ENVIRONMENTAL IMPACT STATEMENT

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

at the Kennedy Space Center, Merritt Island, Florida

Final, Volume II, Appendix B.6, Part 3

January 2026

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.6 Endangered Species Act Section 7 Consultation (NMFS)

A Biological Assessment (BA) was submitted to NMFS on May 24, 2024.

On January 17, 2025, NMFS provided a Conference and Biological Opinion (CBO) on the effects of Starship-Super Heavy operations on endangered and threatened species under NMFS' jurisdiction, as well as critical habitat for those species, in the North Atlantic Ocean, Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. The Federal Aviation Administration provided addendums to NMFS describing proposed modifications to Starship-Super Heavy operations at Launch Complex (LC)-39A, among other locations, on March 10, 2025, March 28, 2025, and April 1, 2025. The addendum submitted on April 1, 2025, supersedes the previous addendums and is included in the EIS appendix. On April 18, 2025, based on the addendum requests, NMFS provided a revised CBO on the effects of Starship-Super Heavy operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. On September 16, 2025, based on the addition of Cape Canaveral Space Force Station as a launch site and new information on vehicle specifications and debris fields, NMFS provided a reinitiation of the CBO on the effects of Starship-Super Heavy operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. This reinitiated CBO replaced the previous CBOs submitted on January 17, 2025, and April 18, 2025; thus, only the revised CBO is included in the EIS appendix.

B.6.3 Reinitiation of the Conference and Biological Opinion (September 2025)

National Marine Fisheries Service
Endangered Species Act Section 7
Conference and Biological Opinion

Title:	Reinitiation of the Conference and Biological Opinion on SpaceX Starship-Super Heavy Operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean Authorized by the Federal Aviation Administration
Action Agency:	Federal Aviation Administration, U.S. Department of Transportation
In Consultation With:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Publisher:	Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Approved:	DAMON RANDALL.KIMBERLY.BETH.1365821093 Digitally signed by DAMON RANDALL.KIMBERLY.BETH.1365821093 Date: 2025.09.16 13:53:23 -04'00'
	Kimberly Damon-Randall Director, Office of Protected Resources
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1. INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. §1531 et seq.), establishes a national mandate for conserving and recovering threatened and endangered species of fish, wildlife, plants, and the habitats on which they depend. Section 7(a)(2) of the Act and its implementing regulations require every Federal agency, in consultation with and with the assistance of the Secretary (16 U.S.C. §1532(15)), to insure that any action it authorizes, funds, or carries out, in whole or in part, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.

Section 7(a)(4) of the ESA requires federal agencies to confer with the Secretary on any action that is likely to jeopardize the continued existence of proposed species or result in the destruction or adverse modification of proposed critical habitat. For actions that are not likely to jeopardize the continued existence of a proposed species or adversely modify critical habitat, a conference can be requested by the action agency, though it is not required. If requested by the federal action agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in 50 CFR §402.14. An opinion issued at the conclusion of the conference may be adopted as the biological opinion when the species is listed or critical habitat is designated.

Section 7(b)(3) of the ESA requires that, at the conclusion of consultation, the National Marine Fisheries Service (NMFS) provide an opinion stating whether the federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify their critical habitat. Similarly, when conferring on proposed species or proposed critical habitat, NMFS also reaches a conclusion as to whether the action will satisfy 7(a)(2) for those entities as proposed. If NMFS determines that the action is likely to jeopardize ESA-listed or proposed species or destroy or adversely modify designated or proposed critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If the action (or reasonable and prudent alternative) is expected to cause incidental take without violating section 7(a)(2), section 7(b)(4), as implemented by 50 CFR §402.14(i), requires NMFS to provide an incidental take statement (ITS) that specifies the amount or extent of incidental taking. Blue whale (*Balaenoptera musculus*), false killer whale (*Pseudorca crassidens*) – Main Hawaiian Islands Insular Distinct Population Segment (DPS), fin whale (*Balaenoptera physalus*), gray whale (*Eschrichtius robustus*) – Western North Pacific DPS, humpback whale (*Megaptera novaeangliae*) – Mexico DPS and Central America DPS, North Atlantic right whale (*Eubalaena glacialis*), North Pacific right whale (*Eubalaena japonica*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), Rice's whale (*Balaenoptera ricei*), Guadalupe fur seal (*Arctocephalus townsendi*), and Hawaiian monk seal (*Neomonachus schauinslandi*), which are considered in this consultation, are regulated under the Marine Mammal Protection Act (MMPA) and the ESA. Each statute has defined the meaning of take independently. The MMPA defines take as to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. Take under the ESA is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. §1532(19)). Actions considered 'take' under one statute do not necessarily rise to the level of take under the other statute. The ITS includes reasonable and

prudent measures, which are actions necessary or appropriate to minimize impacts of incidental taking, and terms and conditions to implement the reasonable and prudent measures.

The action agency for this reinitiated consultation and conference is the Federal Aviation Administration (FAA). The Space Exploration Technologies Corporation (SpaceX) is the applicant. The FAA proposes to modify and issue a vehicle operator license authorizing SpaceX to conduct launches of SpaceX's Starship-Super Heavy launch vehicle, including Super Heavy landings in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), and Gulf of America[1], and Starship landings in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. The purpose of this reinitiation is to amend the proposed action to include Starship-Super Heavy launches from Cape Canaveral Space Force Station Space Launch Complex 37 (SLC-37) and to assess the effects of the overall action, given new information that may affect listed species and critical habitat in a manner or to an extent not previously considered. Specifically, the Starship-Super Heavy vehicle specifications are larger than previously considered, and recent mishaps and anomalies provided new information on debris types and amounts, and debris fields in areas not previously considered.

Updates to the regulations governing interagency consultation (50 CFR Part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). NMFS is applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act (89 Fed. Reg. 24268; 84 Fed. Reg. 45015). NMFS has considered the prior rules and affirms that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

Consultation in accordance with section 7(a)(2) of the statute (16 U.S.C. §1536(a)(2)), associated implementing regulations (50 CFR Part 402), and agency policy and guidance (USFWS and NMFS 1998) was conducted by the NMFS Office of Protected Resources (OPR) ESA Interagency Cooperation Division (hereafter referred to as 'we' or 'us'). We prepared this conference and biological opinion (opinion) and ITS in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR Part 402. The following listed and proposed species, and designated and proposed critical habitat, were considered in this consultation and conference: blue whale, false killer whale – Main Hawaiian Islands Insular DPS, fin whale, gray whale – Western North Pacific DPS, humpback whale – Mexico DPS and Central America DPS, North Atlantic right whale, North Pacific right whale, sei whale, sperm whale, Rice's whale,

[1] OPR-2024-01147, issued on January 17, 2025, referred to this area as the Gulf of Mexico. In accordance with Presidential Executive Order 14172, "Restoring Names that Honor American Greatness," we are updating this opinion to refer to the area formerly known as the Gulf of Mexico (U.S. waters), to the Gulf of America. We note that there are citations and references in this opinion that published prior to Executive Order 14172 and refer to the Gulf of America by its former name, the Gulf of Mexico. In those cases, and cases where 'Gulf of Mexico' is part of a formal name (e.g., loggerhead turtle Northern Gulf of Mexico Recovery Unit), we have not updated accordingly, because, at the time of this consultation, those names and references have not been updated.

