Name ***Scientific Name***	**Status[1]**		**Occurrence**	**Potential Impacts**
	USFWS	**FWCC**		
Florida Scrub-Jay *Aphelocoma coerulescens*	T	T	Documented	Loss of breeding habitat. Disruption due to noise.
Gopher Tortoise *Gopherus polyphemus*	C	T	Documented	Crushing by equipment. Disruption due to noise.
Eastern Indigo Snake *Drymarchon corais couperi*	T	T	Potential	Crushing by equipment. Loss of habitat. Disruption due to noise.
Southeastern Beach Mouse *Peromyscus polionotus niveiventris*	T	T	Documented	Crushing by equipment. Disruption due to noise.
Marine Turtle :Leatherback (*Dermocheyls coriacea*, Green(*Chelona mydas)* Loggerhead(*Caretta caretta)*, Kemps Ridley *Lepidochelys kempii*)	E E/T	E T	Documented	Disruption and disorientation due to light
American Alligator *Alligator mississippiensis*	T	T (S/A)	Documented	Crushing by equipment. Disruption due to noise.
Piping Plover *Charadrius melodus*	T	T	Documented	Disruption due to noise.
Red Knot *Calidris canutus*	T	—	Documented	Disruption due to noise.
Legend: (C) Candidate; (SSC) Species of Special Concern; (T) Threatened; (E) Endangered (S/A) Similarity of Appearance				

1.0 Description of Proposed Action

1.1 Introduction and Description of the Proposed Action

The original Proposed Action described in the 2014 BA included constructing an approximate 200 foot square concrete landing pad at LC-1; the original site concept plan can be seen in Figure 3. This concept has since changed to an approximately 280 foot diameter circular concrete pad, and no "contingency" pads as shown in Figure 4. The pad would be designed to support the weight and thrust energy of the Falcon first stage vehicle and would comply with all CCAFS and other relevant construction requirements. The main pad would be constructed on previously disturbed land of LC-1, and it would be surrounded by an approximately 650 foot diameter compressed soil and gravel, flat semi-pervious surface. Four additional 150 foot diameter concrete "contingency" pads were to be constructed, however significant improvements in the landing vehicle navigation guidance system and radar, and successful "barge landing" tests has eliminated the need for those pads. Subsequently, the revised site design includes only the single main pad for a returning Falcon 9 first stage booster.

NEW ADDITION

In addition to the single main landing pad for a "one-stage" landing scenario, this Proposed Action now includes the proposed addition of two large, approximately 280 feet in diameter, concrete pads for an "up to three-stage" landing scenario with the launch from KSC of the Falcon Heavy vehicle. A new landing site concept map is shown in Figure 5. All additional infrastructure support items would be the same, except that lighted wifi and Radio Frequency (RF) communications towers would not be installed at the two (2) new additional landing sites.

At the location of the former block house, a steel and concrete "stand" would be built to secure the falcon stage during post-landing operations as discussed in the original BA. Following stage landings, a mobile crane would lift the stages from the landing pad, or pads and transport the stages to the stand. Activities such as allowing the landing legs to be removed or folded back to the stage (flight position) prior to placing the stage in a horizontal position would occur there. The Proposed Action would also include installing electrical power underground cable connections and fire protection/ water supply lines to the two additional pads. Existing roadways into the LC-1 pad operations

area would be improved to handle mobile crane movements and the first stage transportation vehicle for the returning stages.

A fire extinguishing system would be constructed with three or four remote controlled water cannons mounted on posts above ground to allow for remote firefighting capabilities at each pad. Existing underground water lines are sufficient in size to support the fire extinguishing system. A tie into the water system would be required and trenching for new water lines to connect to the fire extinguishing system would be required. The original main landing pad and surrounding areas have been constructed with features to manage stormwater runoff; the planned additional two pads will also include similar features. An appropriately designed structure, and/or equipment and procedures, would provide protection for potential spill or firefighting measures according to Federal, State and local storm water regulations. Further site design is required to determine exact locations of these types of structures for the additional two landing pads.

The Proposed Action **Addition** of two new pads would also require clearing or roller-chopping existing vegetation from the land north and south of the LC-1 operations area. Figure 6 shows the relatively undisturbed areas within the solid red lines to be cleared, and within the dotted yellow lines to be roller-chopped. Construction in the previously undisturbed areas would include the two new pads and storm water run-off structures. Cleared vegetation would be taken off the site to an approved burn or burial area or burned onsite via a burn trench. It is anticipated that site grading would be required in order to provide a flat compacted area to construct the two new landing pads and surrounding compacted soil. Soil relocation is considered to be moderate and may approach (30,000 cubic yards) to support this effort. Land shown on the north pad area, beyond the ditch to the east side outlined in a dotted yellow line would be roller chopped, not cleared.

1.2 Falcon 9 Landing Operations

Following a nominal launch of either the Falcon 9 (which has a single first-stage booster) from LC-40, or a launch of the Falcon Heavy (which has three (3) first-stage boosters) from LC-39A, the Falcon first stages would return to LC-1 at CCAFS for potential reuse, rather than splashing down in the Atlantic Ocean. After each of the first- stage booster engine cutoffs occur, exo-atmospheric cold gas thrusters would be triggered to flip the first stages into position for retrograde burn, and three of the nine first stage Merlin engines on each stage would be restarted to conduct the retrograde burn in order to reduce the velocity of the first stage vehicles and to place them in the

correct angle to land. Once the (up to three (3)) first-stage boosters are in position and approaching their landing targets, two of the three engines on each booster would be shut down to end the boost-back burn. Landing legs on each of the up to three (3) first stage boosters would then deploy in preparation for a final single engine burn that would slow each of the first stage boosters to a velocity of zero before landing at the new landing pads at LC-1. Each of the three (3) returning first-stage boosters would land at their own landing pad.

Although propellants would be burned to depletion during flight, there is a potential for approximately 5,840 pounds of Liquid Oxygen (LOX) and a maximum of 2,160 pounds of Rocket Propellant (RP-1) to remain in each of the returning Falcon first stages upon landing. Final volumes of fuel would be included in the Flight Safety Data Plan (FSDP), and would be off-loaded after landing.

Operations at LC-1 would support preparations for, and the landing of up to three (3) Falcon first-stage boosters, as well as support the post-flight landing and safing of each of the stages. Safing activities would begin upon completion of all landing activities and engine shutdowns. The LOX oxidizer system would be purged, and any excess fuel would be drained into a suitable truck-mounted container or tanker. Any remaining pressurants (i.e., helium or nitrogen) would be vented, and any Flight Termination System (FTS) explosives would also be rendered “inert” prior to declaring the vehicle safe. The vehicles would be lifted and placed on to the stand-in series; the landing legs would then be removed or folded back into place. Each of the three (3) returned first-stage vehicles would then be lowered into a horizontal position, placed on separate transport vehicles, and taken to a SpaceX facility. A ground crew would perform and supervise all landing operations and would be familiar with the operating protocol including all potential “off nominal” events.

1.3 Location and Site Construction Preparations for the Original Main Pad

The original Proposed Action area totaled approximately 55.72 acres comprised of a variety of construction levels. The original Proposed Action result in clearing or roller-chopping approximately 48.3 acres of vegetation and extended from the east side of LC-1 to the western limits of the dune. Clearing using heavy machinery did not take place from the landward Toe of Slope (TOS) of the dune eastward (to the beach) or in areas that were determined to be occupied by southeastern beach mice. These areas, which contain tall or “woody” plants such as sea grapes (*Coccoloba uvifera*), were selectively hand-cut to prevent disturbance to beach mice burrows; beach mouse

habitat was marked with flagging. All other areas west of the ditch were cleared using heavy machinery.

Cleared material was either placed in wheeled dump trucks for removal from that area, or burned in approved burn-trenches. Long-term maintenance along the eastern limits of the Proposed Action area near the primary dune will include selective cutting to maintain "woody" plants below three feet in height, and managed to minimize vegetation height, but would not be compacted or filled. The remaining land area east of the ditch will be managed initially to maintain all vegetation to less than three feet in height. Wheeled "roller/copper" machinery would be used on an annual basis to minimize vegetation grow-back height. Each annual maintenance visit would be preceded by a natural resource survey to determine presence/absence of listed wildlife species prior to any site activity (gopher tortoise, scrub jay, etc.). Surveys will consist of pedestrian transects and reviews of available site specific databases (in particular as it relates to scrub jays). As time progresses and expected landing vehicle radar technology improves, vegetation maintenance visits may not be required, and the area may be able to be returned to a natural state and managed as a scrub jay habitat again.

Of the approximately 38 acres that required vegetation cutting or clearing, approximately 22.68 acres extended east of the fence line and to the western limits of the onsite ditch and required heavy, large tracked machinery. The grading of this area was accomplished to support construction of the main landing pad and approximately one half of the 650 foot diameter area around the main landing pad. Construction of stormwater run-off systems (swales and retention ponds) was also developed in this area.

Long-term maintenance for the area between LC-1 and the ditch is expected to be mowed grass. Standard large-scale grass mowing equipment will be used on a periodic basis to maintain vegetation to about three inches in height in this area. It is not expected that a natural resource survey would be required prior to mowing events. Should gopher tortoise burrows appear, they would be avoided. The 45th SW natural resource personnel would be notified if any burrows were found to encroach upon landing pads or roadways for removal. Tortoises would be excavated by Florida Fish and Wildlife Conservation Commission (FFWCC) authorized agents using a trackhoe or via bucket trapping. Tortoises would be relocated onsite to an USAF approved recipient site.

As a result of the original Proposed Action, a short-term moderate level of noise was generated between approximately 8:00 AM and 4:30 PM from clearing and construction

activities within the action area. During landing operational periods, expected to be 12 times per year, the Falcon vehicle would produce engine noise and sonic boom noise. Engine noise generated as the vehicle descends from between 250 and 1000 meters above the landing pad would be the result of only one engine, rather than nine engines used to launch the vehicle. Therefore the noise level would be much less than typical noise produced from launch vehicles. Sonic boom noise produced would be less than 1 psf in the local CCAFS area (Wyle, 2014).

1.4 Location and Site Construction Preparations for the Additional two Pads

The **additional** Proposed Action area totals approximately 23 acres comprised of a north landing area and a south landing area. Approximately 21 acres would be cleared of all vegetation and is shown in Figure 7. Approximately two (2) acres located in the northern area, east of the ditch would be roller chopped; shown within the yellow dotted lines on Figure 6.

The reason these two (2) new landing areas or "pads" are needed and are not "contiguous" with the original main pad, and the separation between the three (3) main landing pads appears to be more than possibly expected, is to limit or remove any interference between the landing sequence of the three returning first stage boosters. Each stage is 150 feet tall and 12-13 feet in diameter. Each stage contains nine (9) Merlin engines, one of which will be operating with thrust energies of up to approximately 147,000 lbf while it is landing. As these relatively large structures return to their landing pads it is critical that they have enough separation from each other so that navigation is unbiased by a 150 vehicle, and is accurate, so that they do not knock each other over, and so that any foreign object debris (FOD) such as dirt, stones, or chips of concrete do not affect another returning or landed booster stage. Additionally, while the occurrence of a "crash landing" is minimal, should that happen the resulting conflagration must be prevented from affecting the other two landed vehicles. That being said, the design for the additional two (2) landing pads has reduced the size and diameter of the outer "apron" by approximately 35% from the originally designed main pad which has been constructed. Therefore an active role was taken to limit the size and area of required clearing while still maintaining required safety set-backs.

Cleared material would be either placed in wheeled dump trucks for removal from this area, or burned in approved burn-trenches. Long-term maintenance for the 2-acre area would maintain "woody" plants below three feet in height, and managed to minimize vegetation height, but would not be compacted or filled. Each annual maintenance

visit would be preceded by a natural resource survey to determine presence/absence of listed wildlife species prior to any site activity (gopher tortoise, scrub jay, etc.). Surveys will consist of pedestrian transects and reviews of available site specific databases (in particular as it relates to scrub jays). As time progresses and expected landing vehicle radar technology improves, vegetation maintenance visits may not be required, and the area may be able to be returned to a natural state and managed as a scrubjay habitat again.

The approximately 21 acres that required vegetation cutting and clearing in both the north and south landing areas would require heavy, large tracked machinery. The grading of this area would be accomplished to support construction of the two landing pads and "apron" of compacted soil to about 400 feet in diameter around the main landing pads. Construction of stormwater run-off systems (swales and retention ponds) would also be developed in the north and south areas. Long-term maintenance for the 21 acre area is expected to be mowed grass. Standard large-scale grass mowing equipment would be used on a periodic basis to maintain vegetation to about three inches in height in this area. It is not expected that a natural resource survey would be required prior to mowing events. Should gopher tortoise burrows appear, they would be avoided. The 45th SW natural resource personnel would be notified if any burrows were found to encroach upon landing pads or roadways for removal. Tortoises would be excavated by Florida Fish and Wildlife Conservation Commission (FFWCC) authorized agents using a trackhoe or via bucket trapping. Tortoises would be relocated onsite to an USAF approved recipient site. The USAF would relocate the tortoises similar to the earlier work, most likely to one of the following management units; LMU 10, 110, 112, 114 and/or 119. All of these units have undergone restoration within the past two years and have suitable habitat available to support these tortoises. A survey would be done at the recipient site to ensure the unit is not already occupied and/or would not result in overpopulation with the additional tortoises.

