DRAFT ENVIRONMENTAL IMPACT STATEMENT

SPACEX STARSHIP-SUPER HEAVY LAUNCH VEHICLE AT LAUNCH COMPLEX 39A

at the Kennedy Space Center, Merritt Island, Florida

Volume II, Appendix B.2

August 2025

Federal Aviation Administration

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Appendix B *Regulatory Consultations*

This appendix provides regulatory consultation documentation for Endangered Species Act Section 7 consultation with the United States (U.S.) Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), Magnuson-Stevenson Fishery Conservation and Management Act consultation with the NMFS, National Historic Preservation Act (NHPA) Section 106 consultation with the Florida State Historic Preservation Officer (SHPO), U.S. Department of Transportation Act Section 4(f) consultation with officials with jurisdiction over affected properties, Coastal Zone Management Act consultation with the Florida Department of Environmental Protection, and Marine Mammal Protection Act Incidental Harassment Authorization with NMFS.

B.2 Essential Fish Habitat Assessment (NMFS)

The following Essential Fish Habitat Assessment was provided to the National Marine Fisheries Service for review as part of the Draft EIS public and agency review process. Additional correspondence in this regard will be added to this section as the consultation process continues.

DRAFT

ESSENTIAL FISH HABITAT ASSESSMENT

for the

SpaceX Starship-Super Heavy Launch Vehicle at Launch Complex 39A

at the

Kennedy Space Center

Merritt Island, Florida

August 2025

Draft Essential Fish Habitat Assessment

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Abbreviations and Acronyms

Acronym	***Definition***
°C	degrees Celsius
°F	degrees Fahrenheit
ASU	air separation unit
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
FAA	Federal Aviation Administration
FMC	fishery management council
HAPC	Habitat Areas of Particular Concern
KSC	Kennedy Space Center
LC	Launch Complex
LOX	liquid oxygen
LN_2	liquid nitrogen
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MT	metric tons
NASA	National Aeronautics and Space Administration
NMFS	National Marine Fisheries Service
SpaceX	Space Exploration Technologies Corporation
U.S.	United States

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1 Introduction

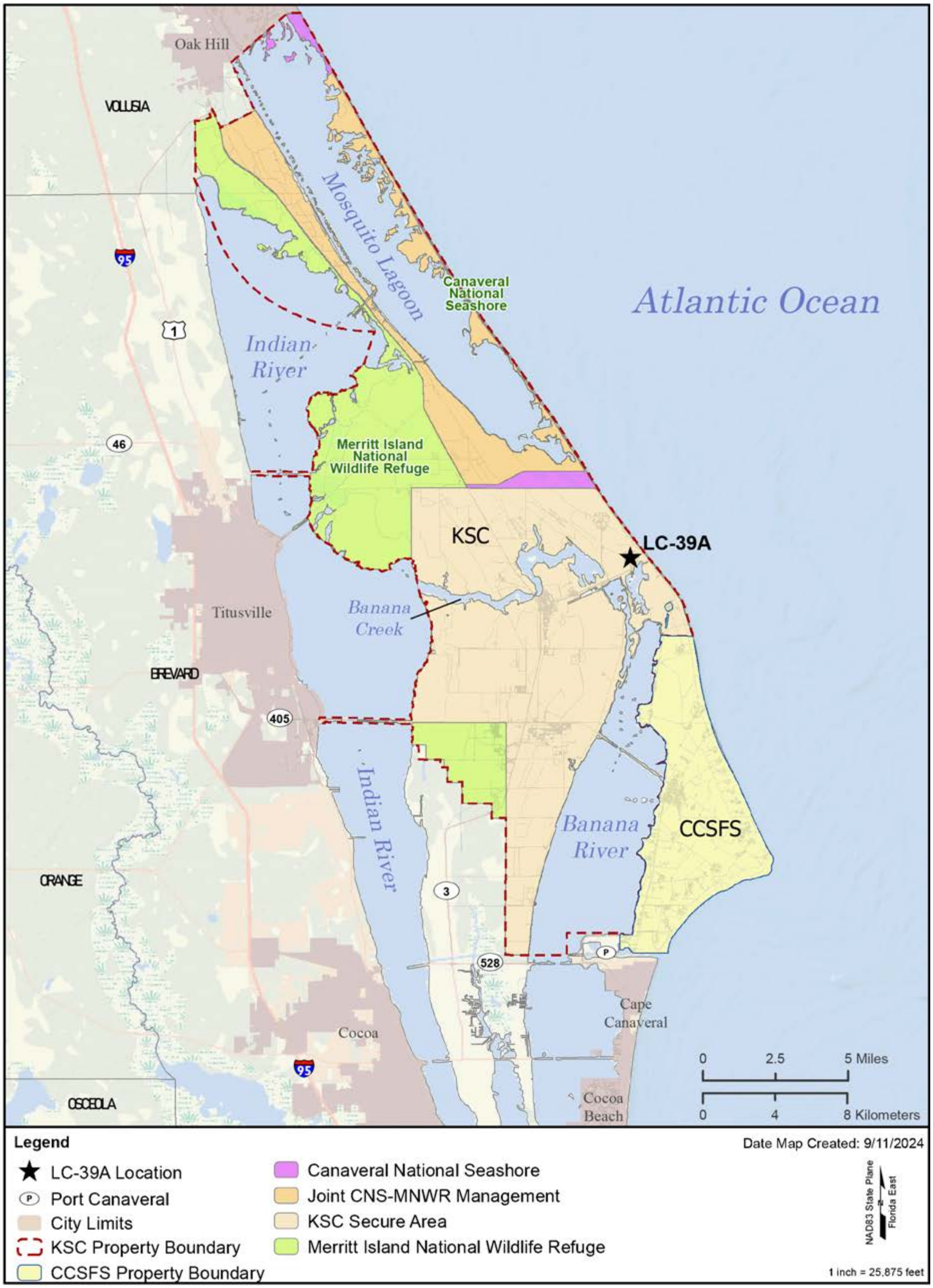
As required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Federal Aviation Administration (FAA) is assessing the impacts on essential fish habitat (EFH) that may result from granting a Vehicle Operator License to Space Exploration Technologies Corporation (SpaceX) for operation of the Starship-Super Heavy at Launch Complex (LC)-39A within the National Aeronautics and Space Administration (NASA) Kennedy Space Center (KSC) (Figure 1-1, Location of Launch Complex 39A). SpaceX's proposed operations (the Proposed Action) include construction of a launch pad and other launch support infrastructure at LC-39-A, launches at LC-39A, landings at LC-39A, and landings in the ocean. This EFH Assessment evaluates how the actions proposed by SpaceX may affect EFH that is present for managed species or species groups in the study area.

SpaceX is a commercial space transportation and services company that designs, manufactures, launches, and operates advanced rockets and spacecraft. SpaceX's Falcon 9 and Falcon Heavy vertical orbital launch vehicles are the world's only reusable orbital-class rockets. SpaceX supports the full spectrum of United States (U.S.) government space mission requirements, including crew and cargo transportation for NASA to the International Space Station and spacecraft launches for NASA and the Department of Defense. SpaceX also conducts most of the world's commercial satellite launches.

SpaceX's proposed operations are needed to increase operational efficiency, capabilities, and cost effectiveness of the Starship-Super Heavy program. Satisfaction of these needs benefit government and public interests and reduces operational costs. Demand for launch services has increased over the past 20 years, and space industry growth projections indicate this will continue into the foreseeable future. By providing a reusable launch vehicle that returns to its launch site, the Proposed Action would reduce the cost of launch and increase efficiency, delivering greater access to space and enabling cost-effective delivery of cargo and people to the moon and Mars. SpaceX's Proposed Action would satisfy requirements for more efficient and effective space transportation methods and continue the United States' goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure.

This EFH Assessment includes the following information: a description of the Proposed Action (Chapter 2); a description of managed species and associated EFH in the action area (Chapter 3); an analysis of the effects of Proposed Action activities (Chapter 4); a summary of the FAA's conclusions on the effects of the Proposed Action (Chapter 5); and proposed best management practices and minimization measures (Chapter 6).

Figure 1-1. Location of Launch Complex 39A



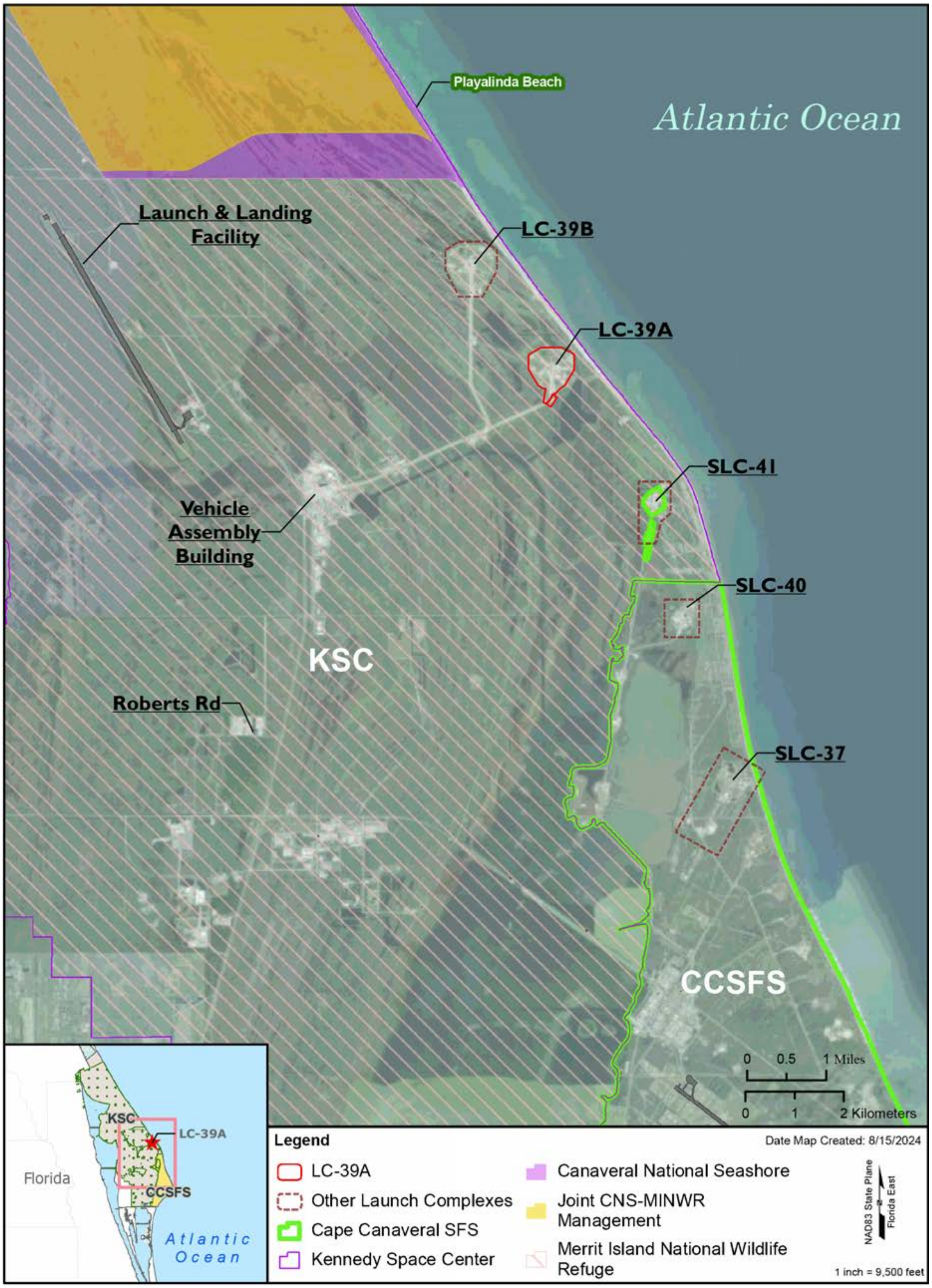
2 Proposed Action

The FAA's Federal Action is to issue a Vehicle Operator License to SpaceX that would allow Starship-Super Heavy operations at LC-39A and any subsequent license modifications and renewals under 14 Code of Federal Regulations Part 400 that are within scope of the Environmental Impact Statement. SpaceX's Proposed Action consists of Starship-Super Heavy launch and landing operations (up to 44 launches and 88 landings—44 for each stage [Starship and Super Heavy] of the launch vehicle—per year) at LC-39A, to include ocean landings of Super Heavy in the Atlantic Ocean and Starship in the Atlantic, Pacific, and Indian Oceans. Starship and Super Heavy could land on floating platforms (referred to as "droneships") in the ocean. Infrastructure improvements at LC-39A are proposed to support launch and landing operations. A detailed discussion of the Proposed Action is provided in the following subsections.