2

Guadalupe fur seal, Hawaiian monk seal; green turtle (*Chelonia mydas*) – North Atlantic DPS, South Atlantic DPS, East Pacific DPS, Central North Pacific DPS, East Indian-West Pacific DPS, North Indian DPS, and Southwest Indian DPS, hawksbill turtle (*Eretmochelys imbricata*), Kemp's ridley turtle (*Lepidochelys kempii*), leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS, North Pacific Ocean DPS, South Pacific Ocean DPS, North Indian Ocean DPS, Southwest Indian Ocean DPS, and Southeast Indo-Pacific Ocean DPS, and olive ridley turtle (*Lepidochelys olivacea*) – Mexico's Pacific Coast breeding colonies and all other areas/not Mexico's Pacific Coast breeding colonies; Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS, Chesapeake Bay DPS, and South Atlantic DPS, giant manta ray (*Manta birostris*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), Nassau grouper (*Epinephelus striatus*), oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead shark (*Sphyrna lewini*) – Central and Southwest Atlantic DPS, Eastern Pacific DPS, and Indo-West Pacific DPS, shortnose sturgeon (*Acipenser brevirostrum*), smalltooth sawfish (*Pristis pectinata*) – U.S. portion of range DPS, steelhead trout (*Oncorhynchus mykiss*) – South-Central California Coast DPS and Southern California DPS, black abalone (*Haliotis cracherodii*), boulder star coral (*Orbicella franksi*), elkhorn coral (*Acropora palmata*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), pillar coral (*Dendrogyra cylindrus*), rough cactus coral (*Mycetophyllia ferox*), staghorn coral (*Acropora cervicornis*), white abalone (*Haliotis sorenseni*), proposed sunflower sea star (*Pycnopodia helanthoides*); and designated critical habitat of the Main Hawaiian Islands Insular DPS of false killer whale, Central America DPS and Mexico DPS of humpback whale, Hawaiian monk seal, North Atlantic right whale, hawksbill turtle, leatherback turtle, North Atlantic DPS of green turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, Carolina DPS and South Atlantic DPS of Atlantic sturgeon, Gulf sturgeon, Nassau grouper, U.S. portion of range DPS of smalltooth sawfish, black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, and proposed critical habitat of the Central North Pacific DPS, East Pacific DPS, North Atlantic DPS, and South Atlantic DPS of green turtle and Rice's whale.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA; section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file electronically with the NMFS OPR in Silver Spring, Maryland, and available in the National Oceanic and Atmospheric Administration (NOAA) Library Institutional Repository https://repository.library.noaa.gov/welcome.

1.1 Background

The FAA Office of Commercial Space Transportation oversees, licenses, and regulates U.S. commercial launch and reentry activities, as well as the operation of launch and reentry sites within the United States or as carried out by U.S. citizens, as authorized by the Commercial Space Launch Act of 1984, as amended and codified at 51 U.S.C. §§ 50901–50923. Section 50903 requires the Secretary of Transportation (or FAA Administrator, as codified in 49 CFR § 1.83(b)) to encourage, facilitate, and promote commercial space launches and reentries by the

private sector. The same launch vehicle operators that receive a license or permit from the FAA may also conduct operations for the Department of Defense (DoD).

This opinion (OPR-2025-02468) is a reinitiation of OPR-2025-00164, which was issued on April 18, 2025. In OPR-2025-00164, the FAA proposed to modify and issue a vehicle operator license authorizing SpaceX to conduct Starship-Super Heavy launch and reentry operations, with Super Heavy landings in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), and Gulf of America, and Starship landings in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. After our biological opinion was issued on April 18, 2025 concluding consultation, the FAA and SpaceX notified us of a need to include Cape Canaveral Space Force Station Space Launch Complex 37, SLC-37, as a launch site under the current license. They also provided new information on vehicle specifications, and new information on debris generated during the recent Starship and Super Heavy mishaps and anomalies.

In this reinitiation, we evaluate whether the inclusion of launches from SLC-37 and new information on vehicle specifications and debris substantively change exposures and effects to ESA-listed species and critical habitat such that the ITS of OPR-2025-00164 requires revision.

1.2 Consultation History

- **April 28, 2025:** SpaceX notified NMFS via email that other regulatory processes for launches from SLC-37 are in process. In a telephone call on May 8, 2025, FAA and NMFS discussed inclusion of SLC-37 in ESA section 7 consultation and in relation to the other regulatory processes.
- **May 28, 2025:** NMFS notified FAA via email that an amendment to OPR-2025-00164 should be sufficient to include launches from SLC-37.
- **June 27, 2025:** As required by OPR-2025-00164, FAA provided, via email to NMFS, the Fate Report for Flight 9, which included some new information regarding the extent of debris generated by a Super Heavy breakup.
- **July 15, 2025:** NMFS notified FAA and SpaceX via email that NMFS is required to analyze effects of the action as related to new information about the debris from Flight 9. Thus, NMFS requested additional information on the debris referenced in the Flight 9 Fate Report.
- **August 1, 2025:** NMFS, FAA, and SpaceX met to discuss new information on, and reinitiation triggered by, Starship and Super Heavy debris from Flights 7 (Starship debris in Turks and Caicos), 8 (Starship debris in the Bahamas), and 9 (Super Heavy debris in Mexico).
- **August 4, 2025:** SpaceX, via email to NMFS and FAA, provided a summary of debris types that may be generated from Starship and Super Heavy. On August 5, 2025, NMFS responded and requested clarification of the information discussed in the August 1, 2025 meeting regarding Flight 9 Super Heavy debris. On the same day, SpaceX clarified that

Flight 9 Super Heavy debris had not been verified yet, and provided additional information on SpaceX's debris analysis and Flight 8 Starship debris in the Bahamas.

- **August 8, 2025:** Given SpaceX's August 4, 2025 correspondence, NMFS requested additional information on the availability of the debris analysis, Flights 7 and 8 Starship debris characteristics and location, and the upcoming Flight 10.
- **August 12, 2025:** SpaceX provided responses to a limited number of our requests for additional information.
- **August 21, 2025:** NMFS reminded FAA via email that reinitiation must be requested by the Federal action agency. FAA requested reinitiation via email on August 22, 2025. NMFS initiated consultation the same day.