As a result of the additional Proposed Action, a short-term moderate level of noise would be expected between approximately 8:00 AM and 4:30 PM from clearing and construction activities within the action area. During landing operational periods, expected to be 12 times per year, the Falcon vehicles would produce engine noise and sonic boom noise. Engine noise generated as the vehicles descend from between 250 and 1000 meters above the landing pad would be the result of only one engine, rather than nine engines used to launch the vehicle. Therefore the noise level would be much less than typical noise produced from launch vehicles. Sonic boom noise produced would be less than 1 psf in the local CCAFS area (Wyle, 2014).

2.0 Description of the Area Impacted by the original Proposed Action

2.1 Original Proposed Action

The original Proposed Action area is located in and around the existing LC-1 complex. The area located within the fence line was loosely maintained, comprised of a few scattered trees and herbaceous groundcover. Beyond the fence line, within the limits of the Proposed Action, the site contains two (2) distinct habitat types. The majority of the area beyond the fence line is best described as coastal scrub. This habitat type is predominantly a forested area interspersed with dense patches of saw palmetto. The Proposed Action area also contains a ditch between the fence line and the beach, and extends from the northern end of the proposed action area to the south.

The area within the fence line of LC-1 contained remnants of the launch pad and ancillary support structures and represents approximately 8.16 acres. Species observed within this area include sand cordgrass (*Spartina bakerii*), crowfoot grass (*Dactyloctenium aegyptium*), prickly pear (*Opuntia humifusa*), saw palmetto (*Serenoa repens*), Brazilian pepper (*Schinus terebinthifolius*), sand live oak (*Quercus geminata*), cabbage palm (*Sabal palmetto*), beach sunflower (*Helianthus debilis*), dog fennel (*Eupatorium capillifolium*), ragweed (*Ambrosia* sp.), and pepper grass (*Lepidium virginicum*).

The coastal scrub community dominates the majority of the Proposed Action area representing the approximately 38 acres. This community type is comprised by a mix of coastal and oak scrub; scrub oaks are the dominant canopy species but the area is overgrown and contains strands of Brazilian pepper. This coastal scrub community did not appear to have undergone land management activities in recent years and contained a dense, mature canopy. Species observed within this community type include sand live oak, live oak (*Quercus virginiana*), myrtle oak (*Quercus myrtifolia*), Brazilian pepper, tough buckthorn (*Bumelia tenax*), cabbage palm, and Spanish bayonet (*Yucca aloifolia*). This habitat type had a closed canopy along with a dense understory comprised of saw palmetto, greenbrier (*Smilax* sp.), beauty berry (*Callicarpa americana*), wax myrtle (*Myrica cerifera*), rusty lyonia (*Lyonia ferrunginea*), partridge pea (*Galactia elliottii*), bracken fern (*Pteridium aquilinum*), and morning glory (*Ipomoea indica*).

The remaining habitat type within the Proposed Action area is a ditch. This man-made feature is a linear excavation approximately 0.85 acres extending from the north to the south within the Proposed Action area. The majority of the ditch has vertical side slopes

and lacks any significant vegetative coverage. Species within the ditch are include cattail (Typha sp.), sawgrass (*Cladium jamaicense*), bulrush (*Scirpus* sp.), maidencane (*Panicum hemitomon*), and water pennywort (*Hydrocotyle umbellata*). Included within the ditch area is the narrow upland band containing the spoil excavated from the ditch. This area is predominantly open but contains species such as wax myrtle, prickly pear, sand cordgrass, Brazilian pepper, cabbage palm, saw palmetto, beauty berry, and grape vine.

At the time of the writing of this revised BA, all areas of the original BA that had proposed actions to be cleared or roller-chopped have been taken. The ditch was not affected.

2.2 Additional Proposed Action Area

A site environmental survey was accomplished in late April and early May 2015. The area currently supports three (3) land use types/vegetative communities. These land use types were identified utilizing the Florida Land Use, Cover and Forms Classification System, Level III (FLUCFCS, FDOT, January 1999). The on-site upland land use type/vegetative community is classified as Disturbed Land (740). The wetland/surface water land use types/vegetative communities found just north and east of the northern landing area on the site are classified as Streams and Waterways (510) and Exotic Wetland Hardwoods (619). The following provides a brief description of the on-site land use types/vegetative communities:

Uplands:

740 – Disturbed Land

The uplands associated with the project site are most consistent with the Disturbed Land (740) FLUCFCS classification. The dominant vegetation within the project area was Brazilian pepper (*Schinus terebinthifolius*). Other observed vegetation within this community type includes slash pine (*Pinus elliottii*), sand live oak (*Quercus geminata*), buckthorn (*Rhamnus cathartica*), Spanish bayonet (*Yucca aloifolia*), live oak (*Quercus virginiana*), laurel oak (*Quercuslaurifolia*), winged sumac (*Rhus copallium*), saw palmetto (*Serenoa repens*), blackberry (*Rubuscuneifolius*), wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), winged sumac (*Rhus copallinum*), lantana (*Lantana camara*), chalky bluestem (*Andropogon glomeratus*), broomsedge (*Andropogon* spp.), greenbriar (*Smilax* spp.), pokeweed (*Phytolacca americana*), prickly pear cactus (*Opuntia humifusa*), muscadine vine (*Vitis rotundifolia*), sand cordgrass (*Spartina bakeri*), dogfennel (*Eupatorium capillifolium*), maidencane (*Panicum hemitomon*), air potato (*Dioscorea bulbifera*), guineagrass (*Panicum maximum*), cogongrass (*Imperata*

cylindrica), primrose willow (*Ludwigia peruviana*), chinaberry tree (*Melia azedarach*), rattlebox (*Sesbania punicea*), and caesarweed (*Urena lobata*).

Wetlands

510 – Streams and Waterways

Ditches that boarder the project boundaries are most consistent with the Streams and Waterways (510) FLUCFCS classification. Vegetation observed within this community type includes wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), maidencane (*Panicum hemitomon*), sawgrass (*Cladium jamaicense*), primrose willow (*Ludwigia peruviana*), Brazilian pepper (*Schinius terebinthifolius*), pickerel weed (*Pontederia cordata*), and water hyssops (*Hydrocotyle umbellate).*

619 – Exotic Wetland Hardwoods

The remainder of the wetland areas just north of the northern pad area, and south of the southern pad area are most consistent with the Exotic Wetland Hardwoods (619) FLUCFCS Classification. Vegetation observed within this community type includes loblolly bay (*Gordonia lasianthus*), wax myrtle (*Myrica cerifera*), saltbush (*Baccharis halimifolia*), winged sumac (*Rhus copallinum*), lantana (*Lantana camara*), sand cordgrass (*Spartina bakeri*), white-topped sedge (*Rhynchospora colorata*), dogfennel (*Eupatorium capillifolium*), maidencane (*Panicum hemitomon*), chalky bluestem (*Andropogon glomeratus*), Brazilian pepper (*Schinus terebinthifolius*), air potato (*Dioscorea bulbifera*), guineagrass (*Panicum maximum*), cogongrass (*Imperata cylindrica*), primrose willow (*Ludwigia peruviana*), chinaberry tree (*Melia azedarach*), rattlebox (*Sesbania punicea*), and caesarweed (*Urena lobata*).

PROTECTED SPECIES

Using methodologies outlined in the Florida's Fragile Wildlife (Wood, 2001); Measuring and Monitoring Biological Diversity Standard Methods for Mammals (Wilson, et al., 1996); Wildlife Methodology Guidelines (1988); and Florida Fish and Wildlife Conservation Commission's (FFWCC) Gopher Tortoise Permitting Guidelines (April 2013 - revised February 2015); a cursory assessment for "listed" floral and faunal species was conducted at the site on April 27th, 2015. This assessment included both direct observations and indirect evidence, such as tracks, burrows, tree markings and birdcalls that indicated the presence of species observed. The assessment focused on species that are "listed" by the FFWCC's Official Lists - Florida's Endangered Species, Threatened Species and Species of Special Concern (January 2013) that have the potential to occur in Brevard County (See attached Table 1 above).

No plant species “listed” by either the state or federal agencies were identified on the subject site during the assessments conducted.

3.0 Description of listed species within original and additional action area

3.1 Florida Scrub-Jay

The Florida Scrub-jay (*Aphelocoma coerulescens*) is a federally threatened bird endemic to open, oak-dominated scrub habitats of Florida. Widespread destruction and degradation of scrub habitat over the last century have resulted in dramatic declines in the distribution and abundance of this species. Because the scrub-jay is intimately tied to open, oak-dominated scrub, conservation of the species depends upon restoration of sufficient optimal habitat to support large populations. The jay population on CCAFS figures prominently in recovery plans for the species. Believed to be one of the largest remaining populations, the CCAFS population has been designated as belonging to one of three core populations for the species.

The USAF conducts a yearly census, as well as monitoring, of the Cape population of scrub-jays. All suitable accessible jay habitat is surveyed on a yearly basis. The 2014 census resulted in 150 groups with a total of 480 birds, which included 49 juveniles. Data from the 2014 census indicates the presence of one group northeast of the LC-1 project site directly east of LC-14, well removed from the proposed project area, see Figure 8. The USAF has not been monitoring this group, therefore territory information is not available. There was an additional group observed in 2013 just north of the proposed north pad area; however this group was not observed in 2014 or during the April 2015 survey performed for this BA.

Management actions for scrub-jays on CCAFS are primarily oriented toward habitat improvement. Since a large portion of CCAFS is or could be scrub-jay habitat, many land clearing activities have the potential to adversely impact scrub-jays and their habitat. The U. S. Fish and Wildlife Service (USFWS) has designated CCAFS as part of a core scrub-jay area, indicating that all scrub habitat on CCAFS is highly valuable to the recovery of the species. Consultations between the USFWS and the USAF have resulted in a requirement to mitigate loss of scrub or potential scrub at a rate of 2:1. The objective of scrub habitat restoration on CCAFS is to restore the over-mature scrub to a condition suitable to support the Florida scrub-jay. The main methods used for habitat restoration are mechanical treatment to reduce height of the scrub and prescribed burning of mechanically treated sites to provide open patches of sand and prevent accumulation of fuels. Due to strict restrictions associated with burning on CCAFS, the USAF has been using mechanical methods to create openings for the past several years. Although burning is the preferred method of creating these openings,

mechanical methods have proven to be very effective at creating the desired results in the short-term until burning can occur.

3.2 Gopher Tortoises

Currently the gopher tortoise *(Gopherus polyphemus)* is classified as a "Category 2 Candidate Species" by USFWS, and as of September 2007 is now classified as "Threatened" by the Florida Fish and Wildlife Conservation Commission (FWC), and as "Threatened" by FCREPA. The basis of the "Threatened" classification by the FWC for the gopher tortoise is due to habitat loss and destruction of burrows. The gopher tortoise can live from 40 to 60 years, and is commonly found in upland habitats such as sandhill, pine flatwoods, scrub, scrubby flatwoods, dry prairies, xeric hammock, pine-mixed hardwoods, and coastal dunes. Burrows can be quite deep and long with average depth at 6.5 feet and average length at 15 feet, and can be used by more than 350 other commensal species such as frogs, mice, snakes, and insects. Gopher tortoises are a threatened wildlife species and are protected by state law, Chapter 68A-27, Florida Administrative Code. Gopher tortoises and their burrows have been observed within the Proposed Action area of Landing Complex 1. Based upon an initial pedestrian gopher tortoise survey, at least 72 potentially occupied (PO) burrows were identified in the original project area. That number was based upon a survey conducted in 100% of the "previously disturbed area", and approximately 15% of the "undisturbed area". Prior to clearing activities, additional surveys were accomplished. All burrows in the original area west of the ditch were excavated; of the 78 excavated burrows, 11 tortoises were recovered and were relocated by the USAF on CCAFS property. The 21 burrows located east of the ditch were left in place since clearing did not take place.

The additional approximately 23 acres were surveyed on April 27, 2015 and one burrow was discovered and marked in the northern area, and nine were discovered and marked in the southern area, most were found on the western boundary in a man-made bermed area as shown in Figure 9.

3.3 Eastern Indigo Snake

The longest of North American snakes (up to 8.6 ft), the Eastern indigo snake (*Drymarchon corais couperi*) is locally abundant in parts of Florida, but as a top carnivore, population densities are typically low. The Eastern indigo snake has been observed on CCAFS and likely occurs throughout the installation, however exact numbers are not known. This primarily diurnal snake is known to occur in most types of habitat and is often associated with gopher tortoise burrows, although this has never

been observed on CCAFS. The reproductive season encompasses copulation (November through April), egg-laying (May through June), and hatching (late July through October). Home ranges for male indigos range from 191 to 360 acres and female home ranges vary between 14 and 130 acres. Major threats to the indigo snake on CCAFS are habitat loss and vehicle traffic. There has not been an installation wide census completed for indigos; however, based on the different habitat types around LC-1, it is likely to occur within the areas to be cleared.

3.4 Southeastern Beach Mouse

The Southeastern beach mouse (*Peromyscus polionotus niveiventris)* is a subspecies of the widely distributed oldfield mouse (*P. polionotus*). Originally occurring on coastal dunes and coastal strand communities along the Atlantic coast of Florida, this beach mouse generally occurs along the beach primary dune line, and is presently known to exist in six sites in Brevard, Indian River, and St. Lucie Counties. Most breeding activity occurs November through January, and females can produce two or more litters per year, with litters averaging three to four offspring.

On CCAFS, the mice occur from the coastal dunes inland to the west side of Samuel C. Phillips Parkway, and are generally found where the sand is suitable for burrows, coastal scrub is present, and the water table is not close to the surface. While inland populations may be more stable, their abundance varies from site to site inland of the dune system. However, nearly every coastal scrub site surveyed on CCAFS supports the beach mouse.