2.1 Proposed Location

LC-39A is a KSC-owned, SpaceX-leased launch site located on KSC property, approximately 3 miles east of NASA's Vehicle Assembly Building (Figure 2-1, Proposed Action Location). LC-39A currently supports Falcon 9 and Falcon Heavy launches. In 2019, NASA completed the *Final Environmental Assessment* [EA] *for the SpaceX Starship and Super Heavy Launch Vehicle at Kennedy Space Center (KSC)* (NASA, 2019) to evaluate the potential environmental impacts resulting from construction and operations associated with the proposed SpaceX Starship-Super Heavy launch vehicle at LC-39A. Following completion of the 2019 NASA EA, SpaceX began developing a site within the perimeter of LC-39A for Starship-Super Heavy launch operations intended for future Starship-Super Heavy missions. SpaceX would continue to launch Falcon missions at LC-39A while Starship-Super Heavy is operational.

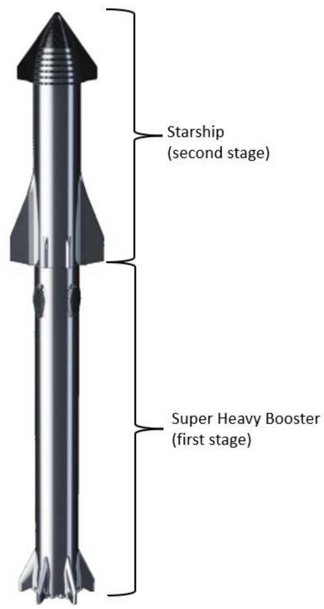
Figure 2-1. Proposed Action Location



2.2 Starship-Super Heavy Launch Vehicle

Starship-Super Heavy is composed of two stages: (1) Super Heavy is the first stage (or booster), and (2) Starship is the second stage (Figure 2-2, Starship-Super Heavy Launch Vehicle Design). The fully integrated Starship-Super Heavy launch vehicle is expected to be up to 492 feet (150 meters) tall, depending on configuration, and approximately 30 feet in diameter. As designed, both stages are reusable, with any potential refurbishment actions taking place at SpaceX facilities at KSC. Both stages are expected to have minimal post-flight refurbishment requirements; however, they may require periodic maintenance and upgrades.

Figure 2-2. Starship-Super Heavy Launch Vehicle Design



The proposed Starship-Super Heavy configuration consists of 35 Raptor engines for Super Heavy and 9 Raptor engines for Starship. The Raptor engine is powered by liquid oxygen (LOX) and liquid methane. Super Heavy is expected to hold up to 4,100 metric tons (MT) of propellant and Starship up to 2,650 MT of propellant. Current maximum lift-off thrust of the launch vehicle is anticipated at 103 meganewtons. Starship would have a maximum thrust of approximately 28 meganewtons. Launch propellant and commodities include liquid nitrogen (LN_2), water, gaseous oxygen, gaseous methane, gaseous nitrogen, helium, hydraulic fluid, LOX, and liquid methane.

2.3 Starship-Super Heavy Operations

2.3.1 Pre-Launch

Pre-flight operations could include ground testing activities, tanks testing, spin-prime tests, mission rehearsals (i.e., dry and wet dress rehearsals), and static fire engine tests. A dry dress rehearsal simulates launch day conditions where a full launch countdown is conducted, but the vehicle is not fueled. A wet dress rehearsal is similar to a dry dress rehearsal, but the vehicle is fueled. This test allows the launch team to practice timelines and procedures used for launch, and to identify potential issues. The goal of these operations is to verify that all vehicle and ground systems are functioning properly, as well as to verify that all procedures are properly written.

SpaceX could conduct tank tests and spin-prime tests prior to static fire or launch. If needed, proof tests could be performed to confirm the structural integrity of the launch vehicle tanks. Proof pressure tests are broken into two main categories: (1) pneumatic and (2) cryogenic. Pneumatic proof pressure testing consists of pressurizing the launch vehicle's tank with gaseous media (either helium, nitrogen, oxygen, or methane) and holding pressure for an extended duration. Cryogenic proof pressure testing consists of loading the tank with a single propellant, typically LN_2 or LOX. The tanks are then pressurized to a predefined limit to confirm their structural integrity with appropriate factors of safety. These proof pressure tests do not release any propellant to the environment. Propellants are recycled back into the ground system tanks after the test is completed. Tank tests do not involve the mixing of explosive commodities and are designed to test an accepted safety limit; thus, they are not expected to explode or spread debris. Spin-prime tests verify the engine system is operational prior to static fire tests. During a spin-prime test, the vehicle engines are chilled, and pumps are spun to operating speed, but are stopped prior to engine ignition.

Prior to launch operations, SpaceX could conduct static fire engine tests of both Starship and Super Heavy (Starship static fire tests would be conducted before integration with Super Heavy). The goal of a static fire engine test is to verify engine control and performance. During a static fire engine test, the launch vehicle engines are ignited for a short duration, generating noise and a heat plume, then shut down. SpaceX estimates that Starship and the Super Heavy booster would each conduct one static fire engine test per launch, respectively (i.e., 44 total static fire tests per stage for a total of 88 per year). SpaceX may also reduce the cadence of the static fires of the Starship or Super Heavy vehicles, not requiring a static fire of each engine test per launch operation. Static fires would utilize the deluge system, with each event utilizing approximately 300,000 gallons of water. Static fires would be up to 15 seconds in duration and would only occur during the daytime.

During pre-flight operations, SpaceX would connect the launch vehicle to ground systems. After an operation involving propellant (i.e., wet dress rehearsal and static fire engine test), SpaceX would transfer the propellant back to the commodity tanks. During Starship fuel loading for a static fire engine test, gaseous methane could be released to the atmosphere or combusted; however, SpaceX intends to recapture methane where practicable. This release would be minimal as the liquid methane would be released as gaseous methane vented from the stage to maintain pressure, and it would be a very small percentage of the vehicle tank's propellant vented.

2.3.2 Launch

Starship-Super Heavy would launch from LC-39A up to 44 times per year and could occur at any time of day or night. During a launch, ignition of the Super Heavy booster Raptor engines would generate a heat plume. The plume would appear clear and consist of water vapor, carbon dioxide, carbon monoxide, hydrogen, methane, nitrogen oxides, and oxygen. The heat plumes and increased temperatures in this area would be temporary and would only occur during engine ignition and dissipate within minutes. A flame diverter or similar infrastructure (e.g., a water-cooled diverter) would be constructed to reduce potential impacts due to the plume (a diverter can direct the plume upward, away from the ground). For LC-39A, SpaceX has only notional designs for a flame diverter; the notional design is a bifurcated diverter, where the engines would be encased in the launch mount that sits on top of the diverter. The two opposite sides of the rectangular diverter would be open and angled upwards. Deluge water (potable water) would be released inside the launch mount to cool the mount and diverter as the launch occurs. SpaceX anticipates approximately 400,000 gallons of deluge water would be used during each integrated launch.

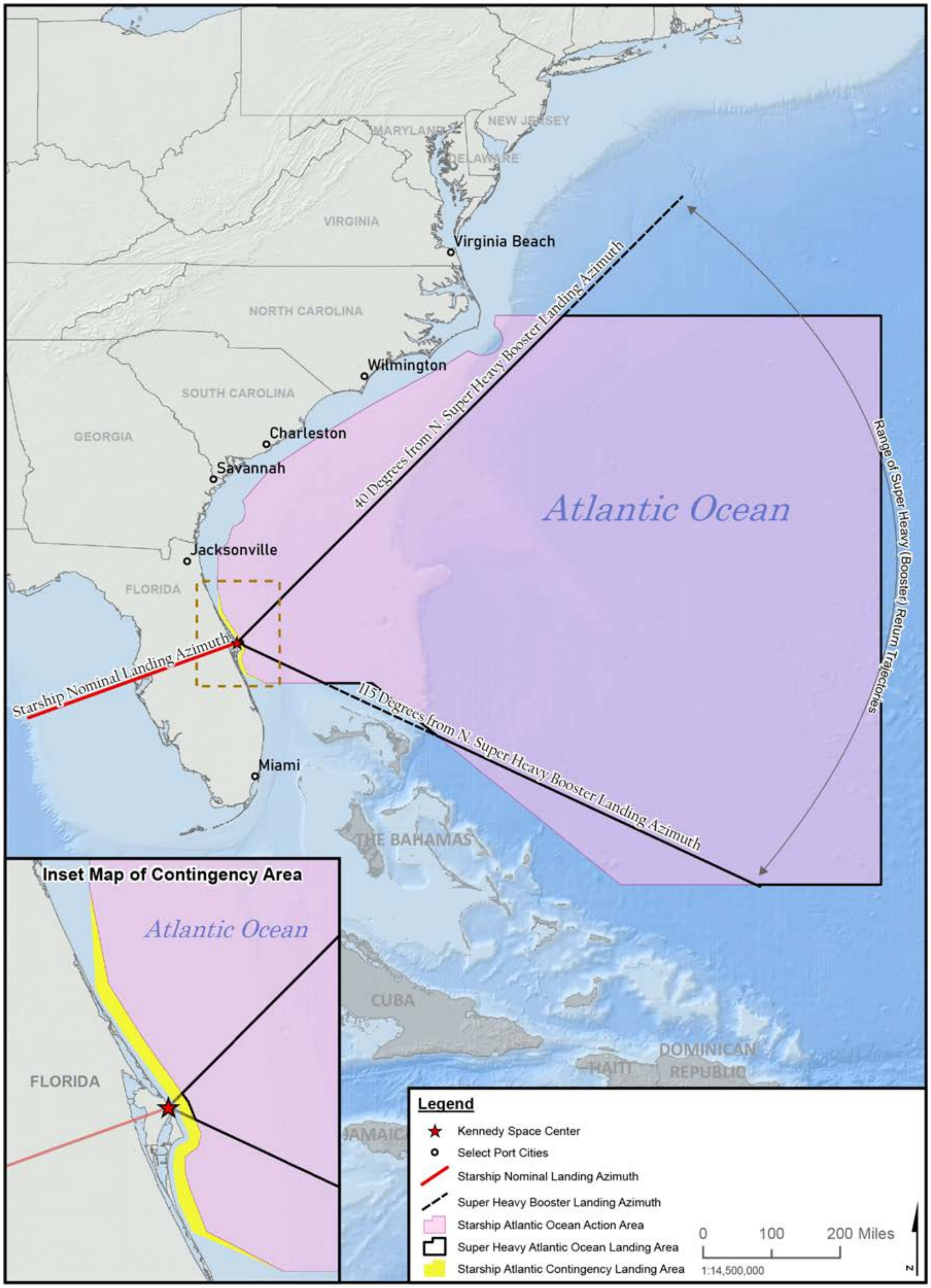
2.3.3 Super Heavy and Starship Landings

Super Heavy Landings

Each Starship-Super Heavy orbital launch would include landing Super Heavy at LC-39A, downrange in the Atlantic Ocean on a floating platform/barge, or on a droneship (mobile vessel not attached to the sea floor) or being expended in the Atlantic Ocean, no closer than approximately 5 nautical miles off the coast within the Super Heavy Atlantic Ocean Landing Area (Figure 2-3, Proposed Super Heavy and Starship Atlantic Ocean Landing Areas). While it is acknowledged that there may be landings occurring in the ocean, the goal is for all landings to occur at LC-39A. During flight, Starship's engines would start, most of Super Heavy's engines would cut off, and the booster would separate from Starship. Starship would continue to the desired orbit location and Super Heavy would rotate and ignite to conduct the retrograde burn, which would place it in the correct angle to move the vehicle impact point to approximately its final target. Once Super Heavy is in the correct position, the engines would cut off. Super Heavy would then perform a controlled descent using atmospheric resistance to slow it down and guide it for a precise return to the tower at LC-39A to be caught with the tower's arms. As Super Heavy slows down during its landing approach, a sonic boom would be generated. Once near the landing location, Super Heavy would ignite its engines to conduct a controlled landing. Super Heavy would land vertically at the catch tower or other landing location, such as a floating platform.