1.3 Analytical Approach

This opinion includes a jeopardy analysis and an adverse modification or destruction of critical habitat analysis. Prior to 2016, the designation of critical habitat for Northwest Atlantic Ocean DPS of loggerhead turtle and other species used the term primary constituent element (PCE), essential features, or generally identified aspects of critical habitat that were essential to the conservation of the species. The 2016 critical habitat regulations (50 CFR §424.12) replaced these terms with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether an action agency is able to insure its proposed action is not likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify all aspects of the proposed action (as defined in 50 CFR §402.02), including activities that rely on the action for their occurrence.
- Identify the physical, chemical, and biological modifications to land, water, and air (stressors) that result from those actions and subsequent activities.
- Establish the spatial extent of those stressors, which is the action area (50 CFR §402.02).
- Identify the listed and proposed species (as defined at 16 U.S.C. §1532(16)) and designated and proposed critical habitat (as defined at 16 U.S.C. §1532(5)) in the action area.
- Identify the species and critical habitats that are not likely to be adversely affected by the action.
- Evaluate the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline (as defined in 50 CFR §402.02) as it pertains to the species and critical habitat.
- Evaluate the effects of the proposed action on listed or proposed species and their designated or proposed critical habitat using a stressor-exposure-response approach.

When complete, this section anticipates the amount or extent, as well as the forms (harass, harm, etc.), of take of listed species (or a surrogate) that is reasonably certain to occur as a result of the action, as well as the extent of effects to critical habitat.

- Evaluate cumulative effects (as defined at 50 CFR §402.02).
- Produce an integration and synthesis, where we add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat.
- Compile our jeopardy and destruction or adverse modification analysis relying on the justification in the integration and synthesis.
- If the opinion determines the action agency failed to insure its action is not likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat, we suggest a reasonable and prudent alternative to the proposed action and assess the effects of that alternative action.
- For actions that do not violate section 7(a)(2) of the ESA or an alternative action is identified that does not violate section 7(a)(2) of the ESA, after we conclude our opinion, we provide an incidental take statement that specifies the impact of the take on listed species (amount or extent), reasonable and prudent measures, and terms and conditions to implement those measures.

In each of the steps above, we rely on the best scientific and commercial data available. In order to ensure we reach supportable conclusions, we used information from FAA and SpaceX, including the FAA's 2024 Biological Assessment (ManTech SRS Technologies Inc. 2024), Revised Draft Tiered Environmental Assessment (FAA 2024b), Starship addenda and revised addenda (FAA 2025a; FAA 2025b; FAA 2025c; FAA 2025d), releasable information from the Starship-Super Heavy Fate Reports, SpaceX information on Starship and Super Heavy debris, responses to our requests for additional information, peer-reviewed scientific literature, government reports, and commercial studies. We also relied on technical information from SpaceX on their launch vehicle and operations.

2. PROPOSED FEDERAL ACTION

Action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or on the high seas. Examples include, but are not limited to: 1) actions intended to conserve listed species or their habitat; 2) the promulgation of regulations; 3) the granting of licenses, contracts, leases, easements, rights-of-way, permits, or grants in aid; or 4) actions directly or indirectly causing modifications to the land, water, or air (50 CFR §402.02).

2.1 Description of the Action

The FAA proposes to modify and issue its vehicle operator license (VOL 23-129), to include Starship-Super Heavy launches from SLC-37 located approximately 6 miles (mi; 9.5 kilometers [km]) from the Kennedy Space Center's Launch Complex 39A (LC-39A). This modification increases the maximum number of launches covered by the license (see below). Of the three launch sites, the Boca Chica Launch Site is already operational; launches from LC-39A are

anticipated to begin in fall of 2025 and launches from SLC-37 are anticipated to begin in early 2027. The maximum number of launches per year from each launch site, covered under the FAA license, is as follows: 25 from the Boca Chica Launch Site, 44 from LC-39A, and 76 from SLC-37. Launch cadence at all launch sites is expected to ramp up over time, although at an unknown rate. The Federal action is the modification and subsequent issuance of VOL 23-129, which expires April 14, 2028. Thus, this opinion and ITS are valid until April 14, 2028, corresponding with the FAA license, or until reinitiation is requested by FAA.

Starship-Super Heavy Launch Vehicle

Starship-Super Heavy is a two-stage vertical launch vehicle that is designed to eventually be fully reusable. While working towards reusability, Starship and/or Super Heavy will be expended (i.e., discarded) in the ocean. Starship-Super Heavy is expected to be fully reusable by October 2030 (i.e., Starship and Super Heavy will land back at the launch site or on a floating platform/ocean-going barge, or autonomous spaceport drone ship [drone ship] after October 2030). Between the date of issuance of this opinion and October 2030, Starship and/or Super Heavy may be expended in the ocean. The interstage (see below) may still be expended in the Gulf of Mexico (non-U.S. waters) or Gulf of America through calendar year 2026. As noted above, the FAA license covers the period until April 2028, which is also the period considered in this consultation.

OPR-2025-00164 considered a previous version of Starship-Super Heavy that measured approximately 404 feet (ft; 123 meters [m]) tall by 30 ft (9 m) in diameter: Super Heavy, the first stage (or booster), was approximately 233 ft (71 m) tall, and Starship, the second stage (or spacecraft), was approximately 171 ft (52 m) tall. Super Heavy was equipped with up to 37 Raptor engines and Starship was equipped with up to nine Raptor engines. The Raptor engine is powered by liquid oxygen (LOX) and liquid methane (LCH_4). Super Heavy held up to 3,748 tons (t; 3,400 metric tons [MT]) of propellant and Starship held up to 1,653 t (1,500 MT) of propellant. The current iteration of Starship-Super Heavy (Version 3) is approximately 492 ft (150 m) tall by 30 ft (9 m) in diameter: Super Heavy is approximately 263 ft (80 m) tall, and Starship is approximately 230 ft (70 m) tall. Super Heavy will be equipped with up to 35 Raptor engines. Version 3 Super Heavy can hold up to 4,520 t (4,100 MT) of propellant and Starship can hold up to 2,922 t (2,650 MT) of propellant.

During a Starship-Super Heavy launch, the launch vehicle reaches supersonic speeds, generating a sonic boom. After launch, Super Heavy's engines cut off at high altitude and Super Heavy separates from Starship. After Super Heavy separates from Starship, Super Heavy conducts a boost-back burn prior to descent and Starship flies to its desired orbit. Starship conducts an in-space coast phase before beginning its descent. Another sonic boom is generated as Super Heavy and Starship reach supersonic speeds during descent. Super Heavy and/or Starship may conduct a landing burn as it returns to the launch site, lands on a floating platform/ocean-going barge or drone ship, or lands in the ocean.

The subsections below describe the ways each vehicle may be expended during operations to full reusability.

Super Heavy Operations

Super Heavy may be expended in the Gulf of Mexico (non-U.S. waters) or Gulf of America (Gulf portion of the action area; Figure 1), or the Northwest Atlantic Ocean (Atlantic Ocean portion of the action area; Figure 2). Super Heavy will be expended more than 5 NM from shore in the Gulf and Atlantic Ocean portions of the action area, or expended 1–5 NM from shore directly east of the Boca Chica Launch Site, LC-39A, or SLC-37. In the Gulf portion of the action area, Super Heavy will be expended at least 20 NM from the Flower Garden Banks National Marine Sanctuary. Super Heavy landings are expected to generate an overpressure of up to 21 pounds per square foot (psf). A landing on a floating platform/ocean-going barge or drone ship would produce an overpressure of up to 8 psf.