A beach mouse survey was conducted to determine the presence/absence of beach mice within the Proposed Action area. The survey was performed from June 8, 2014 to June 12, 2014. The survey consisted of the placement of 50 Sherman Live Traps for four (4) consecutive nights along the eastern boundary of the Proposed Action area as shown in Figure 10. More specifically, the survey was conducted from the top of the beach dune down the backside of the slope outward to the palmetto edge. Beach mice were observed during the survey occurring from the top of the dune to the toe of slope on the landward side of the dune. Based on these surveys, there are approximately 5.40 acres of occupied beach mouse habitat located within the area east of the ditch. The 5.40 acres of occupied habitat was determined by taking the western most occurrences of captured beach mice and creating a rough polygon to the eastern boundary, as shown in Figure 10.

The **additional** Proposed Action area of approximately 23 acres would not be expected to support the beach mouse therefore surveys have not been accomplished.

3.5 Marine Turtles

Three species of federally protected sea turtles have been documented as nesting on CCAFS: the loggerhead (*Caretta caretta*), green (*Chelona mydas*) and leatherback *(Dermocheyls coriacea*). Additionally, two Kemp Ridley (*Lepidochelys kempii*) sea turtle nests were documented in May 2015 by 45th SW USAF personnel. Based on nest surveys from 2009-2013, the average number of loggerhead and green nests deposited annually is 2,084 and 152, respectively. Forty three (43) leatherback nests have been documented since 2009.

While sea turtles spend much of their lives in the ocean, females come ashore each year to nest. Research has shown that females will avoid highly illuminated beaches and postpone nesting. Artificial lights have also resulted in hatchling mortality as disoriented hatchlings move toward these light sources rather than the ocean.

In 1988, in compliance with Section 7 of the Endangered Species Act, the USAF developed Light Management Plans (LMPs) for various areas and facilities on CCAFS to protect sea turtles. A Biological Opinion (BO) issued by the USFWS requires that LMPs be developed for all new facilities that are in close proximity to the beach, are not compliant with Wing lighting policies, have lighting directly visible from the beach and/or may cause significant sky glow. In addition, USAF biologists conduct nighttime inspections to ensure all exterior lighting is being operated in accordance with policies. The BO authorizes no more than 3% incidental take of turtles as the result of disorientation on CCAFS. In 2013, the incidental take reported to USFWS was 0.34%. Currently there is no exterior lighting operating at LC-1 and no disorientation has been documented on the beach in this area for several years.

As part of the SJRWMD ERP permit that was issued, development and review of a Light Management Plan was included as a condition of the permit.

While the **additional** Proposed Area is further away from the beach area, this area will be included and addressed within a revised Light Management Plan.

3.6 American Alligator

The American alligator (*Alligator mississippiensis*) is federally listed as threatened due to its similarity in appearance to another endangered species, the American crocodile (*Crocodylus acutus*). The species has made a strong recovery in Florida. Alligators inhabit and reproduce in nearly all CCAFS waters. Alligators are apex predators and consume fish, amphibians, reptiles, birds, and mammals. They play an important role as ecosystem engineers in wetlands through the creation of alligator holes, which provide both wet and dry habitats for numerous other organisms.

The original Proposed Action area and the **additional** area contain a linear man-made ditch that has the potential for use by the American alligator and nests have been documented along the canal in recent years.

3.7 Piping Plover

The Piping Plover (*Charadrius melodus*) is a small sand-colored, sparrow-sized shorebird that nests and feeds along coastal sand and gravel beaches in North America. The adult has yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. Their breeding habitat includes beaches or sand flats on the Atlantic coast, Great Lakes, and the mid-west. They forage for food on beaches moving across in short bursts around the high tide wrack zone eating insects, marine worms, and crustaceans.

The Piping Plover is not known to breed in Brevard County; however it does have the potential to occur on Brevard beaches during the non-breeding season (July-March) and has been observed on CCAFS beaches in small numbers.

3.8 Red Knot

The Red Knot (*Calidris canutus*) is a medium sized shorebird which breeds in tundra and the Arctic Cordillera in the far north of Canada, Europe, and Russia. The red knot has one of the longest migrations of any bird. The Red Knot is an occasional visitor along the Florida seashore during its annual migration. This species is not known to breed or nest in Brevard County however it has been observed on CCAFS beaches in small numbers.

4.0 Effects of Action on Listed Species

The following sections discuss specific effects from the Proposed Action. Effects are caused either by clearing and construction activities or by operational related noise from construction equipment or from the Falcon landing vehicles.

4.1 Florida Scrub Jay

The clearing for the originally Proposed Action resulted in the loss or impact to approximately 38 acres of vegetation as described in Section 2.0. The **additional** area planned to be cleared would be approximately 23 acres. The 2014 Florida Scrub Jay census did not reveal the presence of any scrub jay groups or individuals within the Proposed Action area as shown in Figure 8, or in the new **additional** areas, therefore direct impacts are not expected. The site does contain potentially suitable habitat, coastal scrub, capable of being managed and occupied by Florida scrub jay. The Proposed Action will result in the taking of unoccupied Florida scrub-jay habitat.

Potential noise related effects to the Florida Scrub Jay during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be short-term and would elicit a “startle response” to avoid the noise. This would help the birds to avoid the threat and therefore, would not cause a negative impact to populations near the project area. Just as noise associated with rocket launches may startle many species within the CCAFS area, noise associated with landing, although much less, may do the same. However actual noise impact to wildlife, including Florida Scrub Jay is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, neither the Falcon 9, Atlas, the Titan, nor the Delta launches have been documented to cause any animal mortality or significant impact to wildlife habitat on CCAFS (USAF 2013a). Anticipated sonic boom noise in the area of 1 psf or less is expected to have very little effect on birds.

4.2 Gopher Tortoise

The original Proposed Action resulted in the loss of approximately 38 acres of occupied gopher tortoise habitat. The **additional** area would result in the loss of approximately 23 acres of land. Due to the probability of being disturbed by clearing activities, all tortoises that may be impacted were or would be safely excavated by FFWCC authorized gopher tortoise agents and relocated on an approved gopher tortoise recipient site on CCAFS property. Relocation activities on military bases are exempt from FFWCC permitting and fees per the FFWCC Gopher Tortoise Management Plan.

All excavation activities follow state protocol and requirements. Additionally, the USAF is required to provide an annual report that includes relocation activities taking place on its property in accordance with the Gopher Tortoise Candidate Conservation Agreement. The Proposed Action could result in a direct take due to mortality or injuries sustained by heavy equipment.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would potentially cause short-term disturbance to gopher tortoises. These impacts would be considered short-term and would not cause a significant impact to populations within the vicinity of the project area (USAF 2010). Just as noise associated with rocket launches may startle many species within the CCAFS area, noise associated with landing, although much less, may do the same. However actual noise impact to wildlife is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, neither the Falcon 9, Atlas, the Titan, nor the Delta launches have been documented to cause any animal mortality or significant impact to wildlife habitat on CCAFS (USAF 2013a). Anticipated sonic boom noise in the area of 1 psf or less is expected to have very little effect on wildlife.

4.3 Eastern Indigo Snake

The original Proposed Action resulted in the loss of approximately 38 acres of potential indigo snake habitat. The **additional** area would result in the loss of approximately 23 acres of land. A take may occur as the result of habitat loss, although adjacent habitat is available. Eastern indigo snakes would also be vulnerable to mortality as a result of injuries sustained during construction activities.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would elicit a “startle response” to avoid the noise. These impacts would be considered short-term and would not cause a negative impact to the Eastern Indigo Snake within the vicinity of the project area (USAF 2010). Just as noise associated with rocket launches may startle many species within the CCAFS area, noise associated with landing, although much less, may do the same. However actual noise impact to wildlife is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, neither the Falcon 9, Atlas, the Titan, nor the Delta launches have been documented to cause any animal mortality or significant impact to wildlife habitat on CCAFS (USAF 2013a). Anticipated sonic boom noise in the area of 1 psf or less is expected to have very little effect on wildlife.

4.4 Southeastern Beach Mouse

The original Proposed Action could result in a take of beach mice due to a loss of potential habitat and the destruction of beach mice burrows from equipment conducting land clearing activities in areas not identified as beach mouse habitat. Based on observations made in the field as well as aerial photos of the area, the USAF believed that 5.40 acres proposed to be impacted has the potential to contain habitat that supports the southeastern beach mouse.

Potential noise related effects to the Southeastern Beach Mouse during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be short-term and would elicit a "startle response" to avoid the noise. This would help the mice to avoid the threat and therefore, would not cause an impact to the Beach Mouse within the vicinity of the project area. Just as noise associated with rocket launches may startle many species within the CCAFS area, noise associated with landing, although much less, may do the same. However actual noise impact to wildlife is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, neither the Falcon 9, Atlas, the Titan, nor the Delta launches have been documented to cause any animal mortality or significant impact to wildlife habitat on CCAFS (USAF 2013a). Anticipated sonic boom noise in the area of 1 psf or less is expected to have very little effect on the Beach Mouse.

The **additional** approximately 23 acres of land is not believed to be Beach Mice habitat due to the height and density of vegetation; therefore the additional planned action is not expected to impact Beach Mice in those areas.

4.5 Sea Turtles

Although the proposed clearing and construction of new facilities will not directly impact the nesting beach, exterior lighting proposed for the new facilities has the potential to be visible from the beach and could result in adult and/or hatchling disorientation adjacent to LC-13.

Sea turtles are not expected to be affected vibration and noise associated with construction activities since the project area would be beyond the beach and dune area. Just as noise associated with rocket launches may startle many species within the CCAFS area, noise associated with landing, although much less, may do the same. However actual noise impact to wildlife is expected to be minimal. Additionally,

regarding current and past launch programs on CCAFS, neither the Falcon 9, Atlas, the Titan, nor the Delta launches have been documented to cause any animal mortality or significant impact to wildlife habitat on CCAFS (USAF 2013a). Anticipated sonic boom noise in the area of 1 psf or less is expected to have very little effect on the sea turtle, and large sonic boom close to 3 psf would only occur beyond 30 miles off shore and would also have no effect.

Sea turtles are not expected to be directly impacted in the **additional** approximately 23 acres. However, they may be indirectly impacted due to associated lighting.

4.6 American Alligator

The Proposed Action is not likely to impact the American alligator or its habitat. The Proposed Action area contains a man-made ditch totaling 0.85 acres that could be considered alligator habitat. There is no clearing, dredging, or filling proposed for the ditch. The Proposed Action is not likely to impact alligators.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would potentially cause short-term disturbance to an alligator. These impacts would be considered short-term and would not affect alligators within the vicinity of the project area. Just as noise associated with rocket launches may startle many species within the CCAFS area, noise associated with landing, although much less, may do the same. However actual noise impact to wildlife is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, neither the Falcon 9, Atlas, the Titan, nor the Delta launches have been documented to cause any animal mortality or significant impact to wildlife habitat on CCAFS (USAF 2013a). Anticipated sonic boom noise in the area of 1 psf or less is expected to have very little effect on the alligator.

The **additional** area to be cleared also has man-made ditches on some of the boarders; affects to the alligator would be the same as discussed above.

4.7 Piping Plover

The original Proposed Action was not expected to impact Piping Plover habitat. The original Proposed Action did not anticipate any activities along the adjacent beach and there is no documented nesting of Piping Plover within Brevard County.

Potential noise related effects, either form construction or from Falcon vehicle landing is not expected to impact the Piping Plover.

The **additional** land clearing and operations will also not affect the Piping Plover for the same reasons as mentioned above.

4.8 Red Knot

The original Proposed Action was not expected to impact the Red Knot habitat. The Proposed Action does not anticipate any activities along the adjacent beach and the Red Knot is only recognized as an occasional visitor during migration.

Potential noise related effects, either form construction or from Falcon vehicle landing is not expected to impact the Piping Plover.

The **additional** land clearing and operations will also not affect the Red Knot for the same reasons as mentioned above.

5.0 Compensation

5.1 Florida Scrub Jay

Mitigation for impacts to the scrub-jay would compensate for impacts caused by the Proposed Action, and the **additional** proposed action. Provided the following compensation measures are implemented, both the original and the **additional** Proposed Action may effect but is not likely to adversely affect Florida scrub-jays on CCAFS.

The USAF proposes to restore overgrown unoccupied scrub-jay habitat at a ratio of 2:1 (every acre lost will require compensation in the amount of two acres). Approximately 76 acres in Land Management Unit (LMU) 33 will be restored for the original action, see Figure 11. An **additional** approximately 46 acres also in LMU 33 will also be restored for the additional action, see Figure 11A.

A combination of mechanical treatment and prescribed burning would be used to restore habitat. Any vegetation encountered that is optimal height for jays will be avoided and left untreated. This LMU is located adjacent to occupied habitat and therefore will provide acreage for scrub-jays to expand. Additionally, the USAF has future plans to restore the remaining part of LMU 33 to assist land managers with the corridor connecting the core population of jays on CCAFS. Although the area in which the Proposed Action will occur is not currently occupied, to reduce the potential to impact nesting jays, a survey would be conducted prior to clearing to ensure no jays are nesting within 150 feet of clearing activities. All suitable scrub-jay habitat would be surveyed for nesting jays. Any nests encountered would be flagged and no clearing would be required within 150 feet until after all birds have fledged

SpaceX would be expected to start restoration of LMU 33 within three months of ground breaking at LC-1 and it is expected that all restoration would be completed within 12 months. Controlled burning of the unit, if required, would be conducted as soon as range scheduling allows. Due to the height of the vegetation in the unit, it is expected that much of the vegetative debris would be hauled off and/or disposed on-site using an air curtain incinerator. All other vegetation that is of suitable height would be left and burned as scheduling permits. Yearly maintenance would include monitoring and control of invasive species, as well as maintenance of any artificial openings created during restoration activities. The unit would be placed on a 5-7 burn rotation schedule and roller chopping would occur as the unit exceeds optimal scrub-jay height. SpaceX will be required to fund all restoration and maintenance actions.