While SpaceX intends Super Heavy to be fully reusable and to return to the launch site following operational flights, expending (i.e., not recovering) vehicles may be required; SpaceX anticipates this to be an infrequent occurrence given the goals of the reusable concept. Super Heavy could be expended in the Atlantic Ocean (Figure 2-3, Proposed Super Heavy and Starship Ocean Landing Area) during the initial stages of launch operations at KSC and/or if mission payload or desired orbit requirements would result in too little propellant remaining in Super Heavy to return to the launch site. This expenditure process would occur within several minutes after launch and Starship separation from the Super Heavy booster. An expended Super Heavy would break up above the ocean's surface or on impact with the ocean's surface, or it would sink. Some residual propellant would remain in an expended Super Heavy, and the impact would disperse remaining propellants and drive structural failure of the vehicle. The structural failure would allow the remaining propellant to mix, resulting in an explosive event upon impact with the ocean's surface. Super Heavy could also conduct a soft water landing where the vehicle's engines would fire prior to impact with the ocean's surface, causing the vehicle to land vertically and intact. The vehicle would then take on water and sink on its own, be scuttled (purposefully sunk), or transported back to land. If recovered in the open ocean, via water landing or on a droneship, it would be delivered by vessel to Port Canaveral or the KSC turn basin and transported horizontally the remaining distance to LC-39A or other SpaceX facilities over the roadways. Following Super Heavy landings at the launch site, it may be transported from the landing pad to the adjacent launch mount or to one of SpaceX's production locations over the roadways for refurbishment. Any potential refurbishment actions would take place at SpaceX's facilities at the launch site or at other SpaceX facilities at KSC.

Figure 2-3. Proposed Starship and Super Heavy Landing Trajectories and Ocean Landing Areas



Starship Landings

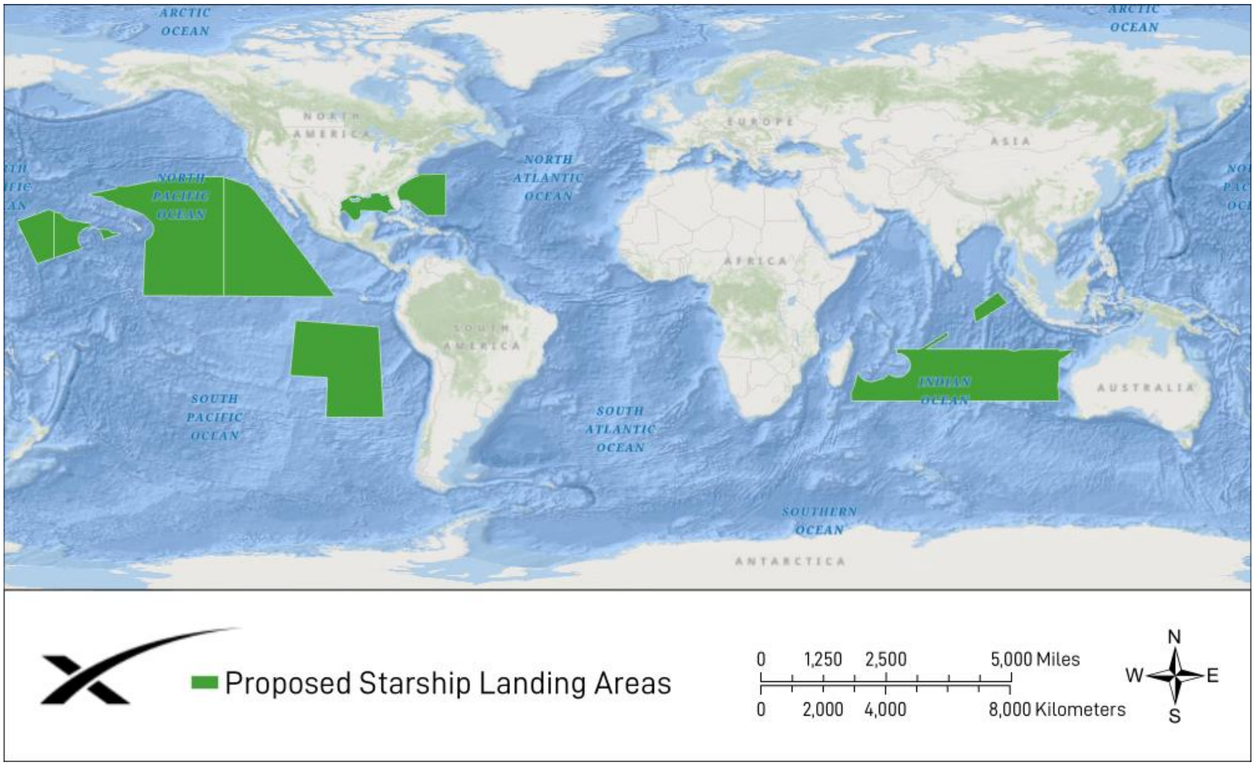
Starship could land at LC-39A, on a droneship in the high seas between 55 degrees south latitude and 55 degrees north latitude, or in the Atlantic Ocean. In the Atlantic Ocean, SpaceX may land the Starship vehicle anywhere within the boundary of the "Starship Atlantic Ocean Action Area" depicted in (Figure 2-3). However, part of the action area consists of an "Starship Atlantic Ocean Contingency Landing Area," which is between one and five nautical miles from shore and runs 50 miles north and south of LC-39A (Figure 2-3). The remainder of the action area begins five or more nautical miles from shore. Starship contingency landing operations would occur if an off-nominal satiation occurred during operations, such as an issue with the catch tower or vehicle operating parameters, or other extenuating safety circumstances which prevent nominal Starship landing operations at KSC. The proposed Starship nominal reentry trajectory is shown in (Figure 2-3). The timeframe for recovery of Starship within the Atlantic Ocean Continency Landing Area would be dependent on the location of occurrence and the rapidity of the SpaceX recovery team's mobilization. Should Starship land in shallow waters, SpaceX would coordinate with the U.S. Coast Guard to mitigate any potential navigable hazard until recovery is accomplished. SpaceX recovery personnel would follow standard salvage procedures in compliance with applicable state and/or federal requirements for the salvage activity and perform an assessment of structural stability required to tow and stabilize Starship as it is returned to the Port. Recovery operations typically consist of one barge and tug boat.

Starship would perform a controlled descent using atmospheric resistance to slow the vehicle down and guide it to its landing location. Guidance systems are used to maneuver the vehicle, and trajectories determine flight paths. As Starship slows down during its landing approach, a sonic boom would be generated. If landing at the catch tower, another plume would be generated and the deluge system would be employed, utilizing approximately 68,000 gallons of water. Following a successful landing, Starship would go into an automatic safing sequence (i.e., put the vehicle in a safe state). After Starship is in a safe state, a mobile hydraulic lift would raise Starship onto a transporter. If a Starship landing occurred downrange in the broad ocean area, it would be delivered by vessel to Port Canaveral or the KSC turn basin. Following Starship landings at the launch site, it would be transported from the landing pad to the adjacent launch mount or to one of SpaceX's production locations over the roadways for refurbishment. Any potential refurbishment actions would take place at SpaceX's facilities at the launch site or at other SpaceX facilities at KSC.

While SpaceX continues to prove accuracy and capability, SpaceX could require expending Starship during early program launches in the broad open ocean. General ocean landing areas are shown in Figure 2-4 (Proposed Starship Ocean Landing Areas). SpaceX anticipates this to be an infrequent occurrence given the goals of the reusable concept. Within the northern Pacific area, landings would not occur within the Exclusive Economic Zone (EEZ) of the Hawaii archipelago or around remote island U.S. territories with identified EFH. The only activities within the Pacific Ocean EEZs would be occasional watercraft transit to and from a port. Starship could be expended in two different ways: a controlled descent that would result in Starship's intact impact with the ocean's surface (hard or soft landing), or an uncontrolled descent resulting in breakup during atmospheric reentry. The timeframe between launch and expenditure (as well as location of expenditure) would vary, depending on mission requirements. If SpaceX assets are in the vicinity, an attempt would be made to recover Starship.

In a controlled descent, after ascent engine cutoff, Starship could vent residual main tank propellant during the in-space coast phase of the launch at or above approximately 74 miles above ground level. Following the in-space coast phase, Starship would conduct a deorbit burn to begin its controlled descent. Some residual LOX and methane would remain in Starship. Starship could impact the ocean intact, horizontally, and at terminal velocity (i.e., the steady speed achieved by a freely falling object), and the impact would disperse remaining propellants and drive structural failure of the vehicle. The structural failure would allow the remaining LOX and methane to mix, resulting in an explosive event upon impact with the ocean's surface. Starship could also conduct a soft water landing where the vehicle's engines would fire prior to impact with the ocean's surface, causing the vehicle to land vertically and intact. The vehicle would then take on water and sink or be scuttled.

Figure 2-4. Proposed Starship Ocean Landing Areas



For uncontrolled descent, SpaceX could expend Starship through a breakup during atmospheric entry. Descent target areas would be in the broad open ocean shown in Figure 2-4 (Proposed Starship Ocean Landing Areas). SpaceX expects that most of the launch vehicle debris would sink because it is made of steel. Lighter items not made of steel, such as composite overwrapped pressure vessels, may float, but are expected to eventually become waterlogged and sink. If large debris remains, SpaceX would coordinate with a party specialized in marine debris management to survey the affected area and sink or recover any large floating debris. SpaceX would coordinate with all land and water regulatory authorities, including the U.S. Coast Guard and the State Department, prior to recovering debris to ensure it is recovered as expeditiously as possible.

Following an orbital landing, Starship would have remaining LOX and liquid methane in the vehicle. Remaining LOX would be released to the atmosphere, and remaining liquid methane would likely be released to the atmosphere or safely combusted. Due to risks to personnel, SpaceX is unable to reconnect the vehicle to ground systems when liquid methane remains on the vehicle. In the future, SpaceX may recycle liquid methane back into tanks as technology and design develops.

2.3.4 Payloads

In general, payloads and their associated materials/fuels/volumes are mission dependent, but would be similar to current commercial and government payloads analyzed in the *Environmental Assessment for Launch of NASA Routine Payloads* (NASA, 2011). Starship-Super Heavy Program payloads would be similar to but larger than current and planned payloads launched on Falcon 9 and/or Falcon Heavy and range from 100,000 to 150,000 kilograms. Missions could include crew, cargo, and spacecraft flights to various orbits, the moon, Mars, and other destinations. SpaceX is also proposing to launch orbital propellant transfer missions, where Starship would carry propellant to refill orbital fuel depots. Payload volumes for Starship propellant tankers and depots could be as much as 2,650 MT. In such cases, no separate tank of propellant will be loaded into Starship as a true “payload or cargo.” Instead, the propellant depot is composed of the tanks already integrated into Starship, which would facilitate its return to Earth if it were not functioning as a depot.