Until full reusability is achieved, Super Heavy may be expended under the following conditions:

1. In-flight breakup: Super Heavy breaking up during reentry, resulting in debris falling into the Gulf or Atlantic Ocean portions of the action area.
2. Explosive event: Super Heavy lands in the ocean either at terminal velocity, breaking up upon impact with debris contained within approximately 0.6 mi (1 km) of the landing point, or conducts a soft water landing and tips over, impacting the ocean. Both result in an explosive event at the surface of the water.
3. Soft water landing: Super Heavy conducts a soft water landing, tips over, and sinks to the bottom of the ocean.

SpaceX anticipates there will be no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Super Heavy in each portion of the action area. FAA and SpaceX stated there is no specific information on the Super Heavy landing locations, or on the probability or frequency that Super Heavy landings will occur more often in any given portion of the action area (e.g., closer to the launch site compared to further offshore, or within one portion of the action area more than another portion of the action area). Thus, we conclude that, based on the best available information, Super Heavy landings are equally likely to occur throughout the action area.

If Super Heavy is expended in an area where it becomes a navigational hazard, or in other circumstances that warrant recovery of the booster, it will need to be removed from the seafloor. Activities related to the recovery or removal of Super Heavy or Super Heavy debris are not part of FAA's Federal action. Those activities would be subject to Section 7(a)(2) if they require authorization from, are funded by, or are carried out, in whole or in part, by a Federal agency.

SpaceX provided the best available information on how a Super Heavy explosive event will occur, based on previous launches and tests of similar vehicles. A Super Heavy explosive event is the result of a breakdown of the fuel transfer tube and subsequent mixing and igniting of residual propellant, which will be located approximately 9.8 ft (3 m) from the ocean's surface due to the vertical orientation of Super Heavy. SpaceX calculated an explosive weight of 14,551 pounds (lb; 6,660 kilograms [kg]) based on a 9% explosive yield and 82 t (74 MT) of residual propellant (no landing burn).

Super Heavy Interstage

The Super Heavy interstage (also known as the hot-staging ring or forward heat shield) will continue to be expended in the Gulf portion of the action area (see OPR-2024-02422), approximately 0.6–249 mi (1–400 km) from shore directly off of the Boca Chica Launch Site and approximately 18.6–248.5 mi (30–400 km) from shore in the western Gulf of Mexico (non-U.S. waters) and Gulf of America (Figure 1). The interstage landing area is at least 20 NM from the Flower Garden Banks National Marine Sanctuary. The interstage is comprised of stainless steel and is approximately 30 ft (9.1 m) in diameter, 5.9 ft (1.8 m) long, and weighs 20,000 lb (9,072 kg). It provides thermal protection against heat produced from Starship engines when the two stages separate. During Super Heavy landings in the Gulf portion of the action area or back at the Boca Chica Launch Site, the interstage will release from Super Heavy. After release, the interstage will gradually drift away from Super Heavy and is expected to land approximately 1.9–2.5 mi (3–4 km) downrange of where Super Heavy lands. Upon impact with the water at terminal velocity, the interstage will break up resulting in debris. The interstage will be expended in the Gulf portion of the action area up to five times a year through calendar year 2026, at which time the interstage will be a permanent fixture on Super Heavy and will no longer be expended.

Starship Operations

Starship may be expended in the Gulf portion of the action area (Figure 1), Atlantic Ocean portion of the action area (Figure 2), Indian Ocean (Indian Ocean portion of the action area; Figure 3), North Pacific Ocean (Hawaii and Central North Pacific portion of the action area and Northeast and Tropical Pacific portion of the action area; Figure 4), or Southeast Pacific (South Pacific portion of the action area; Figure 5). When Starship will be expended in the Gulf and Atlantic Ocean portions of the action area, it will be more than 5 NM from shore, 1–5 NM from shore between 100 mi (161 km) north and 100 mi (161 km) south of the Boca Chica Launch Site in the Gulf portion of the action area, or 1–5 NM from shore between 50 mi (80 km) north and 50 mi (80 km) south of LC-39A and SLC-37 in the Atlantic Ocean portion of the action area. Starship may also be expended in the Indian Ocean portion of the action area at least 200 NM from any land area. When landing in the Hawaii and Central North Pacific portion of the action area, Starship will be expended at least 100 mi (161 km) from Hawaii and at least 150 mi (241 km) from the Papahānaumokuākea National Marine Sanctuary. Starship landings are expected to generate an overpressure of up to 4 psf.

Until full reusability is achieved, Starship may be expended under the following conditions:

1. In-flight breakup: Starship breaking up during reentry, resulting in debris falling into the Gulf, Atlantic Ocean, Indian Ocean, Hawaii and Central North Pacific, Northeast and Tropical Pacific, and/or South Pacific portions of the action area.
2. Explosive event: Starship lands in the ocean either at terminal velocity, breaking up upon impact with debris contained within approximately 0.6 mi (1 km) of the landing point, or conducts a soft water landing and tips over, impacting the ocean. Both result in an explosive event at the surface of the water.
3. Soft water landing: Starship conducts a soft water landing, tips over, and sinks to the bottom of the ocean.

SpaceX anticipates there will be no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in each portion of the action area. FAA and SpaceX stated there is no specific information on the Starship landing locations, or on the probability or frequency that Starship landings will occur more often in any given portion of the action area (e.g., closer to the launch site compared to further offshore, or within one portion of the action are more than another portion of the action area). Thus, we conclude that, based on the best available information, Starship landings are equally likely to occur throughout the action area.

As for Super Heavy, if Starship is expended in an area where it becomes a navigational hazard, or in other circumstances that warrant recovery of the ship, it will need to be removed from the seafloor and the removal action may be subject to the section 7(a)(2) requirements.

SpaceX provided the best available information on how a Starship explosive event will occur, based on previous launches and tests of similar vehicles. A Starship explosive event is the result of a breakdown of the fuel transfer tube and subsequent mixing and igniting of residual propellant, which will be located, at minimum, 12.8 ft (4.5 m) from the ocean's surface due to the horizontal orientation of Starship. SpaceX calculated an explosive weight of approximately 21,929 lb (9,947 kg) based on a 9% explosive yield and approximately 77 t (70 MT) of residual propellant in the main tanks, and an 11.9% yield and approximately 34 t (31 MT) of residual propellant in the header tanks (no landing burn).

Number of Launches and Expended Super Heavy and Starship Landings

Given the launch cadence will increase at an unknown rate before the maximum number of launches from each launch site is reached, NMFS estimated the number of launches and landings that could occur from each launch site for the duration of the proposed FAA license, which expires April 14, 2028 and is also the end date considered in this consultation.