If a dead scrub-jay is found at the project site, it will be collected and frozen, and notification will be made to the USFWS office in Jacksonville.

5.2 Gopher Tortoise

Significant impacts to gopher tortoises are not expected for either the original or the **additional** action provided that minimization measures are implemented. To minimize impacts to gopher tortoises, pre-construction surveys would be conducted to locate tortoises within the project area. Pre-construction surveys would consist of walking the entire site that is accessible by foot. Since tortoises have been found in extremely overgrown areas elsewhere on CCAFS, surveys in thick vegetation would be conducted by creating transects using heavy equipment with personnel following behind performing surveys on either side of the transect. The initial transect would be cut by hand to allow personnel to survey on either side (approximately 15-20') of the transect. The next transect would then be conducted using heavy machinery, following the area that was previous surveyed, avoiding all burrows that have been marked. This method would continue until the entire area has been surveyed. Tortoises found during pre-construction surveys would be relocated to viable habitat elsewhere on CCAFS. The tortoise surveys would include a burrow count and habitat characterization and would be conducted in accordance with FFWCC guidelines. A map showing the locations of the burrow, as well as their occupancy status if a tortoise was captured will be provided by the USAF. Educational posters will be provided to equipment personnel who will be required to be observant for any tortoises that may wander onto the construction site. Any live or dead tortoises observed will be reported to the USAF immediately.

5.3 Eastern Indigo Snake

The 45 SW Indigo Snake Protection/Education Plan has been presented to the project manager, construction manager and personnel. An education sign has been be displayed at the site informing personnel of the snake's appearance, its protected status, and who to contact if any are spotted in the area. If any indigo snakes are encountered during clearing activities, they will be allowed to safely move out of the project area. Any observations of live or dead indigo snakes will be reported to the USAF immediately, who will then report it to USFWS if appropriate.

5.4 Southeastern Beach Mouse

Mitigation for direct impacts to the southeastern beach mouse would offset impacts caused by the Proposed Action. Provided the following mitigation measures are implemented, the Proposed Action would not significantly impact the southeastern beach mouse population at CCAFS.

The proposed restoration of habitat in LMU 33 for the scrub-jay is expected to be beneficial to southeastern beach mice as well. Although LMU 33 has not been specifically surveyed for beach mice, it is doubtful they are present based on the height and thickness of the vegetation. During restoration activities, any area encountered that is optimal scrub-jay height will not be treated. If beach mice are present, it is probably they would be located in these areas; therefore, leaving these areas untreated would reduce potential impacts to beach mice. The USAF has a Programmatic Biological Opinion that addresses impacts to beach mice associated with certain activities, which includes restoration actions. Based on past studies completed for CCAFS, beach mice benefit from the same land management activities being conducted for scrub-jays, and the population is expanding into inland locations. Therefore, the potential exists to create approximately 122 acres of additional habitat for beach mice. Additionally, areas in which beach mice were previously trapped would be hand-cut to avoid disturbance by heavy machinery, which would result in destruction of burrows. This habitat is contiguous with adjacent beach mouse habitat to the north and south and therefore would allow movement of individuals.

No **additional** mitigation actions for beach mice are expected to be required for the **additional** approximately 23 acres.

5.5 Marine Turtles

To minimize potential impacts to sea turtles from new or temporary facility lighting, the majority of exterior lighting proposed for this project would be in accordance with the 45th SW Instruction 32-7001, *Exterior Lighting Management* dated January 25, 2008. It is expected that some “non-turtle friendly” lighting may be required if any landings were to occur at night. An amended Light Management Plan will be completed by SpaceX once the design is completed and this Plan will be forwarded to USFWS for approval prior to new or temporary lighting construction. Clearing of vegetation at the LC-13 area would not have an impact to nesting or hatchling sea turtles; therefore, no mitigation is required for those activities. This applies to the **additional** land area. Also,

conditions within the ERP issued by the SJRWMD contain language which requires a Light Management Plan.

5.6 American Alligator

Significant impacts are not expected, for either the original action or the **additional** action, therefore no mitigation measures are needed. However construction crews would be alerted to the potential of alligator presence and disturbance to nests will not be authorized. Additionally, SpaceX will be responsible for ensuring all personnel understand the laws regarding the feeding of alligators. Any personnel observed feeding alligators will be reported to the appropriate authorities.

5.7 Piping Plover

Because there would be no clearing on the beach itself for the original or **additional** actions, impacts to Piping Plover habitat is expected to be negligible. However, during landing operations, any Plovers on the beach adjacent to LC-1 could be startled. This would be expected to be a short-term impact.

5.8 Red Knot

Because there would be no clearing on the beach itself for the original or **additional,** impacts to Red Knot habitat is expected to be negligible. However, during landing operations, any plovers on the beach adjacent to LC-1 could be startled. This would be expected to be a short-term impact.

6.0 Cumulative Impacts

Potential cumulative adverse impacts would occur for the Florida scrub-jay and eastern indigo snake. When evaluated with other projects occurring or proposed on CCAFS, the proposed removal of 38 acres, and an **additional** approximately 23 acres of occupied/potential habitat would result in a reduction of available breeding habitat, as well as a reduction in the availability of scrub habitat for restoration. However, the restoration of the original 76 acres, plus an **additional 46 acres** of habitat within LMU 33 (mitigation for the original Proposed Action and the **additional** action) will result in habitat that could support at a minimum, an additional four scrub-jay territories. The current INRMP (Integrated Natural Resources Management Plan) goal is for CCAFS to support 200 breeding pairs of jays. Because of the 2:1 mitigation requirement, the overall result will be a net increase in suitable habitat for jays.

Cumulative impacts associated with the restoration program, specifically controlled burning, are expected to be minimal. SpaceX is a member of the CCAFS Prescribed Burn Working Group and has go/no go authority on the day of burns. There may be restrictions on where the USAF can conduct a burn in order to ensure no smoke is placed on LC-1 during landing operations; however, the USAF has land management units prepared in different areas at any one time so that there is always an area available to burn depending on wind direction.

Cumulative impacts on the gopher tortoise are not anticipated with the Proposed Action. Gopher tortoises observed within any area to be impacted by ground disturbance would be excavated and relocated to an onsite recipient area approved and managed by the USAF.

Cumulative Impacts on beach mice are not anticipated for the Proposed Action. . Although beach mice are known to occur in the area west of the ditch, those areas in which beach mice were captured will be hand-cut and the area will remain as beach mouse habitat.

Cumulative impacts on sea turtles have the potential to occur. The new facilities will result in more exterior lighting than is currently present at LC-1. Adherence to the Light Management Plan and Air Force lighting policies will help reduce these impacts. Amber LED lighting will be used to the maximum extent possible to minimize potential adverse impacts on nesting turtles and/or their young.

Cumulative impacts on American alligator, Piping Plover, and Red Knot are not expected to occur with the Proposed Action. There are no activities proposed within the onsite ditch or the shoreline.

7.0 List of Prepares

John Kaiser PMP, Project Manager

Mark Ausley, Senior Biologist and Certified Wildlife Biologist
Authorized Gopher Tortoise Agent

Steve Volpe, Scientist

David Holly, Biologist, CAD and GIS Technician

Matthew Humphrey, Engineering and CAD

8.0 References and Documents Cited

Florida Administrative Code (FAC) Chap 68A-27

Florida Fish and Wildlife Conservation Commission (FWC) GOPHER TORTOISE PERMITTING GUIDELINES April 2008 (Revised April 2013)

National Wetlands Inventory Map: www.fws.gov/wetlands/

Title 50 Code of Federal Registration (CFR) §402.12(f) (Section 7)

USAF CCAFS Gopher Tortoise Relocation Permit WR04151C

USAF 45 SW Indigo Snake Protection/Education Plan

USAF, 45SW Instruction (SWI) 32-7001 Exterior Light Management Plan

USAF, 1991. CCAFS Scrub Jay Management Plan, 1991

USAF, 2002. Scrub Habitat Restoration Plan 45th Space Wing, CCAFS, 2002

USAF, 2007. *Environmental Assessment for the Operation and Launch of the Falcon 1 and Falcon 9 Space Vehicles at Cape Canaveral Air Force Station Florida*. November 2007

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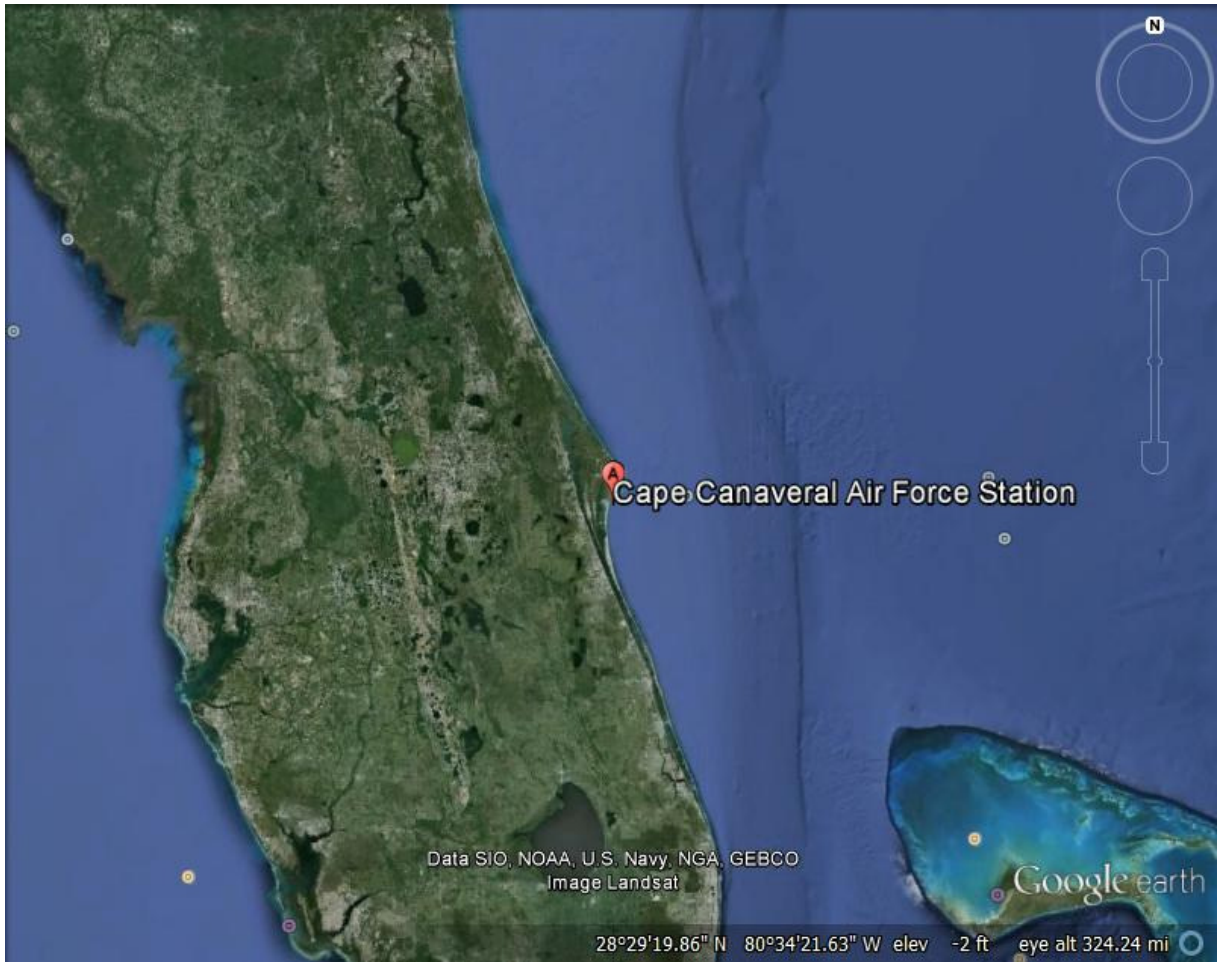
USAF, 2013a. *Supplemental to the November 2007 Environmental Assessment for the Operation and Launch of the Falcon 1 and Falcon 9 Space Vehicles at Cape Canaveral Air Force Station Florida*. July 2013

USAF, 2013b United States Air Force 45th Space Wing, CCAFS 2013 Scrub Jay Survey Results

USAF, 2013c United States Air Force 45th Space Wing, CCAFS 2009-2013 Sea Turtle Nesting Survey Results

USAF, 2014 Environmental Assessment for SpaceX Falcon 9 landing operations at LC-13, December, 2014.