2.4 Launch Complex 39A Infrastructure

A conceptual plan of proposed infrastructure improvements at LC-39A is shown in Figure 2-5 (Proposed Launch Complex 39A Infrastructure) and described in the following subsections. The figure shows facilities that were previously approved for construction (and currently under development) under the 2019 NASA EA, as well as those associated with this Proposed Action.

2.4.1 Super Heavy Catch Tower

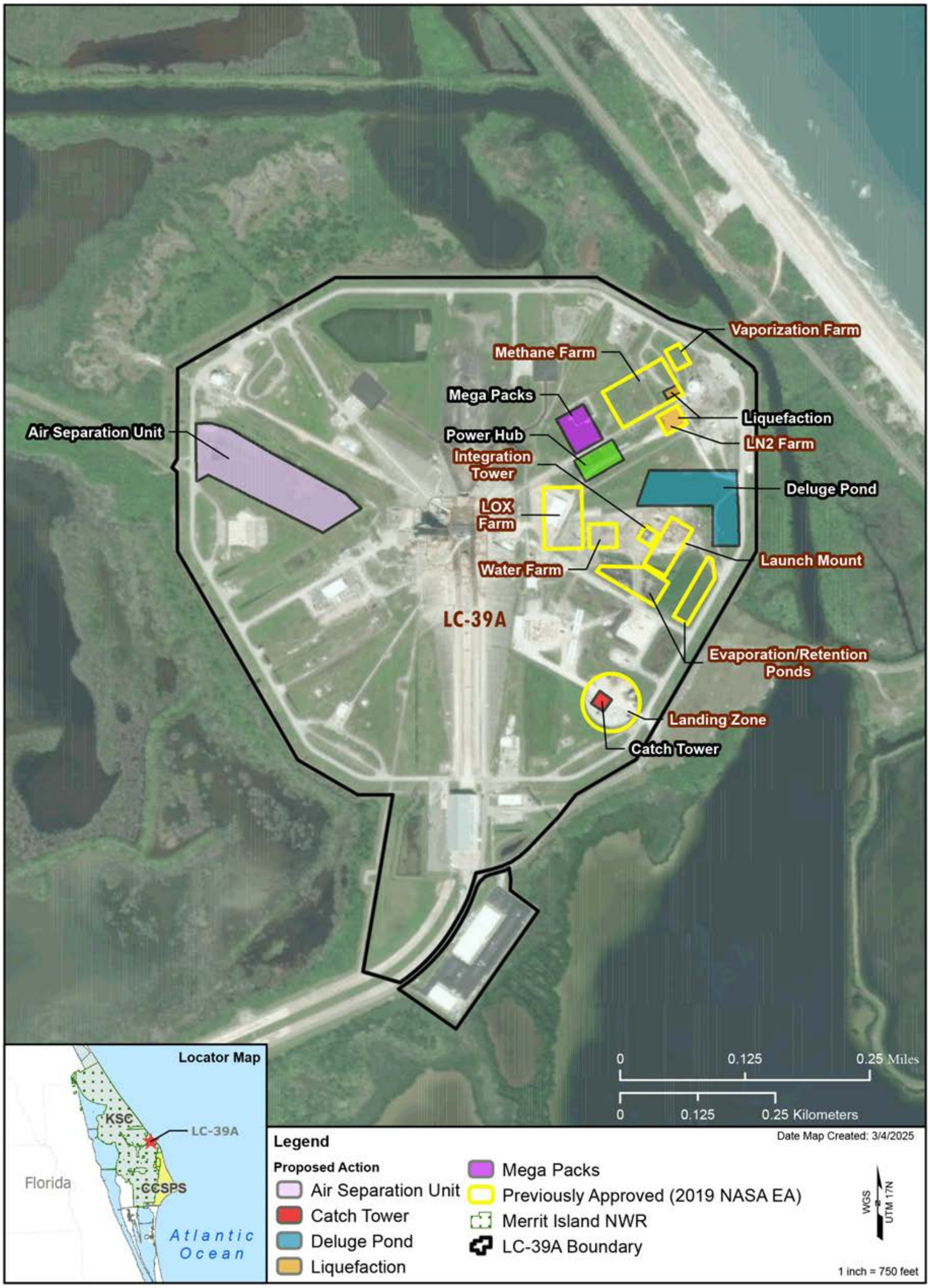
SpaceX would construct an additional tower within the LC-39A fence line to support landing operations. While the integration tower used for launch could support Super Heavy landings, an additional landing tower would reduce launch pad refurbishment needed between each launch, providing a shorter turnaround period between launches and increasing the efficiency of launch operations. The catch tower would be approximately 480 feet tall and similar in appearance to the existing integration tower. The additional tower will be for catches only and not launches.

2.4.2 Propellant Generation

Starship-Super Heavy is equipped with Raptor engines that are powered by LOX and liquid methane. SpaceX is proposing to construct onsite facilities for propellant generation and propellant storage, and storage tanks for LOX and liquid methane are under construction, as approved under the 2019 NASA EA. Propellant generation facilities would be operated using natural gas and/or existing electrical power lines and “MegaPacks” (a large-scale rechargeable lithium-ion battery stationary energy storage product). The current concept of operations is that, until the liquefaction plant and air separation unit (ASU) are constructed (this is due to the extensive lead time necessary for final design, construction, and on-boarding of these facilities), commodities would be trucked to LC-39A to generate propellant.

SpaceX would process natural gas brought to the site for propellant generation. A natural gas pretreatment system would remove impurities such as mercury, sulfur, water, carbon dioxide, and hydrocarbons heavier than methane from the natural gas to produce a stream of higher purity gaseous methane; impurities would be captured through a filtration system and managed according to KSC solid and hazardous waste requirements. Surplus natural gas would be used for process work, power generation, or would boil off like a natural gas line venting. In the future, natural gas would be supplied to LC-39A through a multiuser pipeline extending from the existing natural gas main line on KSC. The natural gas pretreatment system would include a small amine treating unit for carbon dioxide removal, a scrub column to remove heavy hydrocarbons that would be up to 100 feet tall and 10 feet in diameter, and four to six smaller vessels approximately 6 feet in diameter and up to 30 feet tall.

Figure 2-5. Proposed Launch Complex 39A Infrastructure



As part of the liquefaction process, SpaceX proposes to construct a methane liquefier to supercool pretreated natural gas into a liquid state for storage and transportation to the launch vehicle. The liquefier would use a compressor and turboexpanders to operate a gas refrigeration cycle with nitrogen or air to liquefy the methane in a primary heat exchanger. The natural gas pretreatment and liquefier together would be comprised of several structures each up to 65 feet tall. The methane liquefier would be cooled by a typical evaporative cooling tower, requiring up to approximately 8,000 gallons per hour (30 cubic meters per hour) of water and producing up to approximately 800 gallons per hour (3 cubic meters per hour) of wastewater, which would be captured by evaporation/retention ponds as identified in Figure 2-5 (Proposed Launch Complex 39A Infrastructure).

SpaceX proposes to construct an ASU within the LC-39A fence line to generate LN_2 and LOX to support launch activities. An ASU dehumidifies, liquefies, and separates air into its major components (oxygen and nitrogen). The liquid would then be transferred via pipeline to storage tanks at LC-39A. In addition to the primary oxygen and nitrogen liquid products, a waste nitrogen stream composed of rejected atmospheric gases would be produced, primarily nitrogen, oxygen, and argon, that would be vented back to the atmosphere. The ASU would be cooled by a typical evaporative cooling tower requiring approximately 20,000 gallons per hour (approximately 75 cubic meters per hour) of water and producing approximately 2,000 gallons per hour (approximately 7 cubic meters per hour) of wastewater. Water/wastewater would be managed in the same way as identified for the evaporative cooling tower as discussed previously. The ASU would be up to approximately 180 feet tall with supporting infrastructure up to approximately 60 feet tall. An onsite ASU reduces the need to transport nitrogen and oxygen to LC-39A from offsite via trucks.

Wastewater generated by the ASU and stormwater would be treated onsite via evaporation and retention ponds. Any residuals could be treated onsite, hauled off, or conveyed in a wastewater system that has capacity. Onsite treatment could include, but is not limited to, methods such as using membrane aerated biofilm reactors or other processes. Reclaimed wastewater could then be discharged onsite via a stormwater pond, exfiltration trenches, infiltration basins, Class V group 6 drainage wells, percolation/evaporation ponds, or industrial evaporators or used for irrigation purposes or some other permitted method. If discharge would occur, SpaceX would acquire all necessary permits from the St. Johns River Water Management District. Utility work within LC-39A would occur to provide power and water to the system, with any new utility lines placed underground. Up to 12 MegaPacks would be installed to support power generation. Existing commodity tanks would be used where practicable and a 10,000-gallon above ground storage tank constructed to store LN_2 for system purges.

2.4.3 Stormwater Evaporation/Retention and Deluge Ponds

SpaceX proposes to construct additional stormwater evaporation/retention and deluge ponds, if needed, to manage water associated with deluge and stormwater within LC-39A. Preliminary pond locations are shown in Figure 2-5 (Proposed Launch Complex 39A Infrastructure). In general, the deluge system would apply a large amount of water to rapidly cool and create a barrier between the steel plate of the launch mount and rocket exhaust that will help to absorb sound energy and heat produced by the rocket engines and would allow the steel plate to be reused. It is expected that approximately 92 percent of the water would be vaporized by the heat of the rocket engines.

The deluge and diverter system and associated operational parameters are still in the design phase, and specific details are currently unknown. However, the diverter is expected to be bifurcated and divert the heat plume and exhaust vertically to reduce the radial extent of the plume, and deluge system components and operational parameters would likely include water containment, water storage, a press tank, a pumping system and piping network, and a control system and valves. The deluge system would be activated during each ignition event on the orbital launch pad, including engine ignition tests and launches and during landings. Each launch is associated with an estimated two static fire engine tests (one each for Starship and Super Heavy). Therefore, the deluge system may operate up to 220 times per year (88 static fires, 44 launches, and 44 landings each for Starship and Super Heavy).