In OPR-2025-00164, NMFS estimated the number of launches that would occur from the Boca Chica Launch Site and LC-39A over the duration of FAA's license. The maximum number of launches authorized from Boca Chica is 25 per year, the maximum number of launches authorized from LC-39A, once operational, is 44 per year, and the maximum number of launches authorized from SLC-37, once operational, is 76 per year. Given the launch cadence will ramp up over time, but the rate of increase is unknown and FAA and SpaceX do not have estimates of launch frequency, NMFS estimated launches will be evenly distributed throughout any given year. Upon issuance of OPR-2025-00164 (April 2025), SpaceX had already conducted two launches from the Boca Chica Launch Site in 2025 (January 16 and March 6). Thus, NMFS had estimated that there could be an additional 23 launches from Boca Chica in 2025. Launches from LC-39A are expected to start in fall of 2025; the start of the fall season in the United States is approximately three-quarters into the year – September 22, 2025. Thus, NMFS estimated that a quarter of the maximum number of launches (11 out of 44) may occur in the last quarter of 2025 from LC-39A. For 2026, NMFS estimated a maximum of 25 launches from the Boca Chica Launch Site, and, because there is no information on the rate of launch cadence increase, NMFS estimated the maximum number of launches (44) may occur from LC-39A. For 2027, NMFS estimated that there may be a maximum of 25 launches from the Boca Chica Launch Site and a maximum of 44 launches from LC-39A. For the portion of 2028 that falls under the current

license (January–April 2028), which is approximately one-third of the year, NMFS estimated that one-third of the maximum number of launches from the Boca Chica Launch Site (approximately 9 out of 25) and LC-39A (approximately 15 out of 44) would occur.

Since OPR-2025-00164 was issued, on April 18, 2025, SpaceX conducted an additional two launches from the Boca Chica Launch Site (on May 27 and August 26). Further, given the addition of SLC-37, NMFS estimates the number of launches from each launch site that could occur over the duration of FAA's license. NMFS estimates an additional 21 launches could occur from Boca Chica and 11 additional launches could occur from LC-39A in 2025. The number of launches estimated in 2026 remains the same (69 launches). For 2027, NMFS estimates a maximum of 25 launches from the Boca Chica Launch Site, 44 launches from LC-39A, and 76 launches from SLC-37. For the portion of 2028 that falls under the current license, NMFS estimates 9 launches from Boca Chica, 15 launches from LC-39A, and 25 launches from SLC-37. In summary, based on estimates described above, the number of launches considered in this reinitiation are as follows: 32 launches in 2025 (September–December), 69 launches in 2026, 145 launches in 2027, and 49 launches in 2028 until the current license expires on April 14, 2028.

As noted above, SpaceX anticipates there will be no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of each vehicle in each portion of the action area, from April 2025 to October 2030. However, FAA and SpaceX do not have estimates of the frequency or the distribution of in-flight breakups, soft water landings, or explosive events per year or estimates of the rate of decrease of these expended vehicle landings. Further, changes made to the launch vehicle while in development may temporarily increase the number of expended vehicle landings because developing a fully reusable launch vehicle is not a linear process. Thus, NMFS estimated the number of in-flight breakups, soft water landings, and explosive events that could occur for the duration of the FAA license. Unlike launches, estimating an even distribution of expended vehicle landings over the span of a given year could be inaccurate given the goal is to reach full reusability of the launch vehicle, which is expected to occur by October of 2030. Thus, while the launch vehicle is still in development, it is reasonable to estimate that a larger proportion of expended vehicle landings will occur on the earlier side of the April 2025[2] to October 2030 timeframe (i.e., there should be zero expended vehicle landings by the time the launch vehicle is fully reusable in October 2030). Thus, NMFS estimates the maximum number of in-flight breakups (25), soft water landings (25), and explosive events (20) will occur for each vehicle, in each portion of the action area over the duration of the license (through April 14, 2028).

[2] See OPR-2025-00164

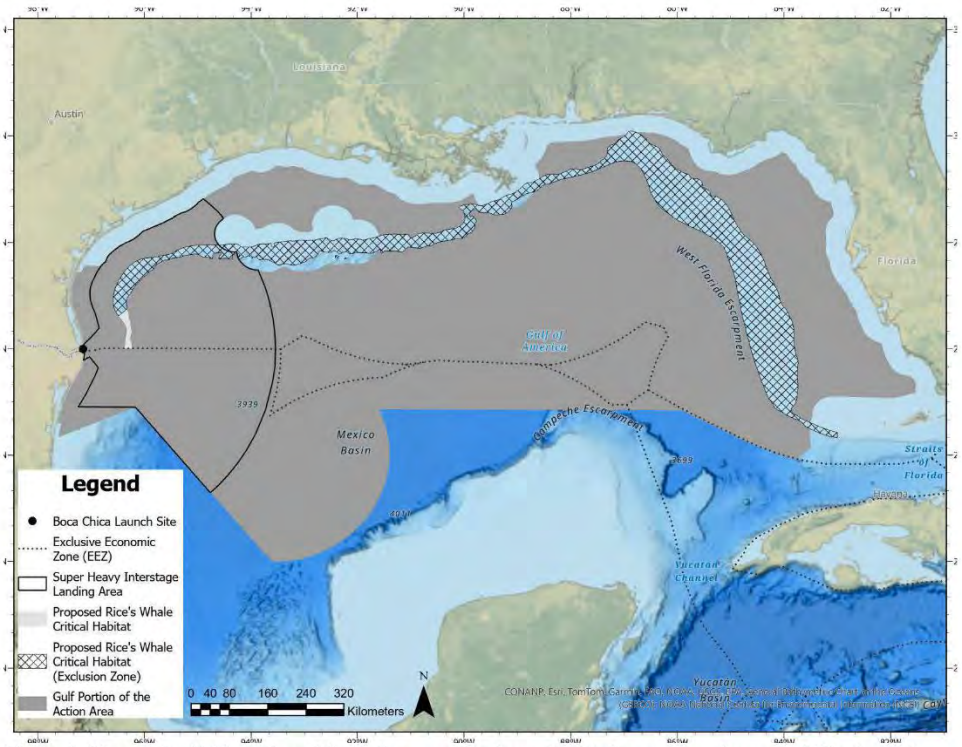

Figure 1. Map of the Gulf portion of the action area (dark grey) with the portion of proposed Rice's whale critical habitat that will be excluded (hatched) and portion of proposed Rice's whale critical habitat that will be included (light grey) in the area where Starship and Super Heavy may land, and Super Heavy interstage landing area (black outline).