Wyle, 2014. *Sonic Boom Assessment of Falcon 9 Landing at Cape Canaveral Air Force Station*, Wyle Environment and Energy Research & Consulting, June 2014

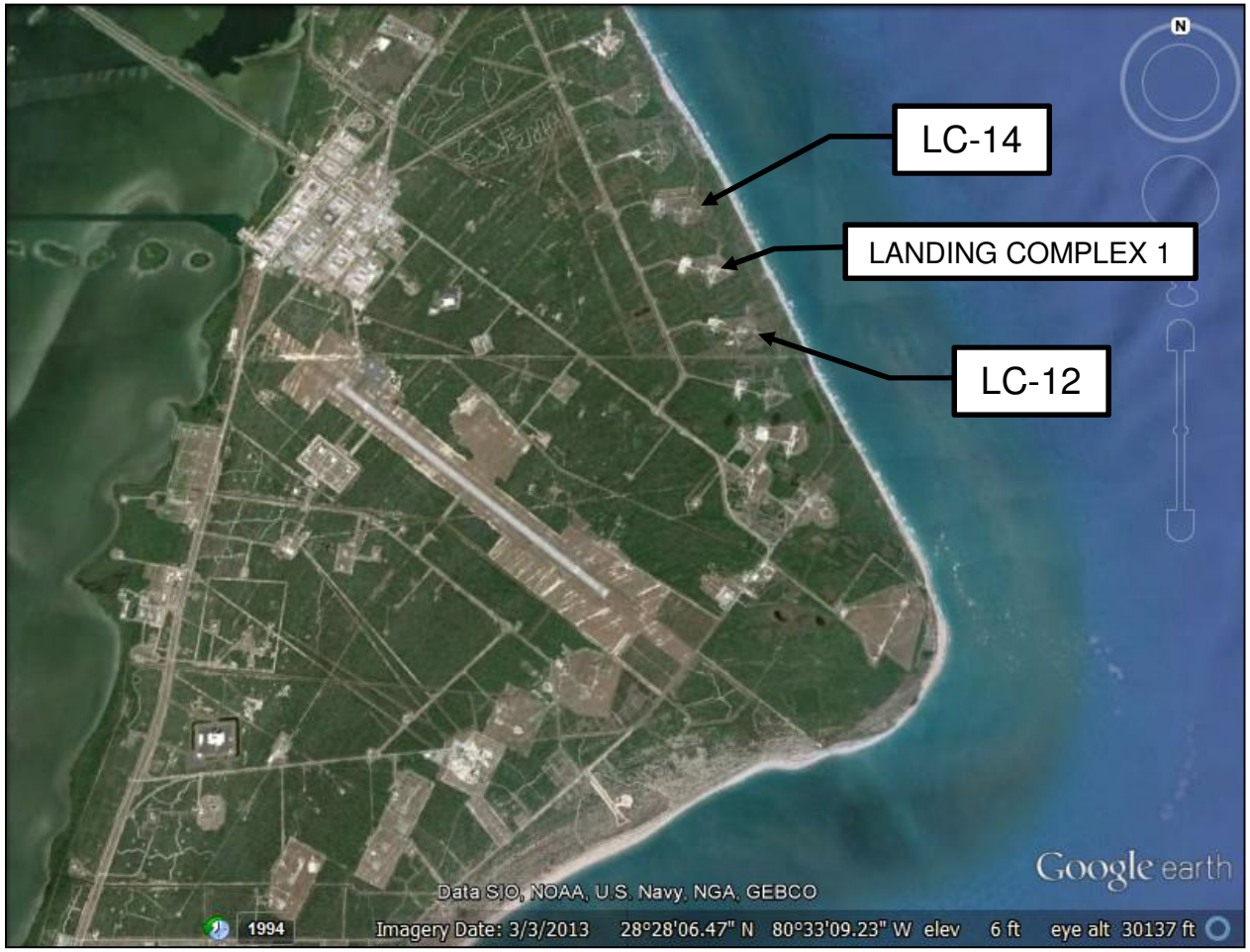


LOCATION OF CAPE CANAVERAL

G.E.A.R.
Gator Engineering & Aquifer Restoration, Inc.

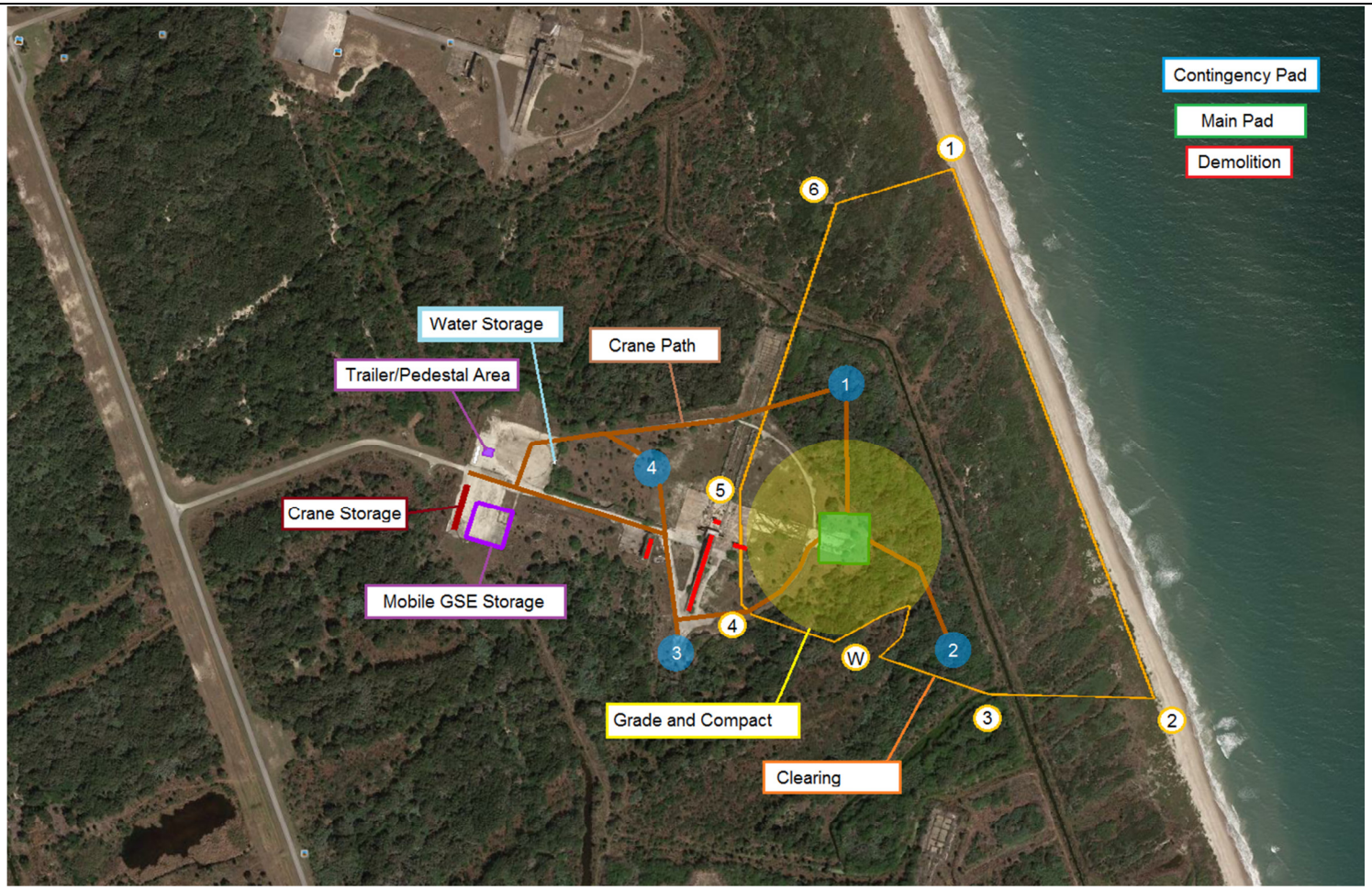
LANDING COMPLEX 1 (LC-1)
CAPE CANAVERAL AIR FORCE STATION

Figure 1



LOCATION OF LANDING COMPLEX 1 AT CCAFS

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION	**Figure 2**



PROPOSED LC-1 LANDING AREA – ORIGINAL CONCEPTUAL PLAN

G.E.A.R.
Gator Engineering & Aquifer Restoration, Inc.

LANDING COMPLEX 1
CAPE CANAVERAL AIR FORCE STATION
(SpaceX rev 6-13-14)

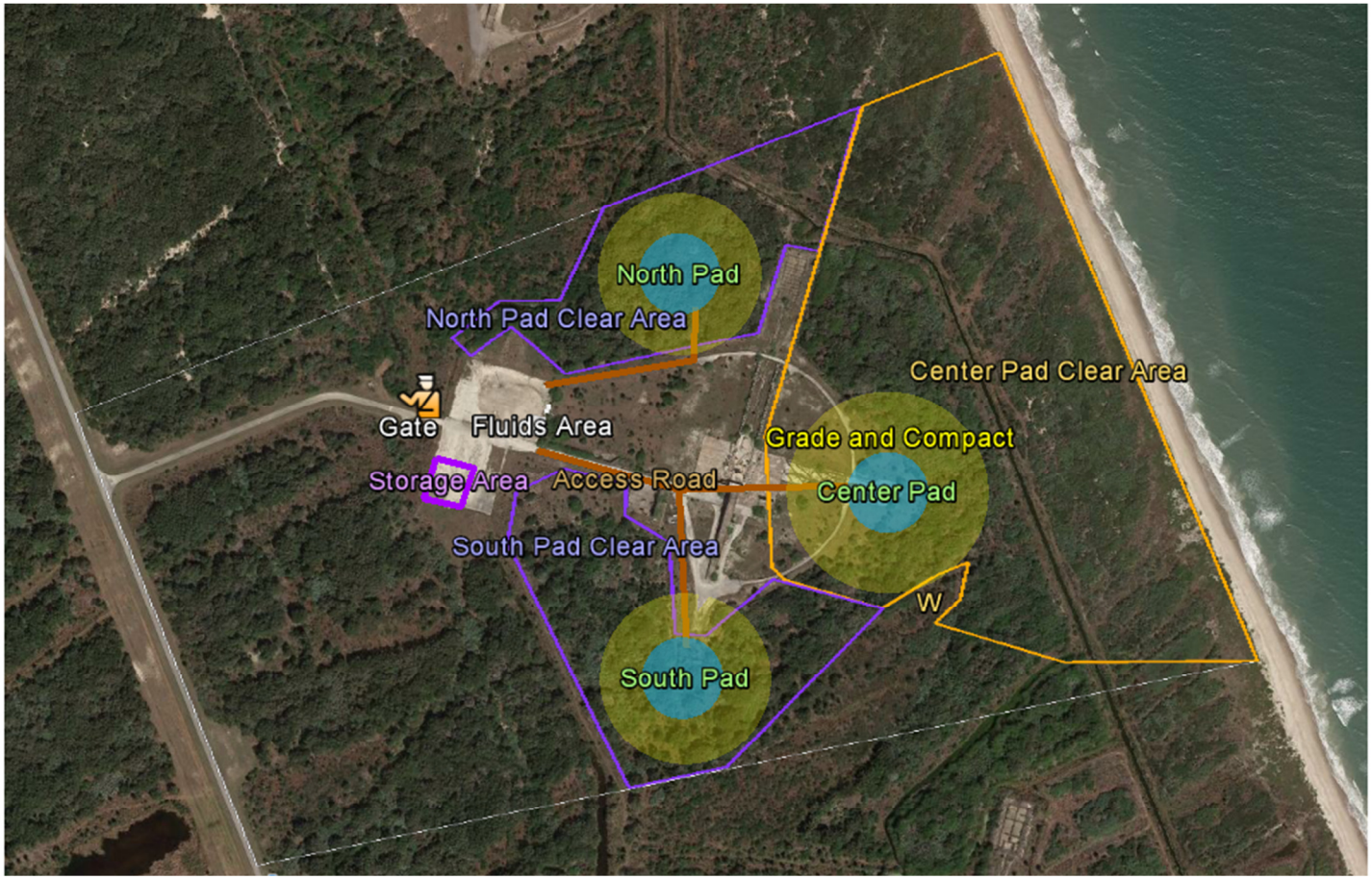
Figure 3

PROPOSED LC-1 LANDING AREA – CURRENT CONCEPTUAL PLAN

Gator Engineering & Aquifer Restoration, Inc.