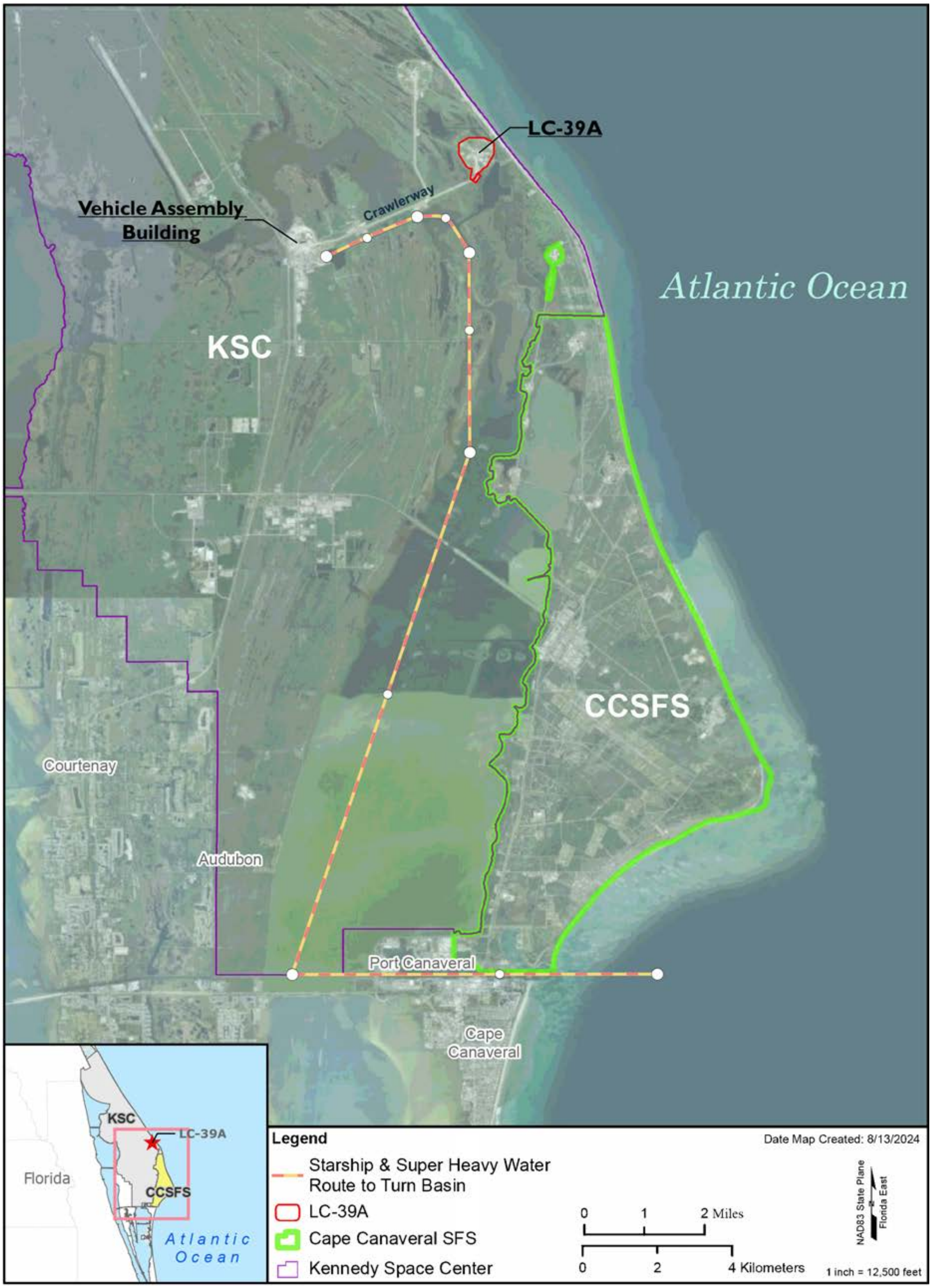
The deluge system would be activated immediately prior to an engine ignition or landing event, allowing water to flow from the storage tanks, through the piping network, and to the spray nozzles at the launch pad. Five seconds prior to ignition/landing, water would begin discharging. Most of this preignition water would be captured by the containment structures. The amount of water applied during activation of the deluge system will differ depending on the type of ignition event. With estimates of 300,000 gallons per static fire even (88 total), 400,000 gallons per launch (44 total), and 68,000 gallons per landing (88 total), SpaceX estimates that up to 50 million gallons of water per year would be utilized for operations at the site (approximately 137,000 gallons per day); approximately 92 percent of deluge water utilized is vaporized during operations. SpaceX plans to reuse deluge water that is retained onsite (i.e., not evaporated). The system would pump and filter water from the deluge pond into storage tanks for reuse. In the event SpaceX is unable to reuse the deluge water, it may be hauled offsite, discharged, or land applied. Prior to any discharge or land application, SpaceX would apply for any applicable Florida Department of Environmental Protection permit. All ponds would be lined to prevent percolation of contaminants into the groundwater and would be maintained and monitored by SpaceX. No deluge water would enter the Banana River or adjacent waterbodies or wetlands.

During engine ignition of the Starship-Super Heavy, the surface of the pad flame diverter could experience a small amount of ablation (erosion of steel from the metal surface resulting from heat and force, considered common on metal launch infrastructure). The ablated steel would quickly recondense near the launch mount when exposed to the deluge water. The metal components of the steel could remain localized to the launch pad, captured in the deluge water and retained onsite, or dispersed in vapor. SpaceX would implement sampling protocols in accordance with an amended Multi-Sector Generic Permit for industrial stormwater from the Florida Department of Environmental Protection and would remove water containing contaminants that exceed the water quality criteria and haul it to an approved industrial stormwater treatment facility. SpaceX would pump all other water not within permitting standards back to the water storage tanks for the deluge system.

2.5 Launch Vehicle Transport and Refurbishment

Starship or Super Heavy components would be delivered over roadways on a mobile transporter. Large vehicle components would be transported by barge from the Port of Brownsville, Texas, utilizing the KSC Turn Basin to the Vehicle Assembly Building location then via Crawlerway to LC-39A (Figure 2-6, Vehicle Starship-Super Heavy Vehicle Transport Routes). Transport of Starship-Super Heavy and related components to and across KSC would generally occur as transport of rocket components currently does at KSC. This could include transport via barge or overland from SpaceX production sites, including Boca Chica, Texas, and Hawthorne, California. Any potential refurbishment actions would take place at SpaceX's facilities at KSC. Starship-Super Heavy would be transported to and from LC-39A to a SpaceX facility via SpaceX transporter over KSC roadways. At this time, no improvements to KSC infrastructure outside those previously identified for LC-39A are proposed.

Figure 2-6. Vehicle Starship-Super Heavy Vehicle Transport Routes



3 Managed Species and Essential Fish Habitat

The MSA was enacted to conserve and restore fisheries within the U.S. territorial sea and EEZ. The MSA addresses issues such as overfishing, bycatch, and fish habitat management. The EFH provision requires that regional fishery management councils (FMCs), through Federal fishery management plans, describe and identify EFH for commercially managed fisheries species and minimize adverse effects caused by fishing and other activities. EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The term "fish" is defined as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds." The regulations for implementing EFH clarify that "waters" include all aquatic areas and their biological, chemical, and physical properties, while "substrate" includes sediment, hard bottom, structures underlying the water, and the associated biological communities that make these areas suitable fish habitats. EFH descriptions include habitats used at any time during a species' life cycle.

In addition to general EFH designations, areas called Habitat Areas of Particular Concern (HAPC) are also designated by the regional FMCs. Designated HAPC are discrete subsets of EFH that provide extremely important ecological functions or that are especially vulnerable to degradation. HAPC may be designated based on one or more of the following: (1) importance of the ecological function provided by the habitat; (2) the extent to which the habitat is sensitive to human-induced environmental degradation; (3) whether, and to what extent, development activities are, or will be, stressing the habitat type; and (4) rarity of the habitat type. Categorization as HAPC does not confer additional protection or restrictions to the designated area.

Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on proposed actions authorized, funded, or undertaken that may adversely affect EFH [Section 305(b)(2)]. An adverse effect is defined as any effect that reduces quality and/or quantity of EFH, and may include direct, indirect, site-specific, or habitat-wide impacts including individual, cumulative, or synergistic consequences of an action (50 Code of Federal Regulations 600.810). Generally, adverse effects include physical, chemical, or biological alteration of waters or substrate, and loss of benthic organisms, prey species, or other ecosystem components. NMFS may provide conservation recommendations for activities that are likely to adversely affect EFH.

EFH designations are often geographically expansive, partly because fishery management plans may encompass multiple species with similar, but not identical, habitat requirements. In addition, most marine fish and invertebrate species have varied life history stages and may use a variety of benthic and pelagic habitats as they mature. Accordingly, three FMCs have jurisdiction over various managed species that occur in portions of the study area: the South Atlantic FMC, Mid-Atlantic FMC, and New England FMC. In addition, EFH for highly migratory species is present in the study area. Highly migratory species, such as tunas, billfish, and sharks, may be found throughout much of the Atlantic Ocean and the scope of management actions extends beyond the geographic area of individual FMCs. NMFS has primary authority for managing these species through the *Consolidated Atlantic Highly Migratory Species Fishery Management Plan*, as amended (NMFS, 2006; NMFS, 2017).

EFH is described and evaluated for two separate areas: (1) estuarine waters near LC-39A that could be affected by launches and landings and (2) marine waters of the Super Heavy Atlantic Ocean Landing Area and Starship Atlantic Ocean Action Area (including the Starship Atlantic Ocean Contingency Landing Area). Construction activities at LC-39A would not affect estuarine EFH (water column or substrate) because implementation of requirements in construction permits, stormwater permits, and the spill prevention plan would prevent sediments and hazardous substances from leaving the site boundary. Construction activities would not overlap EFH in the Atlantic Ocean.

Estuarine waters near LC-39A that are EFH could potentially be affected by heat and vapor plumes and deluge system operation. During launches and static fire tests, the plumes are estimated to extend a maximum of approximately 0.2 miles from the pad. For Starship and Super Heavy landings, the plumes are estimated to extend approximately 96 feet from the pad. The plumes would not extend to the nearshore Atlantic Ocean. The area affected by plumes around the proposed launch and landing sites are shown on Figure 3-1 (Area Potentially Affected during Launches and Landings at Launch Complex 39A). Estuarine waters within and near the 0.2-mile radius launch and static fire area, of which all is considered EFH and HAPC, include the upper Banana River/Pintail Creek and connecting canals east of the site. The 96-foot landing plume would not extend to estuarine waters. The combined Super Heavy and Starship Atlantic Ocean landing areas begin offshore of KSC and extend seaward over and beyond the continental shelf. Areas of EFH that are present in these Atlantic Ocean landing areas for species managed by NMFS and the various FMCs are shown in Figure 3-2 (Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas). HAPC is shown in Figure 3-3 (Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas).

EFH and HAPC within these areas are listed in Table 3-1 (Essential Fish Habitat in Estuarine Waters near Launch Complex 39A), Table 3-2 (Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas), Table 3-3 (Habitat Areas of Particular Concern in Estuarine Waters near Launch Complex 39A), and Table 3-4 (Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas).

In summary, EFH in the study area consists of the water column and most bottom habitats within the applicable estuarine and offshore areas. The type of habitat available, its attributes, and its functions are important to species productivity. Abiotic habitats include the estuarine and open ocean water column at all depths, soft/unconsolidated sediments (sand, silt, clay, and mud), unconsolidated coarse substrates (pebbles, gravel, and shells), and hard structures (hard bottom, artificial reefs, and shipwrecks). Biotic habitats include emergent vegetation, submerged vegetation, algal communities, sponges, floating *Sargassum*, and deep-water corals. Extensive deep-water coral habitats include the Cape Lookout *Lophelia* Banks, *Oculina* Bank and Experimental Closed Area, and Stetson-Miami Terrace. These habitats are included in the Deep-Water Coral category in Figure 3-3 (Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas).