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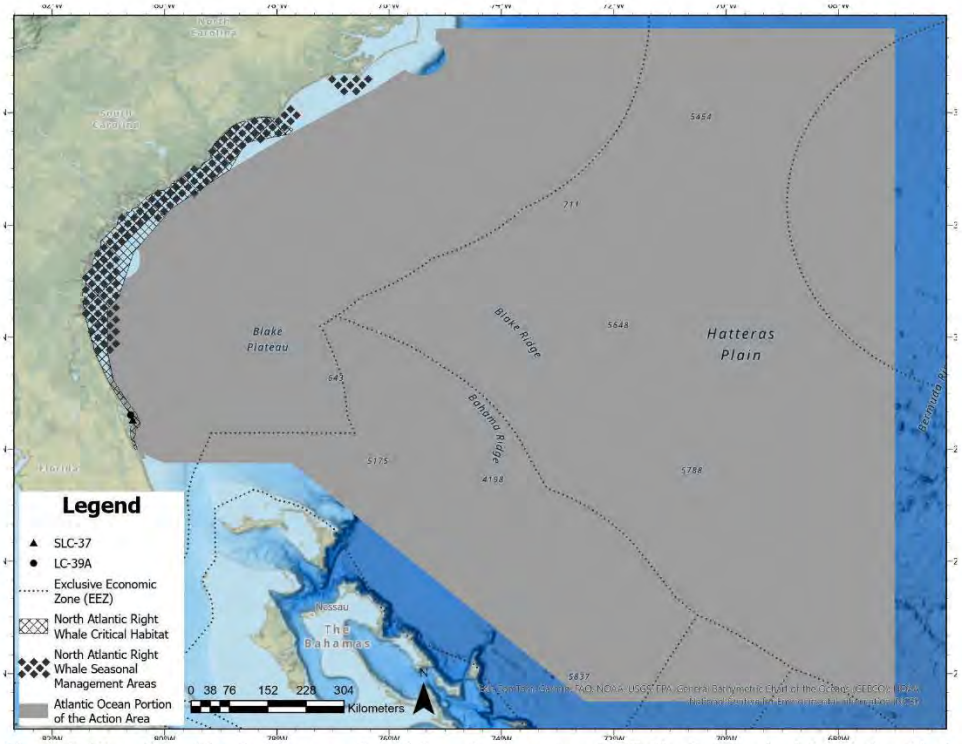

Figure 2. Map of the Atlantic Ocean portion of the action area (non-Gulf), North Atlantic right whale critical habitat (hatched) and Seasonal Management Area (diamonds) shown to illustrate overlap with the Atlantic Ocean portion of the action area.

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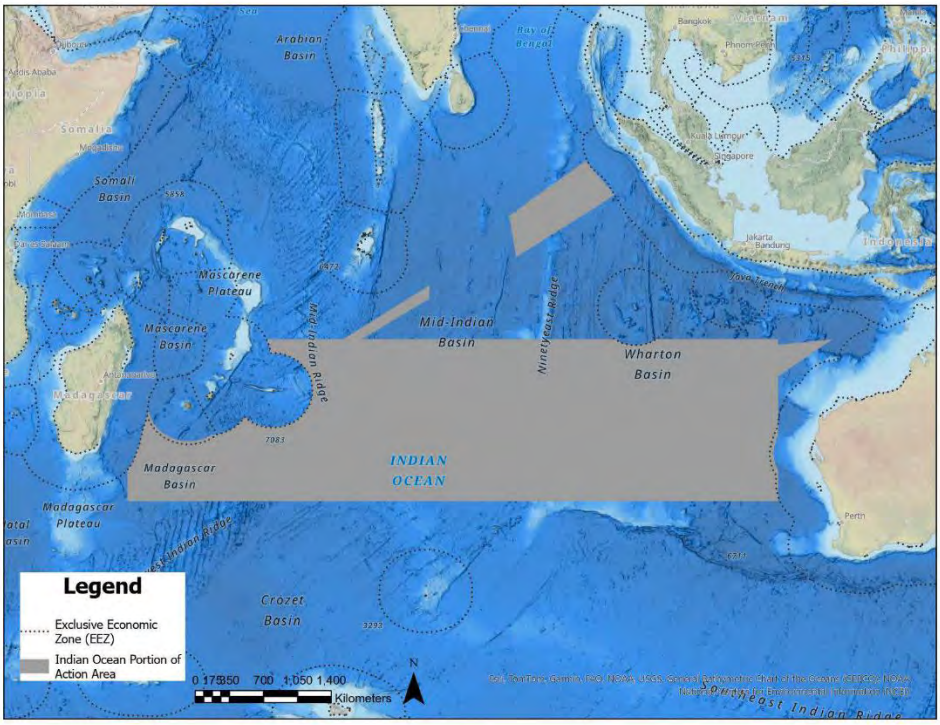

Figure 3. Map of the Indian Ocean portion of the action area.

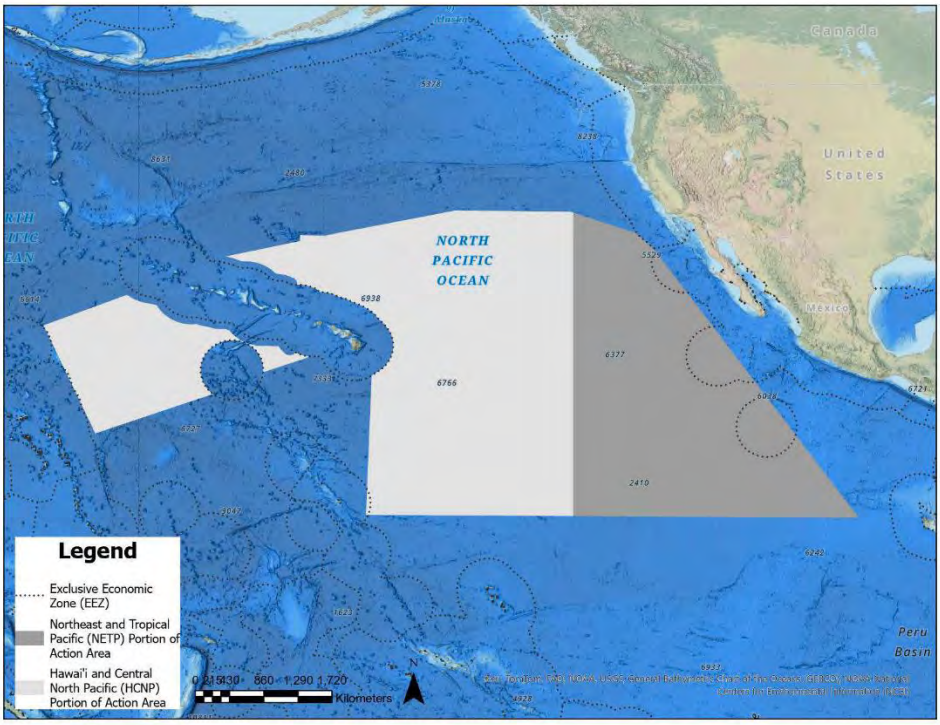

Figure 4. Map of the Hawaii and Central North Pacific portion of the action area (light grey) and Northeast and Tropical Pacific portion of the action area (dark grey).