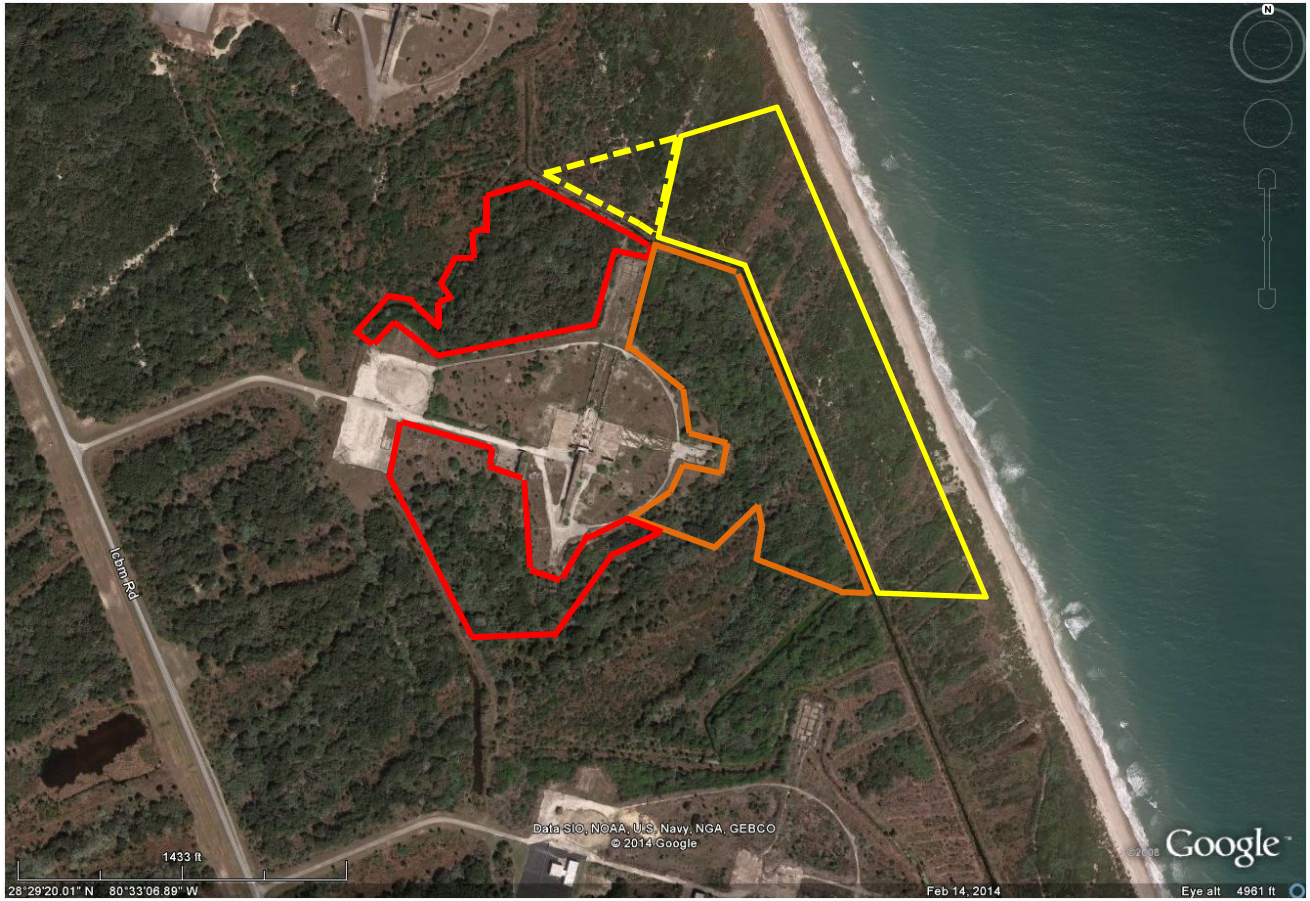
LANDING COMPLEX 1
CAPE CANAVERAL AIR FORCE STATION
(SpaceX rev 1-14-15)

Figure 4



PROPOSED LC-1 LANDING AREA – HEAVY CONCEPTUAL PLAN

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION (SpaceX rev 5-6-15)	**Figure 5**

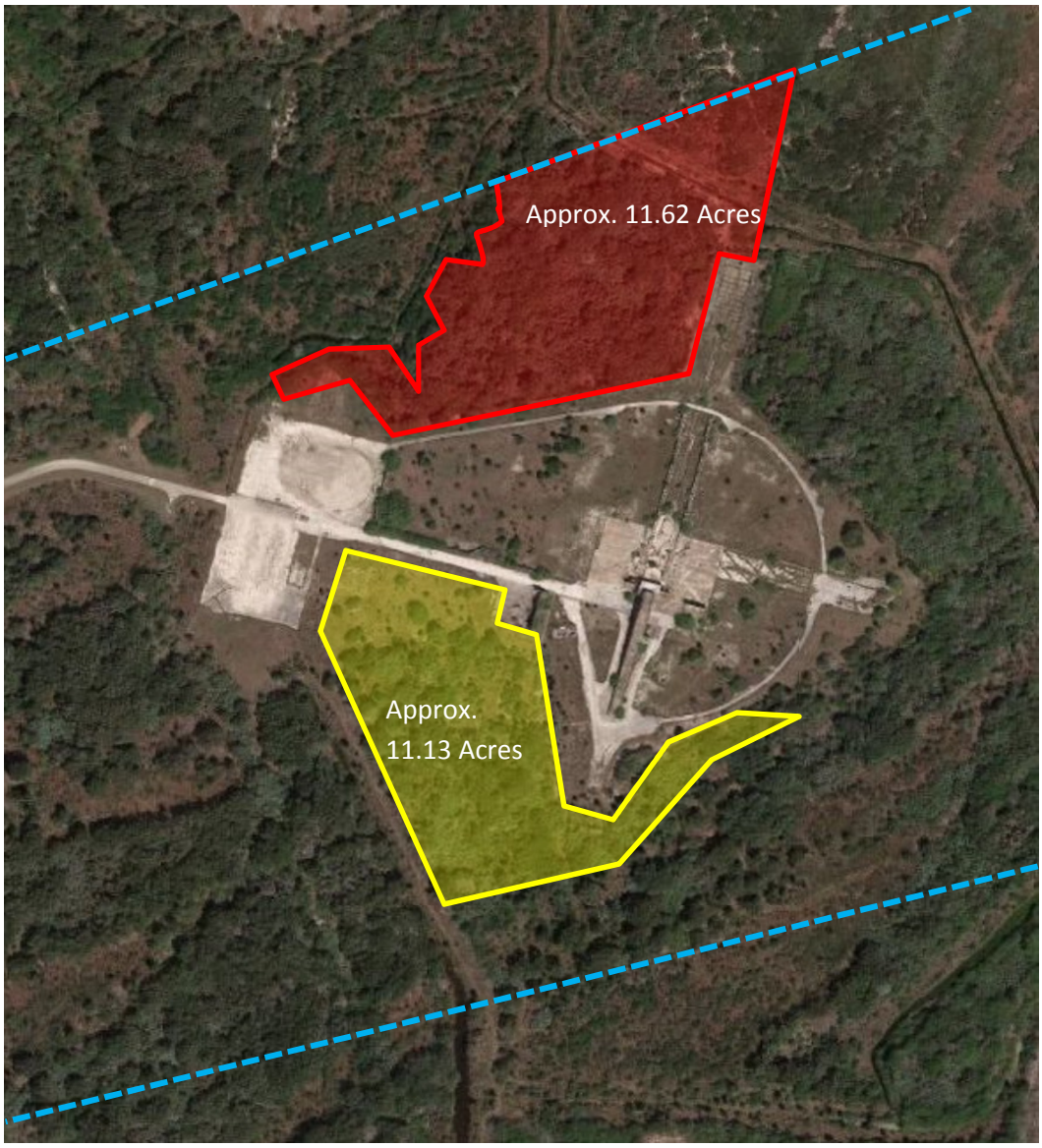


PROPOSED ACTION AFFECTED LANDS

Gator Engineering & Aquifer Restoration, Inc.