Figure 3-1. Area Potentially Affected during Launches and Landings at Launch Complex 39A

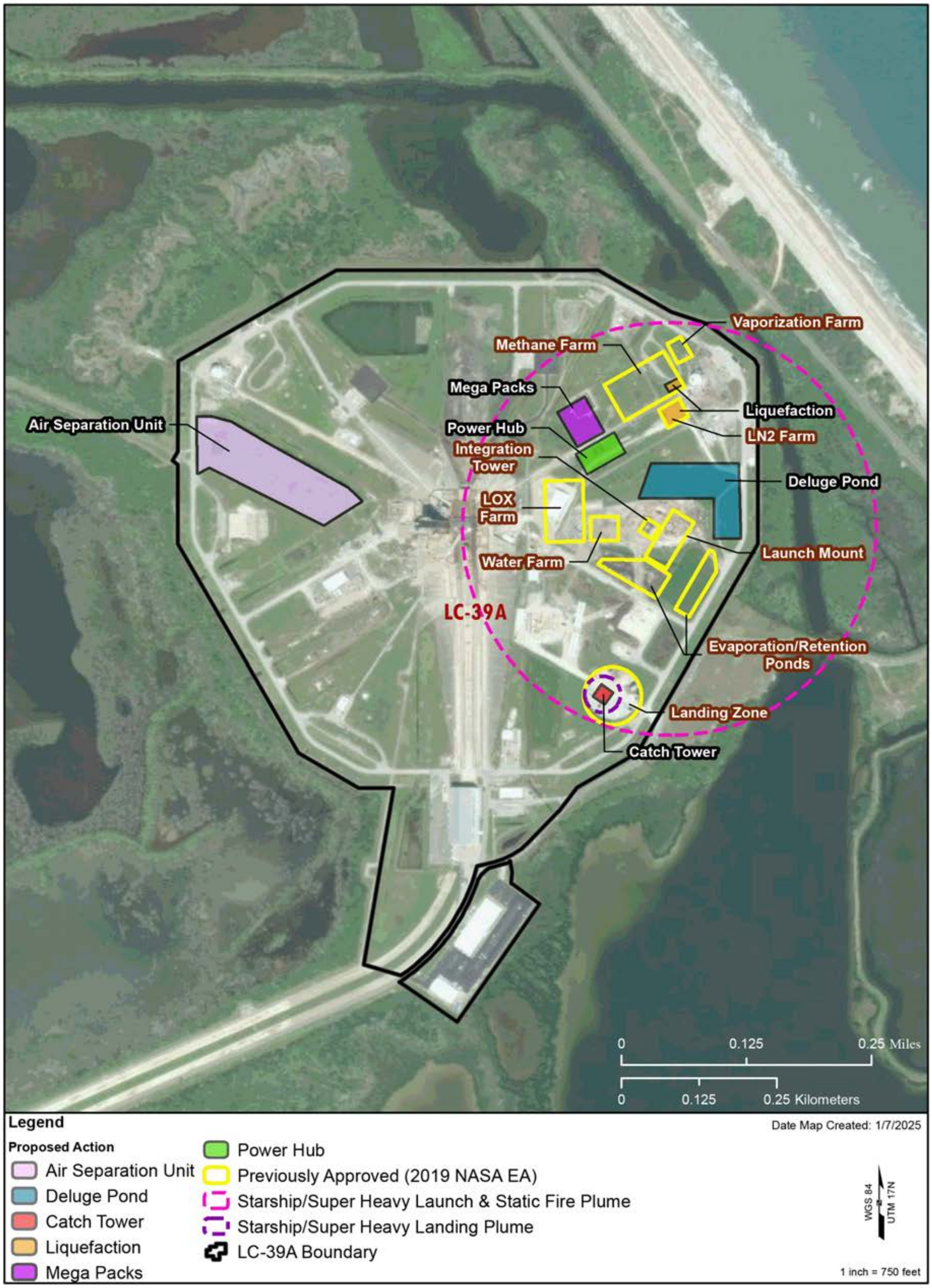


Figure 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

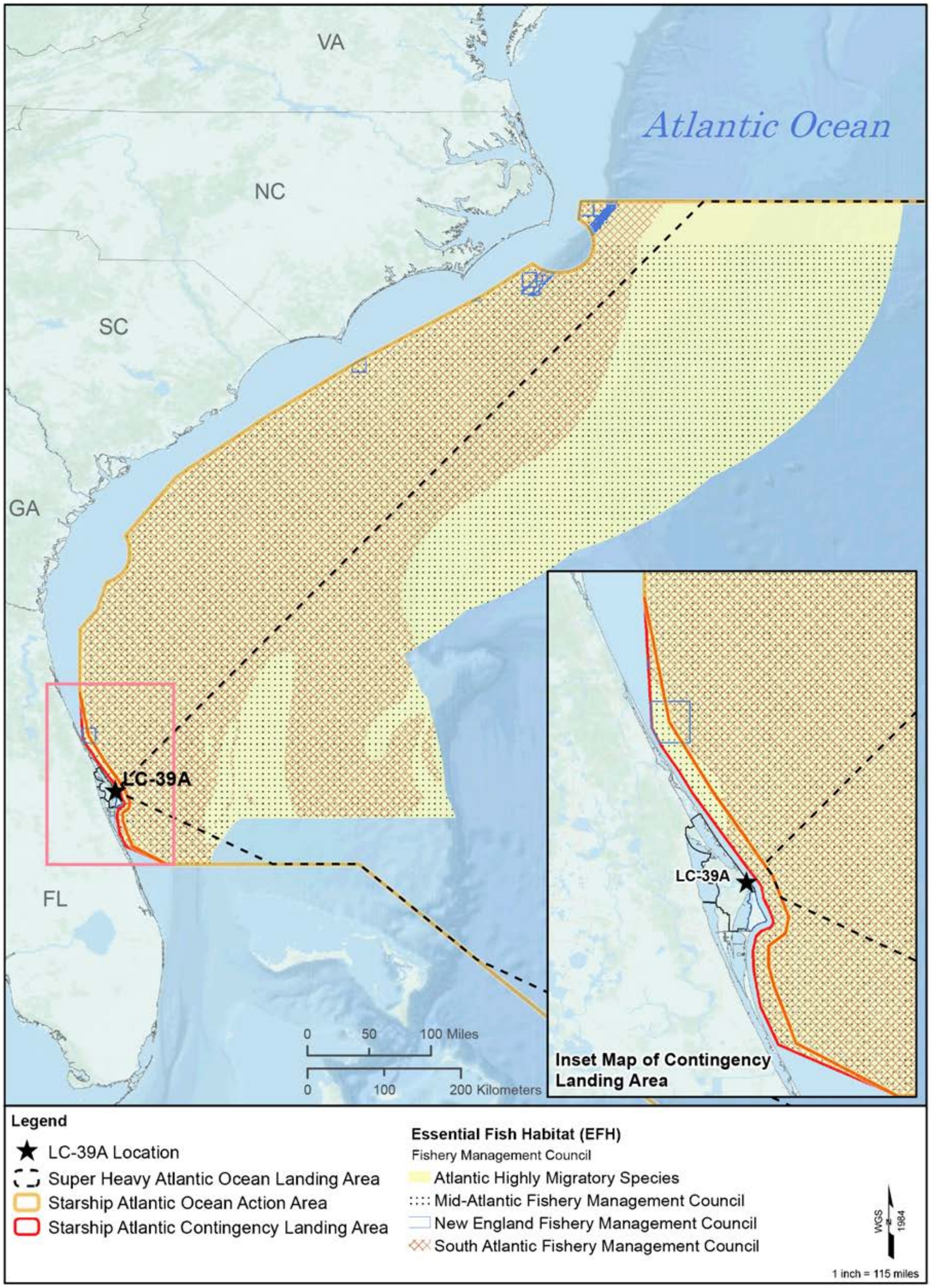


Figure 3-3. Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas

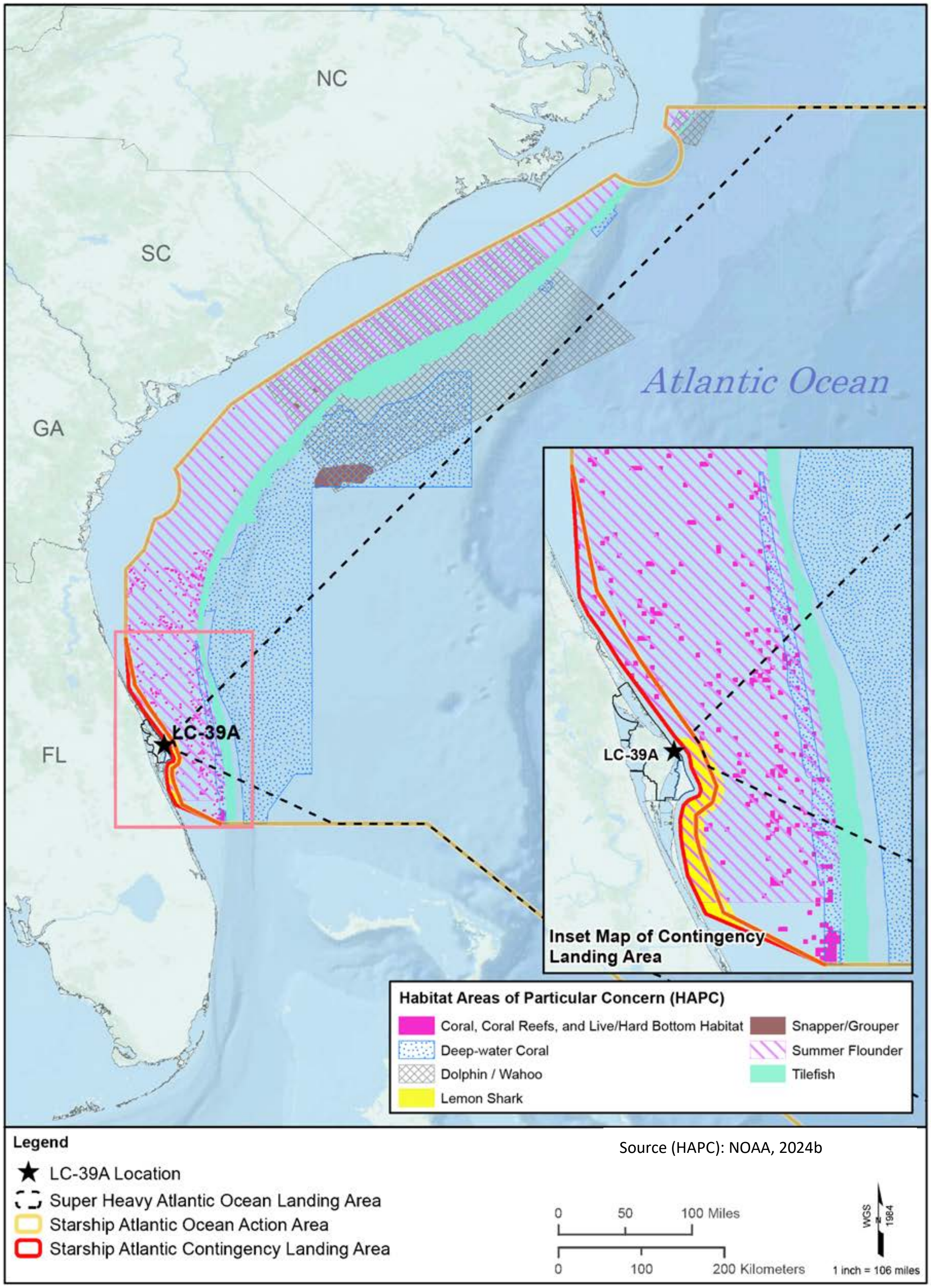


Table 3-1. Essential Fish Habitat in Estuarine Waters near Launch Complex 39A

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
South Atlantic Fishery Management Council			
Spiny lobster	All	Seagrasses, algal communities, mangrove prop root habitat, soft sediments	Spiny Lobster
Snapper/Grouper	All	Attached macroalgae, seagrasses, emergent vegetation, oyster reefs and shell banks, soft sediments	Snapper Grouper
Mid-Atlantic Fishery Management Council			
Bluefish	Adult	Estuarine waters	Bluefish
Summer flounder	Larvae/Juvenile/Adult	Estuarine waters	Summer Flounder, Scup, and Black Sea Bass
Atlantic Highly Migratory Species			
Atlantic sharpnose shark	Neonate/Adult	Estuarine waters	Consolidated Atlantic Highly Migratory Species
Bull shark	Juvenile/Adult	Ocean inlets, seagrass habitat, freshwater creeks	Consolidated Atlantic Highly Migratory Species
Spinner shark	Neonate	Coastal waters	Consolidated Atlantic Highly Migratory Species
Tiger shark	Neonate/Juvenile/Adult	Coastal waters	Consolidated Atlantic Highly Migratory Species
Bonnethead shark	Neonate	Inshore waters	Consolidated Atlantic Highly Migratory Species

Sources: (MAFMC, 1998a; MAFMC, 2001; NMFS, 2017; SAFMC, 1998)

Table 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
South Atlantic Fishery Management Council			
Spiny lobster	Larvae	Gulf Stream	Spiny Lobster
Spiny lobster	Other Life Stages	Unconsolidated substrate, coral and live/hard bottom, sponges, algal communities	Spiny Lobster
Golden crab	Larvae	Gulf Stream	Golden Crab
Golden crab	Other Life Stages	Various soft and hard bottom habitats on the continental shelf	Golden Crab