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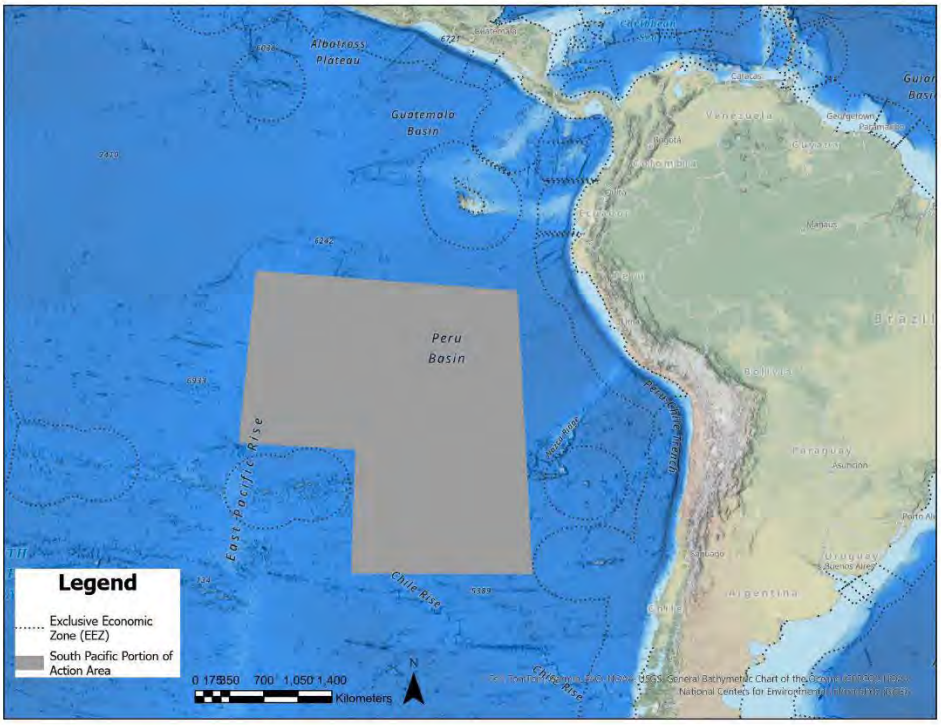

Figure 5. Map of the South Pacific portion of the action area.

Pre- and Post-Launch Activities

Prior to launch, weather balloons will be deployed to measure weather data. Between five and 15 weather balloons are used for each launch. The data, including wind speeds, are necessary to determine if it is safe to launch and land the vehicle. The weather balloons are made of latex with radiosondes attached to each balloon. A radiosonde, typically the size of a half-gallon milk carton, is attached to the weather balloon to measure and transmit atmospheric data to the launch operator. The latex balloon attached to each weather balloon typically has a diameter at launch of approximately four feet (1.2 m). When a balloon is deployed, it rises approximately 12–18 mi (19–29 km) into the air and then bursts. The radiosonde and shredded balloon pieces fall back to Earth and are not recovered. The radiosonde does not have a parachute and is expected to sink to the ocean floor when it lands over water.

A number of spotter aircraft, including drones, and surveillance vessels (or boats) are used during launch activities to ensure that designated hazard areas are clear of non-participating crafts. Combinations of radar, visual spotter aircraft, surface surveillance, and law enforcement vessels, may be deployed prior to launch. Most fixed wing aircraft operate at altitudes of 15,000

ft (4,572 m) but may drop to 1,500 ft (457 m) to obtain a call sign visually from a non-participating vessel.

2.2 Conservation Measures

The FAA will require the implementation of conservation measures in order for their action to result in the least practicable adverse impact to ESA-listed species and their habitat in the different portions of the action area. Conservation measures include measures that avoid or reduce the severity of the effects of the action on ESA-listed species and their critical habitats, and monitoring, which is used to observe or check the progress of the mitigation over time and to ensure that any measures implemented to reduce or avoid adverse effects on ESA-listed species and their critical habitats are successful. This consultation supersedes all previous consultations related to FAA's authorization of Starship-Super Heavy operations (OPR-2025-00164, OPR-2024-02422, OPR-2024-00211, OPR-2023-00318, OPR-2021-02908, and OPR-2024-01147). Conservation measures from previous consultations are incorporated into this consultation and described below. General conservation measures applicable to all portions of the action area are listed first, followed by conservation measures applicable to specific portions of the action area.

General conservation measures:

1. Launch and reentry activities, including vehicle landing locations and breakups, will occur at least 5 NM from the coast of the United States or islands, except between 100 mi (161 km) north and 100 mi (161 km) south of the Boca Chica Launch Site and between 50 mi (80 km) north and 50 mi (80 km) south of LC-39A and SLC-37, where launch and reentry activities will occur at least 1 NM from the coast. The only activities that will occur within 1 or 5 NM from the coast will be interstage landings in the Gulf portion of the action area (as described in Section 2.1) and vessel transits to and from a port for surveillance or when recovering launch vehicle components.
2. No vehicle landings or breakups will occur in coral reef areas.
3. No activities will occur in or affect a National Marine Sanctuary unless the appropriate authorization has been obtained from the Sanctuary.
4. If safe and feasible to do so, conduct surveillance via vessel, aircraft (including unmanned aircraft systems/vehicles), or remote camera 30 minutes prior to either vehicle's landing to document any protected species present in the vicinity of the landing area. After the vehicle lands and once safe to do so, conduct surveillance via vessel, aircraft (including unmanned aircraft systems/vehicles), or remote camera to document any potential impacts to protected species (presence, distribution, abundance, and behavior). This documentation will be included in the reports to NMFS prior to the launch vehicle reaching full reusability (see below).

Education and Observation

5. A dedicated observer(s) (e.g., biologist or person other than the vessel operator that can recognize ESA-listed and MMPA-protected species) will be provided by the launch operator to monitor for ESA-listed and MMPA-protected species with the aid of binoculars during all in-water activities, including transit for surveillance or to retrieve launch vehicle stages and components, other launch and reentry-related equipment, or debris.

a. When an ESA-listed or MMPA-protected species is sighted, the observer will alert vessel operators to implement the appropriate measures (see *Vessel Operations* below).
b. Dedicated observers will record the date, time, location, species, number of animals, distance and bearing from the vessel, direction of travel, and other relevant information such as behavior, for all sightings of ESA-listed or MMPA-protected species.
c. Dedicated observers will survey the landing/recovery area for any injured or killed ESA-listed or MMPA-protected species and any discoveries will be reported as noted below.

6. The launch operator will instruct all personnel associated with launch and reentry operations about ESA-listed species and critical habitat, and species protected under the MMPA, that may be present in the operations areas. The launch operator will advise personnel of the civil and criminal penalties for harming, harassing, or killing ESA-listed or MMPA-protected species.

Vessel Operations

All vessel operators will be on the lookout for and attempt to avoid collision with ESA-listed and MMPA-protected species. A collision with an ESA-listed species will require reinitiation of consultation. Vessel operators will ensure the vessel strike avoidance measures and reporting are implemented, and will maintain a safe distance by following these measures:

7. All vessels will be in compliance with all area restrictions.
8. All vessels will slow to 10 knots (kt) or less when mother/calf pairs or groups of marine mammals are observed.
9. All vessels will maintain, at minimum, a distance of 300 ft (91.4 m) from all ESA-listed marine mammals and MMPA-protected species (except for greater distances specified below), and 150 ft (45.7 m) from sea turtles. If this distance becomes less than 300 ft (91.4 m) or 150 ft (45.7 m), the vessel will slow down and shift the engine to neutral until the animal(s) have left the area.
10. All vessels will attempt to remain parallel or transit away to an ESA-listed species' course when sighted while the vessel is in transit (e.g., bow riding) and avoid excessive speed or abrupt changes in direction until the animal(s) has left the area.