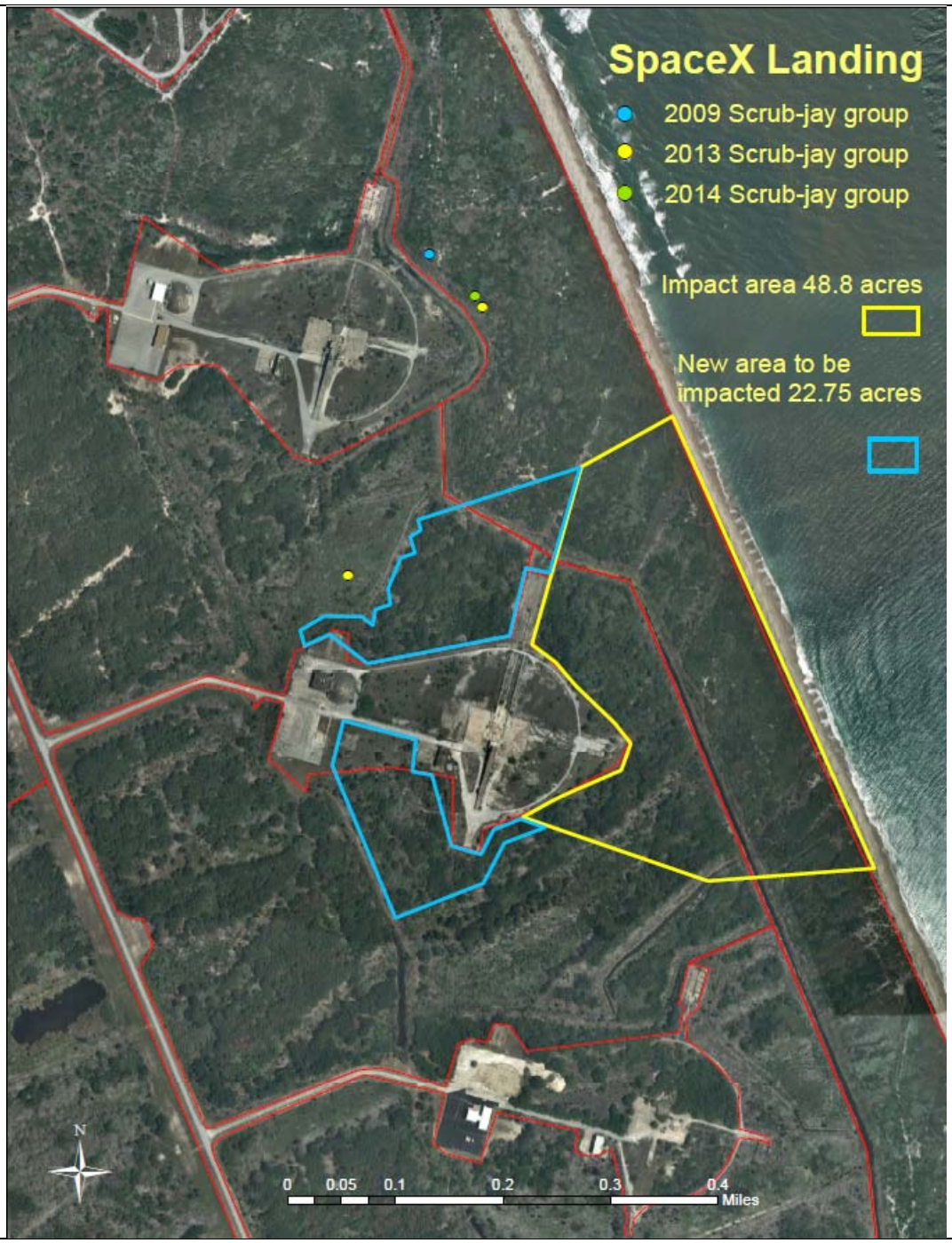
LANDING COMPLEX 1
CAPE CANAVERAL AIR FORCE STATION

Figure 6



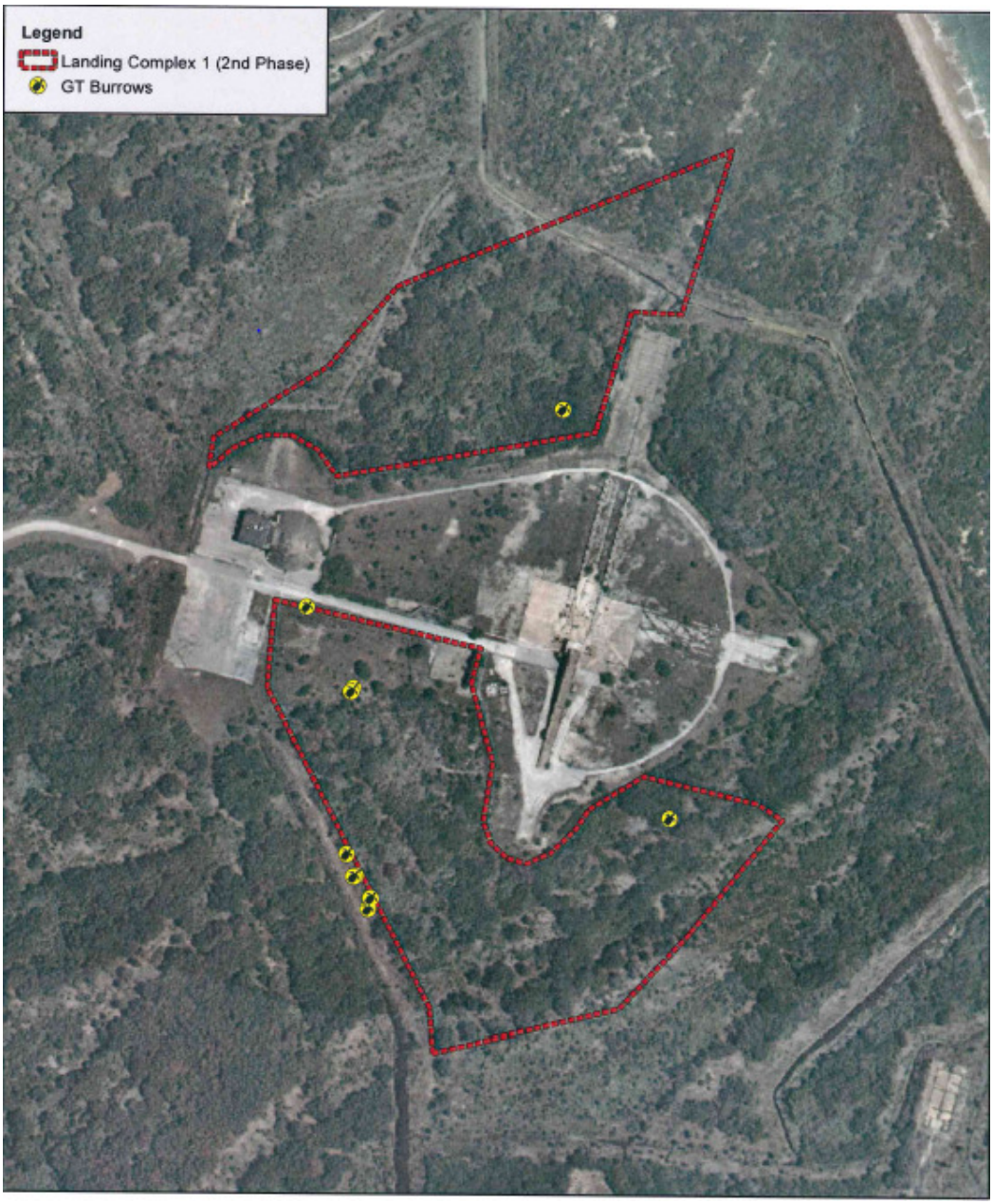
COMBINED NORTH/SOUTH PAD AREA MAP

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION	**Figure 7**



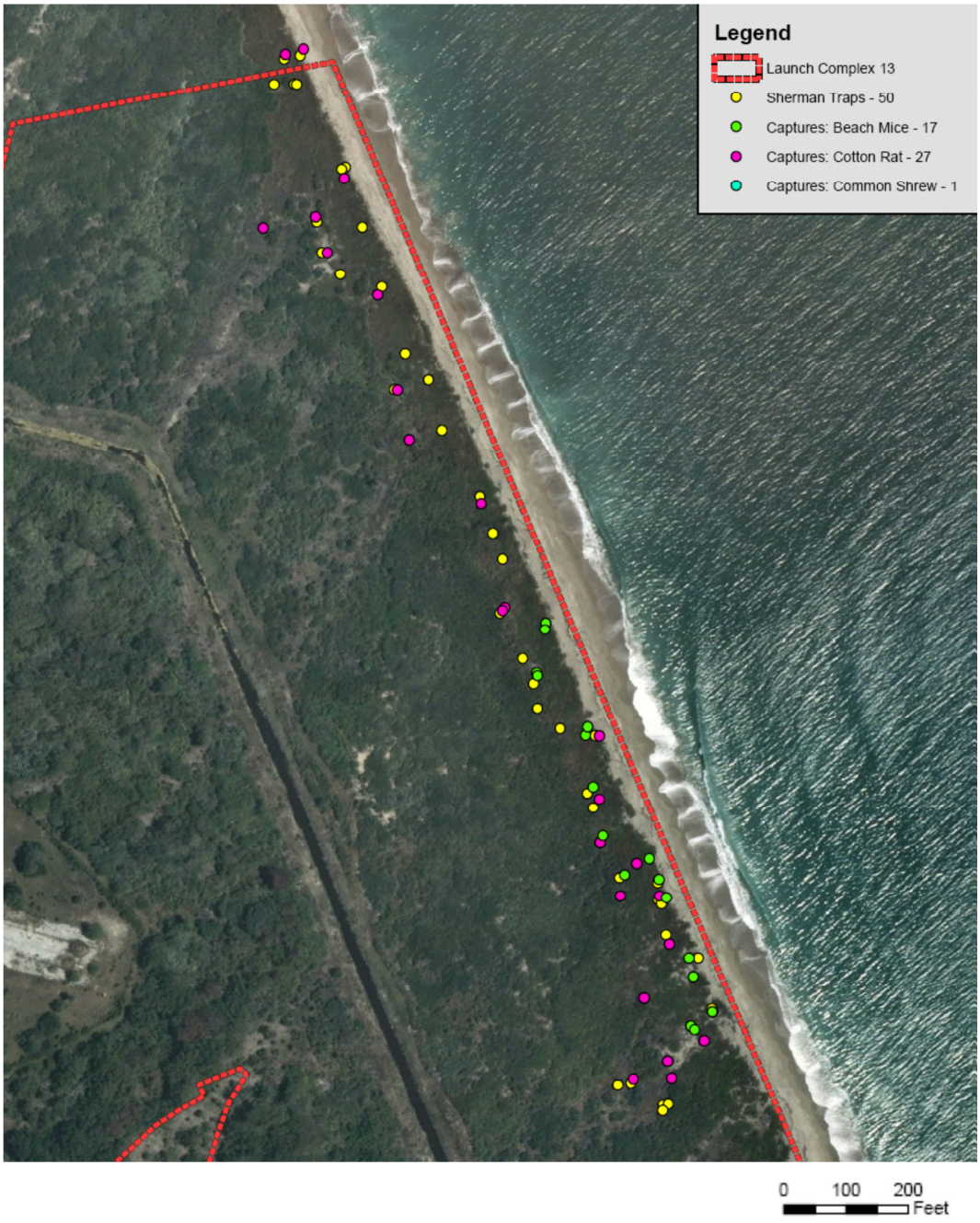
SCRUB JAY SURVEY

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION	**Figure 8**



GOPHER TORTOISE SURVEY

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION (April 27, 2015)	**Figure 9**

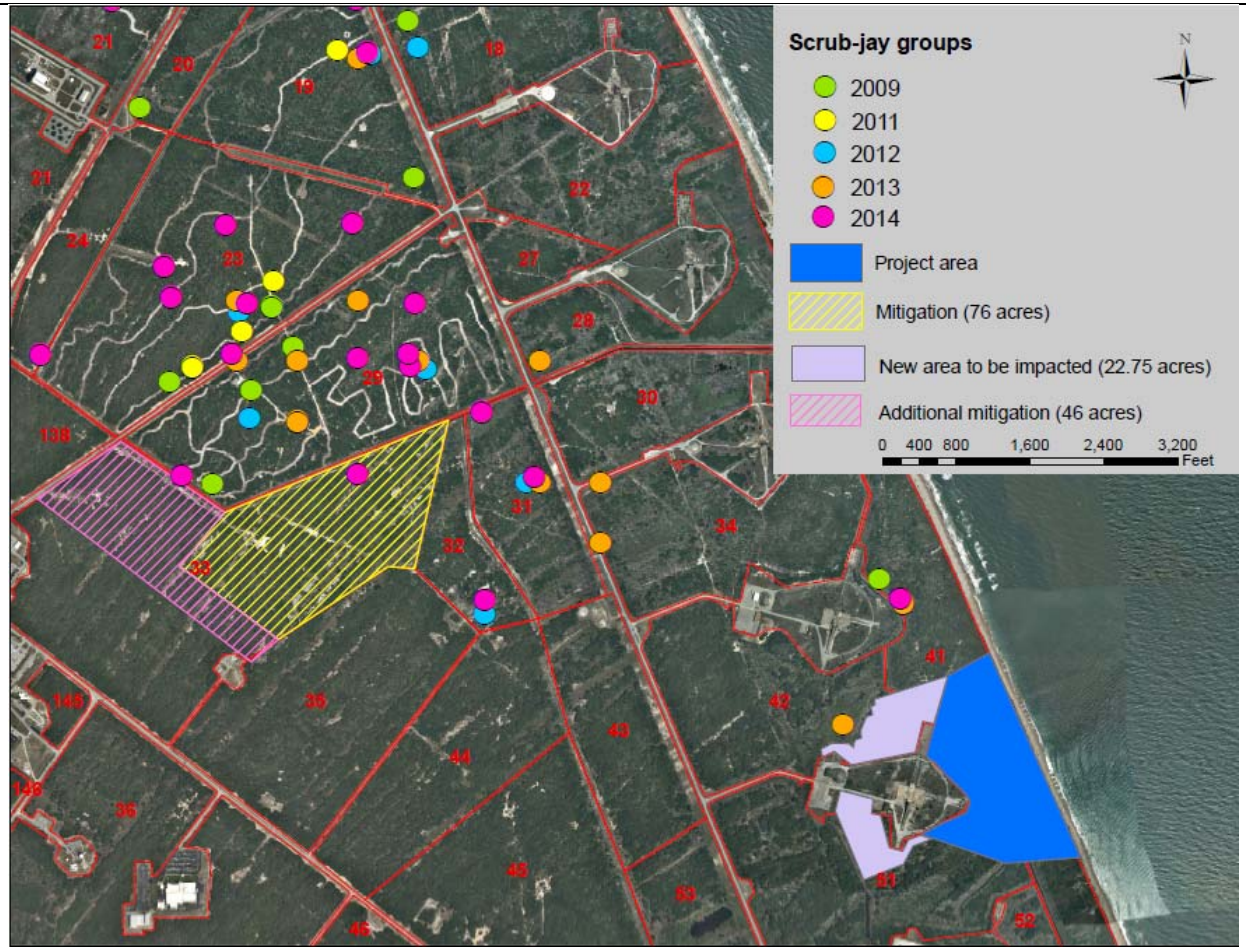


BEACH MICE SURVEY

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION (results 6-12-14)	**Figure 10**

Land Management Unit 33 Location

G.E.A.R. Gator Engineering & Aquifer Restoration, Inc.	LANDING COMPLEX 1 CAPE CANAVERAL AIR FORCE STATION	**Figure 11**



LAND MANAGEMENT UNIT 33 LOCATION

Gator Engineering & Aquifer Restoration, Inc.

LANDING COMPLEX 1
CAPE CANAVERAL AIR FORCE STATION

Figure 11A

Appendix E
Florida State Historical Resource Division Archeological Response Letter

FLORIDA DEPARTMENT of STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Michael A. Blaylock
Chief, Environmental Conservation
45 CES/CEIE
1224 Jupiter Street, MS-9125
Patrick AFB, FL 32925-3343

February 24, 2016

RE: DHR Project File No.: 2014-4037, Received by DHR: February 3, 2016
Project: *Additional Information Investigations at Launch Complex 13 (LC-13) for the Proposed Falcon Vertical Landing Site, Cape Canaveral Air Force Station (CCAFS), Brevard County, Florida*

Mr. Blaylock:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places.* The review was conducted 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.*

Thank you for providing our office with an update on the additional investigations at Launch Complex 13 (LC-13) (8BR2198) for the SpaceX Falcon Vertical Landing Site on Cape Canaveral Air Force Station. The 45th Space Wing Cultural Resource Manager (45 SW CRM) surveyed LC-13 in 2014 and determined that no historic or archaeological sites within LC-13 were eligible for listing on the National Register of Historic Places and determined that the undertaking would have no adverse effect on historic properties. Our office concurred with those findings.

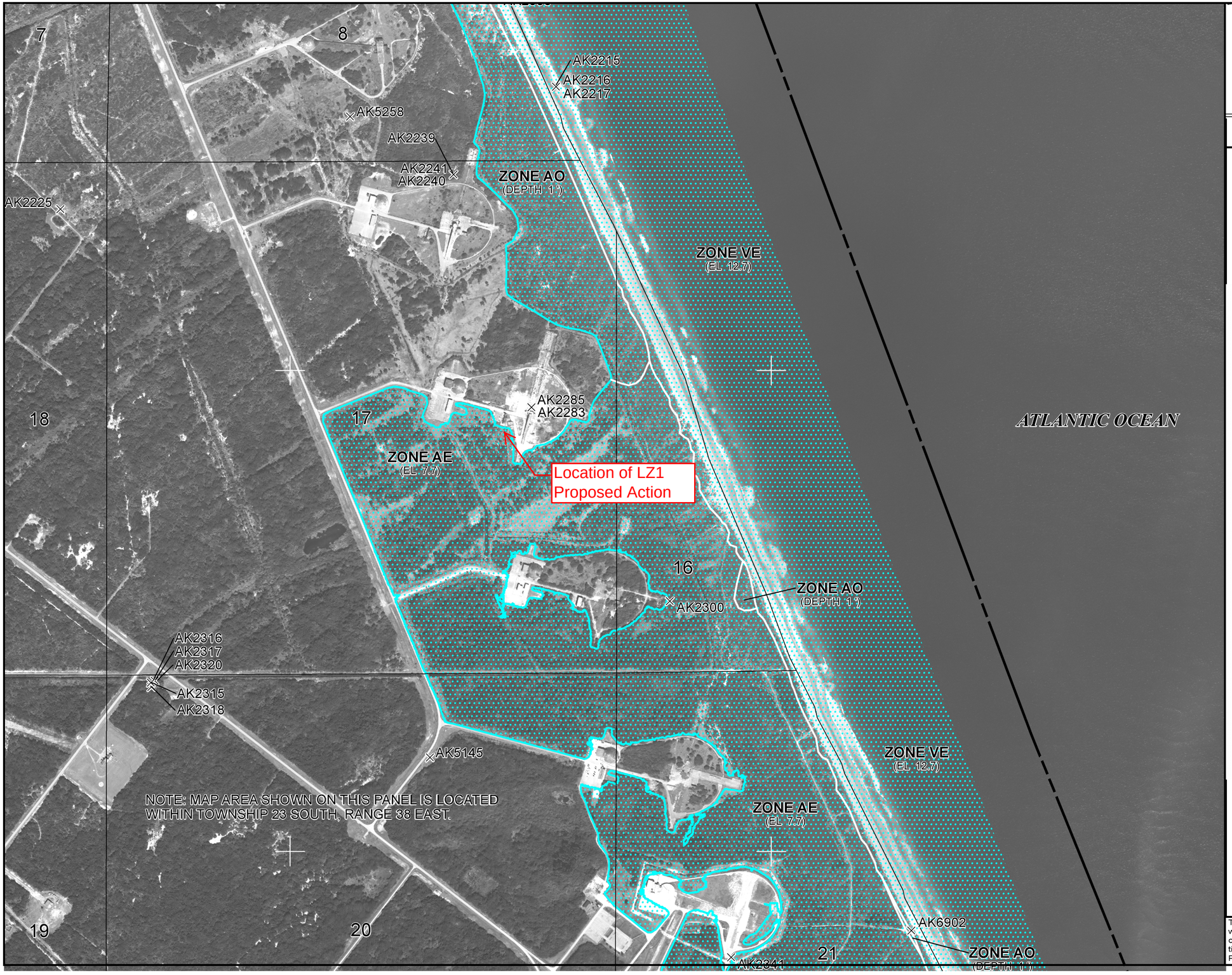
In anticipation of SpaceX's plans to expand the landing facility, the 45 SW CRM conducted further investigations at LC-13 from October 2015 through January 2016. This included a pedestrian survey and additional historical research. Based on the 2014 survey of LC-13 and the additional work conducted by the 45 SW CRM, our office concurs that no further action is required at this time.