Table 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
Coastal migratory pelagics	Larvae	Gulf stream	Coastal Migratory Pelagics
Coastal migratory pelagics	Other Life Stages	Sandy shoals, high profile rocky bottom, floating *Sargassum* mats	Coastal Migratory Pelagics
Corals	All	Wide variety of habitats at various depths, depending on species: rough, hard, exposed, stable substrate; muddy/silty substrate	Corals, Coral Reefs, and Live/Hard Bottom
Snapper/Grouper	Larvae	Gulf stream and floating *Sargassum* mats	Snapper Grouper
Snapper/Grouper	Other Life Stages	Coral reefs, live/hard bottom, submerged vegetation, artificial reefs, outcroppings, water column spawning habitat	Snapper Grouper
Mid-Atlantic Fishery Management Council			
Bluefish	Eggs/Larvae/Juvenile	Pelagic continental shelf waters, generally to the eastern edge of the Gulf Stream	Bluefish
Bluefish	Adult	Pelagic continental shelf waters	Bluefish
Black sea bass	Larvae/Juvenile/Adult	Pelagic continental shelf waters	Summer Flounder, Scup, and Black Sea Bass
Summer flounder	Larvae	Pelagic continental shelf waters	Summer Flounder, Scup, and Black Sea Bass
Summer flounder	Adult	Demersal water column	Summer Flounder, Scup, and Black Sea Bass
Scup	Juvenile/Adult	Demersal water column	Summer Flounder, Scup, and Black Sea Bass
Summer flounder	Eggs/Juveniles	Pelagic continental shelf waters	Summer Flounder, Scup, and Black Sea Bass
Atlantic mackerel	Larvae/Juvenile	Pelagic waters to 100 meters water depth	Mackerel, Squid, and Butterfish
Atlantic mackerel	Adult	Pelagic waters to 170 meters water depth	Mackerel, Squid, and Butterfish
Northern shortfin squid	Juvenile	Pelagic waters to 400 meters water depth	Mackerel, Squid, and Butterfish
Northern shortfin squid	Adult	Pelagic waters to 2,500 meters water depth	Mackerel, Squid, and Butterfish
Longfin inshore squid	Juvenile	Pelagic waters to 160 meters water depth	Mackerel, Squid, and Butterfish
Longfin inshore squid	Adult	Pelagic waters to 400 meters water depth	Mackerel, Squid, and Butterfish
Atlantic butterfish	Larvae	Pelagic waters to 350 meters water depth	Mackerel, Squid, and Butterfish

Table 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
Atlantic butterfish	Eggs	Pelagic waters to 1,500 meters water depth	Mackerel, Squid, and Butterfish
Atlantic butterfish	Juvenile	Pelagic waters to 280 meters water depth	Mackerel, Squid, and Butterfish
Atlantic butterfish	Adult	Pelagic waters to 250 meters water depth	Mackerel, Squid, and Butterfish
New England Fishery Management Council			
Smooth skate	Juvenile/Adult	Mud and various other substrates to 900 meters water depth	Northeast Skate Complex
Deep-sea red crab	Larvae	Near-surface pelagic waters	Atlantic Deep-Sea Red Crab
Deep-sea red crab	Juvenile/Adult	Silt/clay sediments	Atlantic Deep-Sea Red Crab
Monkfish	Eggs/Larvae	Pelagic waters	Monkfish
Monkfish	Juvenile	Mud, sand, pebble, gravel, and shell substrates; attached algae; to 1,000 meters water depth	Monkfish
Monkfish	Adult	Mud, sand, pebble, gravel, and shell substrates to 400 meters water depth	Monkfish
Witch flounder	Larvae	Pelagic waters	Northeast Multispecies
Witch flounder	Juvenile	Mud and mud/sand substrate to 1,500 meters depth	Northeast Multispecies
Witch flounder	Adult	Mud and mud/sand substrate to 1,500 meters depth	Northeast Multispecies
White hake	Adult	Muddy and mixed soft and rocky substrate	Northeast Multispecies
Windowpane flounder	Larvae	Pelagic waters	Northeast Multispecies
Windowpane flounder	Juvenile	Mud and sand substrate to 60 meters depth	Northeast Multispecies
Red hake	Adult	Shell beds, mud/sand substrates, and artificial reefs to 750 meters water depth	Northeast Multispecies
Offshore hake	Eggs	Pelagic waters	Northeast Multispecies
Offshore hake	Juvenile/Adult	Pelagic waters and varied benthic habitats to 750 meters water depth	Northeast Multispecies
Thorny skate	Juvenile/Adult	Mud, sand, gravel, and shell substrates to 900 meters water depth	Northeast Skate Complex
Clearnose skate	Juvenile/Adult	Mud, sand, gravel, and rocky substrate to 40 meters water depth	Northeast Skate Complex
Barndoor skate	Juvenile/Adult	Mud, sand, and gravel substrates to 750 meters water depth	Northeast Skate Complex

Table 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
Atlantic Highly Migratory Species			
Finetooth shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Scalloped hammerhead shark	Neonate	Mud and seagrass substrate	Consolidated Atlantic Highly Migratory Species
Scalloped hammerhead shark	Other Life Stages	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Bonnethead shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Swordfish	All	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Bluefin tuna	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Bigeye thresher shark	All	Pelagic waters, frequently between 35 and 50 meters depth	Consolidated Atlantic Highly Migratory Species
Atlantic sharpnose shark	Neonate	Pelagic waters to 13 meters depth	Consolidated Atlantic Highly Migratory Species
Atlantic sharpnose shark	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Dusky shark	Neonate	Pelagic waters to 60 meters depth	Consolidated Atlantic Highly Migratory Species
Dusky shark	Juvenile/Adult	Pelagic waters from 20 to 2,000 meters depth	Consolidated Atlantic Highly Migratory Species
Tiger shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Shortfin mako shark	All	Pelagic waters in water depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Silky shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Great hammerhead shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Blacknose shark	Juvenile/Adult	Pelagic waters in water depths less than 90 meters	Consolidated Atlantic Highly Migratory Species

Table 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
Night shark	All	Pelagic waters from 50 to 2,000 meters depth	Consolidated Atlantic Highly Migratory Species
Bigeye tuna	Juvenile/Adult	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Smoothhound shark complex	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
White marlin	Juvenile/Adult	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Skipjack tuna	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Yellowfin tuna	Spawning/Eggs/Larvae	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Yellowfin tuna	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Sailfish	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Albacore tuna	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Longbill spearfish	ALL	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Sand tiger shark	Neonate/Juvenile	Pelagic waters over rocky and mud substrate	Consolidated Atlantic Highly Migratory Species
Sand tiger shark	Adult	Pelagic waters in depths less than 200 meters	Consolidated Atlantic Highly Migratory Species
Bull shark	Neonate	Shallow water (less than 9 meters depth) in lower salinity estuaries and river mouths	Consolidated Atlantic Highly Migratory Species
Bull shark	Juvenile/Adult	Pelagic waters to depths of 11 meters	Consolidated Atlantic Highly Migratory Species
Spinner shark	Neonate	Sandy bottom	Consolidated Atlantic Highly Migratory Species
Spinner shark	Juvenile	Pelagic waters to 20 meter water depth	Consolidated Atlantic Highly Migratory Species
Spinner shark	Adult	Pelagic waters to 90 meter water depth	Consolidated Atlantic Highly Migratory Species

Table 3-2. Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Life Stage	Essential Fish Habitat	Fishery Management Plan
Blacktip shark	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Lemon shark	Neonate	Pelagic waters to 15 meters water depth	Consolidated Atlantic Highly Migratory Species
Lemon shark	Juvenile/Adult	Pelagic waters in depths less than 200 meters	Consolidated Atlantic Highly Migratory Species
Roundscale spearfish	Juvenile/Adult	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Blue marlin	Spawning/Eggs/Larvae	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Basking shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
White shark	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Common thresher shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Sandbar shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Nurse shark	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Caribbean reef shark	All	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Longfin mako shark	All	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species
Blue shark	Juvenile/Adult	Pelagic waters	Consolidated Atlantic Highly Migratory Species
Oceanic whitetip shark	All	Pelagic waters in depths greater than 200 meters	Consolidated Atlantic Highly Migratory Species

Sources: (MAFMC, 1998a; MAFMC, 1998b; MAFMC, 2008; MAFMC, 2008; MAFMC, 2011; MAFMC, 2014; MAFMC, 2018; NEFMC, 2018; NMFS, 2017; SAFMC, 1998)

Table 3-3. Habitat Areas of Particular Concern in Estuarine Waters near Launch Complex 39A

Species/Management Unit	Habitat Type or Feature	Fishery Management Plan
South Atlantic Fishery Management Council		
Penaeid shrimp species	Coastal inlet, nursery habitat	Shrimp
Mid-Atlantic Fishery Management Council		
Summer flounder	Submerged aquatic vegetation	Summer Flounder, Scup, Black Sea Bass

Source: (SAFMC, 1998; MAFMC, 1998a)

Table 3-4. Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas

Species/Management Unit	Habitat Type or Feature	Fishery Management Plan
South Atlantic Fishery Management Council		
Corals	Nearshore and offshore hard bottom habitat, Gray's Reef National Marine Sanctuary, worm reefs	Coral, Coral Reefs, and Live/Hard Bottom
Deep-water corals	Cape Lookout *Lophelia* Banks, Stetson-Miami Terrace, *Oculina* Bank and Experimental Closed Area	Coral, Coral Reefs, and Live/Hard Bottom
Snapper and grouper species	Hoyt Hills, hard bottom, management zones, spawning area	Snapper Grouper
Dolphin and wahoo species	The Point, 10 Fathom Ledge, Big Rock, Charleston Bump complex	Dolphin Wahoo
Tilefish	Irregular bottom habitats (troughs, terraces, hard bottom, sand/mud/shell sediments)	Comprehensive Ecosystem-Based Amendment 2 for the South Atlantic Region
Mid-Atlantic Fishery Management Council		
Tilefish	Canyons on the outer continental shelf and shelf slope with clay outcrop habitat	Amendment 1 to the Tilefish Fishery Management Plan
Summer flounder	Submerged aquatic vegetation	Summer Flounder, Scup, Black Sea Bass
New England Fishery Management Council		
Deep-water coral	Baltimore Canyon, Washington Canyon, Norfolk Canyon	Omnibus Essential Fish Habitat Amendment 2
Atlantic Highly Migratory Species		
Lemon shark	Longshore troughs used by juveniles, reef and wreck structure used by adults, and the migratory corridor between	Consolidated Atlantic Highly Migratory Species

Sources: (MAFMC, 1998a; MAFMC, 2008; NEFMC, 2018; NMFS, 2017; SAFMC, 1998; SAFMC, 2011)

4 Effects Determination

4.1 Estuarine Waters Near Launch Complex 39A

Starship-Super Heavy launches and static fire tests at LC-39A would produce plumes consisting of rocket engine exhaust, vaporized deluge water, and heat above ambient temperature extending up to 0.2 miles from the launch pad. These plumes may affect water column and shoreline vegetation EFH in nearby estuarine areas. Flame diverters, which would be used to direct the plume upward instead of horizontally, may reduce the maximum launch and static fire plume radius to less than 0.2 miles. However, the potential reduction cannot be quantified at this time, and a 0.2-mile radius is assumed for analysis. Starship and Super Heavy landings would produce plumes extending approximately 96 feet from the landing pad and would not affect water column or shoreline vegetation EFH. Within the 0.2-mile radius launch and static fire plume, air temperatures over about 4 acres of estuarine water surface area would be above the reference ambient temperature of 90 degrees Fahrenheit (°F) (32 degrees Celsius [°C]) for a short time (seconds to minutes, based on launches at Boca Chica, Texas). Maximum air temperature within the plume is not modeled for the Proposed Action, but measurements from launches at the Boca Chica, Texas, site provide information on the magnitude of increase that could be expected. Although modeling for launches at Boca Chica predicted temperatures of 212°F (100°C) approximately 0.3 miles from the launch mount, measurements during the third launch recorded a maximum temperature of 90°F (32 °C) at 0.2 miles (which lasted for 5 seconds) and no change in air temperature at 0.4 miles (FAA, 2024). Given the probable low magnitude and duration of increased air temperature, as well as the small area of surface water under the plume, launches and static fire tests would not affect water temperature in estuarine water bodies. Elevated temperatures would extend to various types of wetland habitat, including about 1 acre of mangrove swamp habitat (Figure 3-1, Area Potentially Affected during Launches and Landings at Launch Complex 39A). Mangrove prop roots and emergent wetland vegetation are EFH for some managed species. Temporary exposure to increased air temperature would not be expected to damage vegetation along estuarine shorelines or affect its function as EFH. Shoreline estuarine habitat occurs in the outer portion of the launch and static fire plume, about 0.18 miles from the launch pad. As a point of context, Super Heavy post-launch monitoring at the Boca Chica, Texas, site found minimal to no vegetation damage within 0.6 miles of the launch pad (FAA, 2024).

A deluge water system would be activated during each launch, landing, and static fire test. Approximately 92 percent of the deluge water would be vaporized by the heat of the rocket engines. The remainder of the deluge water would be contained within the LC-39A boundary by retention structures, including stormwater evaporation/retention ponds and deluge ponds. No deluge water would enter estuarine waters or adjacent wetlands due to overland flow. Deluge water could contain metals resulting from ablation (erosion of steel from the metal surface resulting from heat and force) of the flame diverter and other structures at the launch and landing pads. Analysis of deluge water from static fire events at the Boca Chica, Texas, launch site revealed trace amounts of metals and chemicals that were comparable to levels in the potable source water (FAA, 2023). Sampling results for the second and third Starship-Super Heavy flights at Boca Chica showed negligible amounts of stainless steel components in deluge water (FAA, 2024). The Texas Commission on Environmental Quality determined, after sampling conducted in March, April, and May of 2024, that deluge water discharges would not cause an adverse risk to the environment at Boca Chica (FAA, 2024)). Although the deluge system design at LC-39A would differ in some ways from the system at Boca Chica, metal and chemical constituents and concentrations in the deluge water would likely be similar. All ponds would be lined to prevent percolation of any contaminants into groundwater and would be maintained and monitored by SpaceX. SpaceX would implement sampling protocols in accordance with applicable permits and would remove water containing contaminants that exceed any water quality criteria. Therefore, deluge water contained within LC-39A would not be expected to affect estuarine waters, sediments, or other benthic features that are EFH.

Because the Starship-Super Heavy engines use LOX and liquid methane as propellants, rather than solid propellant, no metals are produced from propellant combustion. The rocket engine exhaust would consist mostly of water vapor with trace amounts of carbon monoxide and nitrogen oxides and would not affect water or sediment quality on or adjacent to LC-39A. Metals and other constituents in the plume that are associated with ablation of steel components would quickly recondense near the launch and landing sites. The minute concentration of metal and chemical constituents that drift outside the LC-39A boundary in the plume would not be expected to affect estuarine waters or sediments. The amount of vaporized deluge water that would condense and enter estuarine surface waters would be negligible compared to annual area rainfall and would not change salinity or other estuarine water characteristics.

There would be an increase in barge and other vessel traffic in the upper Banana River between Port Canaveral and the Turn Basin under the Proposed Action. Vessel operators would adhere to established operating procedures, which would minimize the potential for fuel or oil spills in estuarine waters. Increased vessel operations would not cause detectable effects on water or sediment quality.

4.2 Atlantic Ocean Landing Areas

Water column and bottom EFH and HAPC are present in the Super Heavy Atlantic Ocean Landing Area and Starship Atlantic Ocean Action Area, where Super Heavy boosters and Starship vehicles could be expended (Table 3-2, Essential Fish Habitat in the Super Heavy and Starship Atlantic Ocean Landing Areas, and Table 3-4, Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas). Fuel in expended boosters and Starship vehicles, which would either break up above the ocean surface, break up on impact with the ocean surface, or sink, would not affect ocean water quality. The fuel in a booster or Starship that breaks up would either be consumed in an explosion or would vaporize. Intact boosters and Starship that sink would release fuel into the ocean over time. Released LOX and methane would quickly become diluted in the large volume of Atlantic Ocean seawater. Gases that reach the surface would evaporate.

Intact boosters and Starship that sink, and debris from vehicles that break up, would settle to the seafloor. Metals would leach into the water column and sediment over time as the items degrade. Metals tend to precipitate out of seawater and would generally sink to the bottom (Zhao, et al., 2012). Some components of the vehicles (e.g., iron and carbon) are not harmful to marine organisms, while others (e.g., chromium) are harmful at relatively high concentrations. In the context of available habitat in the Atlantic Ocean landing area, expended vehicles and debris would not cause detectable changes to sediment quality or function as EFH. The results of studies of metals in ocean sediments at military training ranges and munitions disposal sites, where metal deposition is high and may occur over long time periods, indicate that concentrations are rarely above biological effects levels, and that any effects are highly localized (DoN, 2018). A comparatively low number of boosters and Starship would be expended, and they would likely not be concentrated in any location. In addition, for items that break up at altitude, a portion of the components would burn up in the atmosphere and would not affect the water column or sediments.

The potential release of small amounts of oil, gas, and lubricants from droneships and other vessels (e.g., barges and surveillance vessels) during landing and recovery operations would be comparable to that associated with other commercial vessel operations in the Atlantic Ocean. Vessel operations would be conducted in accordance with the International Convention for the Prevention of Pollution from

Ships (MARPOL), which prohibits certain discharges of oil, garbage, and other substances from vessels. Any spills would be managed according to vessel operating procedures and established best management practices. Vessels involved in landing and recovery operations would have no effect on water quality in the overall landing area.

Most expended boosters, Starship vehicles, and debris that sink to the seafloor would likely settle on unconsolidated substrates (e.g., sand and mud), which occur in much of the offshore landing area. Depending on local water currents, physical conditions, and debris size, deposited items could remain exposed on the seafloor for an extended time, or they or could become covered with sediments. Items exposed on the seafloor would represent a short- to long-term change from soft to hard benthic habitat type and exposed items could be colonized by algae or invertebrates, but the affected area would be negligible relative to the size of the study area.

Expended boosters, Starship, and debris could also settle onto structures such as shipwrecks, reefs, and other hard bottom habitat. Hard structures may support corals and other invertebrates (e.g., sponges) that provide habitat for managed fisheries species. Shallow-water coral reefs would not be affected because the northern extent of their range is outside the boundary of the landing and recovery area (FDEP, 2024). The probability of striking hard bottom habitat and deep-water corals is generally low because, overall, these habitats are rare in the study area compared to soft substrate. However, occurrence is concentrated on portions of the continental shelf (Figure 3-3, Habitat Areas of Particular Concern in the Super Heavy and Starship Atlantic Ocean Landing Areas). Deep-water corals are sensitive to physical damage because of their slow growth rate and long recovery time. The potential for effects on deep-water corals and hard bottom habitats could be reduced by the notionally low number of boosters and Starship vehicles that would be expended (SpaceX intends for expenditures to be an infrequent occurrence given the goals of the reusable concept) and the dispersed locations of expended items (i.e., not all items would be expended in areas with elevated potential for hard bottom or deep-water corals). In addition, most of the debris from boosters and Starship that break up at altitude would burn up in the atmosphere and would not affect EFH.

5 Summary of Effects to Essential Fish Habitat

Based on the above discussion, heat plumes, vapor plumes, deluge system operation, and vessel operation would not adversely affect EFH or HAPC in estuarine areas.

Expended (intact) Super Heavy boosters and Starship vehicles, debris from booster and Starship break up, and vessel operation would not adversely affect water column or soft substrate EFH or HAPC in the Super Heavy and Starship Atlantic Ocean landing areas. Expended boosters, Starship, and debris may adversely affect hard bottom and deep-water corals because of the potential for expended items to settle onto these habitats. The potential for effects would be decreased by the limited distribution of these habitats in the overall study area, the relatively low number and dispersed location of expended items, and number of debris items that would burn up in the atmosphere and therefore have no effect of EFH.

6 Best Management Practices and Minimization Measures

The following measures have been identified for the Proposed Action. These measures would reduce the potential for effects to EFH and HAPC.

- Launch operators will not site a landing area in coral reef areas.
- Activities will not occur in or affect a National Marine Sanctuary (which contain habitats that are EFH) unless the appropriate authorization has been obtained from the Sanctuary.

- Prior to any in-water work (i.e., debris recovery or sinking), SpaceX would ensure all ballast and vessel hulls do not pose a risk of introducing new invasive species and that project implementation would not increase abundance of invasive species present at the project site. SpaceX would sanitize any equipment that has been previously used in an area known to contain invasive species prior to its use for project activities.

7 References

DoN. (2018). *Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement.* Department of the Navy.

FAA. (2023). *Written Re-Evaluation Of The 2022 Final Programmatic Environmental Assessment For The Spacex Starship/Super Heavy Launch Vehicle Program At The Boca Chica Launch Site In Cameron County, Texas.*

FAA. (2024). *Revised Draft Tiered Environmental Assessment for SpaceX Starship/Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site in Cameron County, Texas. July.*

FDEP. (2024). *Florida's Coral Reef*. Retrieved from Florida Deparment of Environmental Protection: https://floridadep.gov/sec/sec/content/floridas-coral-reef.

MAFMC. (1998a). *Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan.* Mid-Atlantic Fishery Management Council.

MAFMC. (1998b). *Amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan.* Mid-Atlantic Fishery Management Council.

MAFMC. (2001). *Framework Adjustment 1 to the Bluefish FMP.* Mid-Atlantic Fishery Management Council.

MAFMC. (2008). *Amendment 1 to the Tilefish Fishery Management Plan.* Mid-Atlantic Fishery Management Council.

MAFMC. (2011). *Amendment 11 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan.* Mid-Atlantic Fishery Management Council.

MAFMC. (2014). *Amendment 3 to the Spiny Dogfish Fishery Management Plan.* Mid-Atlantic FIshery Management Council.

MAFMC. (2018). *EFH Text Descriptions for Bluefish (Pomatomus saltatrix).* Mid-Atlantic Fishery Management Council. Retrieved from https://www.habitat.noaa.gov/application/efhinventory/docs/bluefish_efh.pdf.

NASA. (2011). *Environmental Assessment for Launch of NASA Routine Payloads. August.*

NASA. (2019). *Final Environmental Assessment for the SpaceX Starship and Super Heavy Launch Vehicle at Kennedy Space Center (KSC).*

NEFMC. (2018). *Omnibus Essential Fish Habitat Amendment 2, Volume 2 (amendments to seven Fishery Management Plans).* New England Fishery Management Council.

NMFS. (2006). *Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan.* Silver Spring, MD: National Marine Fisheries Service.

NMFS. (2017). *Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat.* National Marine Fisheries Service.

NOAA. (2024a). *Essential Fish Habitat - Data Inventory*. Retrieved August 10, 2024, from National Oceanic and Atmospheric Administration: https://www.habitat.noaa.gov/application/efhinventory/.

NOAA. (2024b). *GIS Data for Habitat Areas of Particular Concern*. Retrieved August 10, 2024, from National Oceanic and Atmospheric Administration: https://www.habitat.noaa.gov/application/efhinventory/.

SAFMC. (1998). *Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region.* South Atlantic Fishery Management Council.

SAFMC. (2011). *Comprehensive Ecosystem-based Amendment 2 for the South Atlantic Region.* South Atlantic Fishery Management Council.

Zhao, S., Feng, C., Quan, W., Chen, X., Niu, J., & Shen, Z. (2012). Role of living environments in the accumulation characteristics of heavy metals in fishes and crabs in the Yangtze River Estuary. *Marine Pollution Bulletin, 64*, 1163-1171.