If you have any questions, please contact Jason Aldridge, Historic Sites Specialist, by email at *Jason.Aldridge@dos.myflorida.com,* or by telephone at 850.245.6333 or 800.847.7278.

Sincerely

Timothy A Parsons, Ph.D.
Interim Director, Division of Historical Resources
and State Historic Preservation Officer

Appendix F
Floodplain map



MAP SCALE 1" = 1000'

500 0 500 1,000 1,500 2,000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0360G

FIRM

FLOOD INSURANCE RATE MAP

BREVARD COUNTY, FLORIDA

AND INCORPORATED AREAS

PANEL 360 OF 825

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BREVARD COUNTY	125092	0360	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
12009C0360G

MAP REVISED
MARCH 17, 2014

Federal Emergency Management Agency

Appendix G
Brevard County, Florida Soils Map

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Brevard County, Florida

May 8, 2014

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:5,930 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Brevard County, Florida
Survey Area Data: Version 11, Dec 6, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 12, 2011—Mar 13, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Brevard County, Florida (FL009)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
9	Canaveral-Anclote complex, gently undulating	77.4	75.6%
10	Canaveral-Urban land complex	11.5	11.2%
14	Beaches	0.2	0.2%
69	Urban land	13.3	13.0%
Totals for Area of Interest		**102.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments

on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Brevard County, Florida

9—Canaveral-Anclote complex, gently undulating

Map Unit Setting

Elevation: 10 to 60 feet
Mean annual precipitation: 49 to 57 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days

Map Unit Composition

Canaveral and similar soils: 60 percent
Anclote and similar soils: 30 percent
Minor components: 10 percent

Description of Canaveral

Setting

Landform: Dunes on marine terraces, ridges on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very high (19.98 to 50.02 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 6.0
Available water capacity: Very low (about 1.4 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6s
Hydrologic Soil Group: A/D
Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Typical profile

0 to 6 inches: Sand
6 to 12 inches: Sand
12 to 80 inches: Coarse sand

Description of Anclote

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear

Appendix H
Florida CLEARINGHOUSE SEA Review Concurrence Letters

Florida Fish and Wildlife Conservation Commission

Commissioners
Brian Yablonski
Chairman
Tallahassee

Aliese P. "Liesa" Priddy
Vice Chairman
Immokalee

Ronald M. Bergeron
Fort Lauderdale

Richard Hanas
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Managing fish and wildlife resources for their long-term well-being and the benefit of people.

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Tallahassee, Florida
32399-1600
Voice: (850) 488-4676

Hearing/speech-impaired:
(800) 955-8771 (T)
(800) 955-8770 (V)

MyFWC.com

July 27, 2016

Chris Stahl, Coordinator
Florida State Clearinghouse
Florida Department of Environmental Protection
3900 Commonwealth Blvd, M.S. 47
Tallahassee, FL 32399-3000
Chris.Stahl@dep.state.fl.us

RE: SAI # FL201607087692C, Department of the Air Force – Draft Final Supplemental Environmental Assessment for Space Exploration Technology Corporation (SpaceX) to Construct and Operate two Additional Landing Pads at Cape Canaveral Air Force Station (CCAFS), Brevard County, Florida.

Dear Mr. Stahl:

Florida Fish and Wildlife Conservation Commission (FWC) staff has reviewed the Department of the Air Force Supplemental Environmental Assessment (SEA) for the above-referenced project, and provides the following comments and recommendations for your consideration in accordance with Chapter 379, Florida Statutes (F.S.), and pursuant to the federal National Environmental Policy Act (NEPA), the federal Coastal Zone Management Act, and the State of Florida Coastal Management Program.

Project Description

Space Exploration Technology Corporation (SpaceX) proposes to construct and operate two additional landing pads, for their returning Falcon first stage boosters, at Cape Canaveral Air Force Station (CCAFS), Florida. The pads would allow up to three returning first stage vehicles to land, which would support operations when the SpaceX Falcon Heavy vehicle is launched in the near future. The SEA is supplemental to the original EA developed in 2014, which addressed SpaceX constructing the main landing pad at complex 13 (now named Landing Zone 1).

Comments and Recommendations

The SEA identified both state and federally listed species that could be impacted by the proposed action in Table 3-3. The Amended Biological Opinion from the U.S. Fish and Wildlife Service and the SEA addressed potential impacts to the Florida scrub-jay (*Aphelocoma coerulescens*, Federally Threatened [FT]), southeastern beach mouse (*Peromyscus polionotus niveiventris*, FT), Eastern indigo snake (*Drymarchon corais couperi*, FT), loggerhead (*Caretta caretta*, FT), green (*Chelona mydas*, FT) and leatherback (*Dermocheyls coriacea*, Federally Endangered) sea turtles, and gopher tortoise (*Gopherus polyphemus*, State Threatened). The following additional information is intended to assist SpaceX as the project moves forward.

Gopher Tortoise

While the SEA states that gopher tortoises are unlikely to be found in the project footprint, gopher tortoises have been found in the general area and the EA states that surveys will be conducted, per FWC guidelines, 90 days prior to construction. If any tortoises are found in the construction area, they will be relocated elsewhere on the CCAFS where there is suitable habitat. If gopher tortoise relocation is necessary, please contact Rachael King, FWC Gopher Tortoise Permitter, by email at rachael.king@myFWC.com or by phone at (561) 882-5714 so that we may assist in ensuring that the relocations are conducted in accordance with FWC's guidelines, including the need for an authorized agent to conduct the relocations.

Prescribed Fire

The SEA does not discuss the potential impacts of the additional pads on the ability of land managers to apply prescribed fire. Reducing the potential for smoke as a safety precaution for additional launches could reduce the window available to the CCAFS staff to conduct prescribed burns. A reduction in prescribed burns could have indirect effects on Florida scrub-jays by reducing habitat quality. Scrub-jay demographic success decreases as habitat becomes overgrown, and scrub-jays can eventually disappear from areas where fire management has significantly decreased. We recommend that this issue be considered as the project progresses.

We appreciate the opportunity to provide information on this project. If you need any further assistance, please do not hesitate to contact Jane Chabre either by phone at (850) 410-5367 or at FWCConservationPlanningServices@MyFWC.com. If you have specific technical questions regarding the content of this letter, please contact Theodore Hoehn at (850) 488-8792 or by email at ted.hoehn@myfwc.com.

Sincerely,

Jennifer D. Goff
Land Use Planning Program Administrator
Office of Conservation Planning Services

jdg/th
ENV 1
Cape Canaveral SpaceX Draft SEA_31284_07272016

cc: John Kaiser, G.E.A.R, Inc. john@GEARengineer.com

Appendix I
Public Comments Received

The comments (letters and emails) contained in this appendix were generated by the public and received by the USAF 45th Space Wing in accordance with NEPA guidelines. The comments are either in response to a notice issued on July 3, 4, and 5th 2016 in the newspaper Florida Today indicating a 30-day public notice period that construction in a floodplain was in planning, or received in response to a 30-day public review period of the Supplemental Environmental Assessment held between _____(yet to occur).

-----Original Message-----
From: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE [mailto:eva.long@us.af.mil]
Sent: Tuesday, July 19, 2016 2:23 PM
To: John Kaiser [redacted]Trip Harriss; Matthew Thompson
Cc: BLAYLOCK, MICHAEL A GS-13 USAF AFSPC 45 CES/CEIE
Subject: FW: SpaceX planning new landing pads
Importance: High

This has been forwarded to our public affairs office for response.

-----Original Message-----
From: Matt Richardson [redacted]
Sent: Tuesday, July 19, 2016 11:36 AM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: SpaceX planning new landing pads
Importance: High

Hi, Eva,

My name is Matthew Richardson, reporter with the Orlando Business Journal.

I read that SpaceX is seeking to build two additional landing pads at Cape Canaveral Air Force Station. I have some questions I wanted to ask you to get some more details if available. Could you answer these via email:

Are there any public documents that can be sent to me giving more details about SpaceX's landing pad plans?

When did SpaceX submit a request for its wanting to build two additional landing pads?

Is there a rough timeline for when SpaceX would want to start building and have these landing pads available?

Where exactly will the landing pads be located on the base?

What is the approval timeline for this proposed project? Are dates set on when this will be up for discussion? Who will discuss and make the final decision whether SpaceX can have the two landing pads or not?

What challenges might SpaceX have ahead that could prevent them from having the additional landing pads?

How many landing pads does SpaceX have right now?

Thank you,

Matthew Richardson
Technology Reporter

-----Original Message-----
From: Scott Chaplow [redacted]
Sent: Monday, July 18, 2016 8:53 PM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: SpaceX plans for two more landing pads

Hi Eva,

Can you please send me any information you have on the SpaceX plans to add two new landing pads at Cape Canaveral Air Force Station?

Thanks.

Scott.

Scott Chaplow

Systems Architect, HCL Technologies

[redacted]

Eva Long, 45 CES/CEIE, USAF

Cape Canaveral Air Force Station

From: Noel Munson [redacted]
Sent: Tuesday, July 19, 2016 7:59 AM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: Additional SpaceX Landing Pad public comment

Miss Long,

May I respectfully ask for an electronic copy of the SpaceX request for permission to build additional landing pads on Patrick Air Force Base? I understand the public comment period ends in August. Thank you in advance for your response.

Kind regards,

Noel Munson

From: Noel Munson [redacted]
Sent: Tuesday, July 19, 2016 12:41 PM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: RE: Additional SpaceX Landing Pad public comment

Thank you for your kind response. If I may register a public comment, I would like to indicate my support for the plan, and state that it is my opinion that this plan is vital for the continued economic development of Florida's aerospace industry and our national security.

Kind regards,

Noel Munson
Tallahassee, Florida

From: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE [mailto:eva.long@us.af.mil]
Sent: Tuesday, July 19, 2016 2:22 PM
To: John Kaiser [redacted] Matthew Thompson; Trip Harriss
Cc: BLAYLOCK, MICHAEL A GS-13 USAF AFSPC 45 CES/CEIE
Subject: FW: MEDIA INQUIITY: SpaceX additional landing

This has been forwarded to our public affairs office for response.

From: Brendan Byrne [redacted]
Sent: Tuesday, July 19, 2016 11:15 AM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: MEDIA INQUIITY: SpaceX additional landing

Hi Eva –

Following up on a notice for public input regarding the approval of additional landing sites for SpaceX boosters. Can you confirm there's been a request by SpaceX? What's the process going forward?

Brendan Byrne | Space Reporter & Host, 'Are We There Yet?' [redacted] Twitter: [redacted]
90.7 WMFE | wmfe.org | [redacted]

90.7 WMFE | npr

-----Original Message-----
From: rchoch [redacted]
Sent: Wednesday, July 20, 2016 9:28 AM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: SpaceX landing complex

Hi Eva. Please send me all the info you have.

Richard Hoch
[redacted]

-----Original Message-----
From: rchoch [redacted]
Sent: Saturday, July 23, 2016 12:53 PM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: SpaceX landing site

Hi Eva, I have interest in the proposed SpaceX landing complex and the environmental impact in our area. Please send me more info if available. Thank you very much.

-----Original Message-----
From: mdrury [redacted]
Sent: Tuesday, July 26, 2016 9:28 AM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: Public comment regarding SpaceX's two new landing pads

Good morning, Ms. Long.

I'm excited to hear about these pads being considered for LZ-1.

As someone who grew up watching Apollo launches, it was exciting, inspiring, but also seemed to me a waste of hardware each time.
Shuttle promised re-usability, but ultimately at too high a cost - both in dollars, and in lives.

SpaceX has a decent track record now of being able to bring in Falcons to precise landings, by land or by sea. Adding more pads will keep those first stages flowing back to the area once Falcon Heavy gets going, the transport and refurbishing of which keeps people happily employed here. That's heartening in a post-Shuttle era.

And, honestly, I missed the sonic booms. They were a regular reminder of our progress in space, and I'm glad they're back.

--Matt Drury

From: Ken Burkhalter[redacted]
Sent: Monday, July 25, 2016 4:20 PM
To: LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>
Subject: SpaceX Expanded Landing Pads

Just a POSITIVE comment on the SpaceX request to add more landing pads at the Cape.

We live in Central Florida (The Villages) and watch every launch and landing we can. If not sky visible we watch on the live web feeds.

We are both in our 70's and find the SpaceX efforts extremely fascinating, easily recalling the 1st Apollo landing on the Moon. I was wallpapering our Dining Room as Neil set foot on the moon.

On a scale of 1 to 10 we would have to say that approving the added Pads should rank somewhere around 37. [:-)}

I vote, without reservation, to proceed with this approval.

Hopefully, while we are still alive, we will see the fruits of these efforts and perhaps even a launch to Mars !!!!!!!