Reporting Stranded, Injured, or Dead Animals

11. Any ESA-listed species collision(s), injuries, mortalities, or strandings observed will be reported immediately to the appropriate NMFS regional contact listed below (see also (https://www.fisheries.noaa.gov/report), to Tanya Dobrzynski, Chief, ESA Interagency Cooperation Division, by email at Tanya.Dobrzynski@noaa.gov, and to nmfs.hq.esa.consultations@noaa.gov with the subject line "OPR-2025-00164– Collision, Injury, or Mortality Report."
    a. For operations in the Gulf and Atlantic Ocean: for marine mammals (877) WHALE-HELP (877-942-5343) and for sea turtles (844) SEA-TRTL (844-732-8785)
    b. For operations in the North Pacific Ocean: (866) 767-6114 (West Coast) or (888) 256-9840 (Hawaii)

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c. In the Gulf and Atlantic Ocean near Florida, report any smalltooth sawfish sightings to (844) 4SAWFISH or (844) 472-9347 or via email sawfish@fwc.com
d. Report any giant manta ray sightings to (727) 824-5312 or via email to manta.ray@noaa.gov
e. Report any injured, dead, or entangled North Atlantic right whales to (877) WHALE-HELP (877) 942-5343 and the U.S. Coast Guard via VHF Channel 16

Aircraft Procedures
Aircraft will maintain a minimum of 1,000 ft (304.8 m) over ESA-listed or MMPA-protected species and 1,500 ft (457.2 m) above North Atlantic right whales. Aircraft will avoid flying in circles, if marine mammals or sea turtles are spotted, and avoid any type of harassing behavior.

Hazardous Materials Emergency Response
In the event of a failed launch operation, launch operators will follow the emergency response and cleanup procedures outlined in their Hazardous Material Emergency Response Plan (or similar plan). Procedures may include containing the spill using disposable containment materials and cleaning the area with absorbents or other materials to reduce the magnitude and duration of any impacts.

Gulf portion of the action area conservation measures:

1. Reentry trajectories will be planned to avoid vehicle (Super Heavy and Starship) landings, explosions, and breakups within Rice's whale core distribution area and proposed critical habitat. Vehicles may only land in a small portion of Rice's whale proposed critical habitat (see Figure 1) off Boca Chica, Texas. For a single flight, Super Heavy and Starship will not both land in this small portion of Rice's whale proposed critical habitat.
2. All vessels will slow to 10 kt or less when Rice's whales are observed and maintain a minimum distance of 1,500 ft (457.2 m) from Rice's whales. If a whale is observed but cannot be confirmed as a species other than a Rice's whale, the vessel operator must assume that it is a Rice's whale and take appropriate action.
3. Avoid vessel transit in the Rice's whale core distribution area and proposed critical habitat. No vessel transit will occur at night in Rice's whale area or proposed critical habitat. If transit in the Rice's whale area or proposed critical habitat is required, avoid areas where water depth is 328–1,394 ft (100–425 m; where Rice's whale has been observed; Rosel et al. 2021) and transit as slowly as practicable, limiting speeds to 10 kt or less.

Atlantic Ocean portion of the action area (non-Gulf) conservation measures:

1. All vessels will slow to 10 kt or less when North Atlantic right whales are observed and maintain a minimum distance of 1,500 ft (457.2 m) from North Atlantic right whales. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take appropriate action.
2. All vessels will comply with applicable North Atlantic right whale speed rules, including Seasonal Management Areas, Slow Zones, and Dynamic Management Areas.

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Information on Seasonal Management Areas, Slow Zones, Dynamic Management Areas, and how to sign up for alerts is available at NMFS's Reducing Vessel Strikes to North Atlantic Right Whales website.

3. For a single flight, Super Heavy and Starship will not both land in the portion of the Atlantic Ocean portion of the action area that overlaps North Atlantic right whale critical habitat and North Atlantic right whale Seasonal Management Areas from November 1 through April 30.
4. No vehicle (Super Heavy or Starship) landings, explosions, or breakups will occur within designated North Atlantic right whale Slow Zones or Dynamic Management Areas, if the Slow Zone or Dynamic Management Area is established prior to launch.

Indian Ocean portion of the action area conservation measures:

1. To the maximum extent practicable, Starship landings will avoid Important Marine Mammal Areas[3] and Ecologically or Biologically Significant Areas[4].
2. If possible, Starship landings will also avoid other physiographic features, such as seamounts, that may provide conservation benefits to listed species.

Hawaii and Central North Pacific portion of the action area conservation measures:

1. Although unlikely, to prevent debris from a Starship explosive event or in-flight breakup from entering the Papahānaumokuākea National Marine Sanctuary, SpaceX will have a vessel in the area of highest likelihood of debris that will identify large debris for salvage. SpaceX will use the vessel to survey for debris for approximately 24– 48 hours (using visual survey in the daytime and onboard vessel radar at night) depending on the outcome of the breakup. If there is floating debris detected by the vessel during the debris survey, SpaceX will sink or recover any debris before it can drift into the Papahānaumokuākea National Marine Sanctuary by removing the item using a net or boat hook, or puncturing the item using a firearm to cause it to sink. If debris is still identified after the 24–48 hour survey, SpaceX will use an aerial asset, additional vessel, or satellite imaging, to confirm and characterize any debris to verify that debris sinks within 10 days.

Reporting to NMFS

This consultation supersedes all previous consultations related to FAA's authorization of Starship-Super Heavy operations (OPR-2025-00164, OPR-2024-02422, OPR-2024-00211, OPR-2023-00318, OPR-2021-02908, and OPR-2024-01147). Reporting requirements from previous consultations are incorporated into this consultation and described below.

Prior to full reusability of the launch vehicle, FAA, in coordination with SpaceX, will provide a report after each Starship-Super Heavy flight. Reports after each flight, prior to achieving full

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[3] Important Marine Mammal Areas (IMMAs) are "discrete portions of habitat, important to marine mammal species that have the potential to be delineated and managed for conservation." For more information, see https://www.marinemammalhabitat.org/immas/ and https://www.marinemammalhabitat.org/imma-eatlas/

[4] Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity are marine areas that are functionally important in supporting healthy oceans and ocean services. For more information, see https://www.cbd.int/ebsa/.

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reusability, should be submitted no more than 30 days after the flight to NMFS electronically at nmfs.hq.esa.consultations@noaa.gov with the subject line "OPR-2025-02468 [Flight #] Fate Report."

After each Starship-Super Heavy flight prior to achieving full reusability, FAA will provide information to NMFS detailing the results of launches and landings, based on available telemetry data received from the vehicles, including:

1. Whether Starship and Super Heavy resulted in an anomaly or nominal (i.e., all operations occurred as expected) landing, and where (expressed in the last known GPS location) the anomaly or landing occurred.
2. The debris catalog generation, approximate location, and any other information that can corroborate assumptions about the debris and/or debris field from an in-flight breakup or explosive event of each vehicle.
3. Whether Starship and Super Heavy landings occurred in the expected manner. For landings resulting in explosion, information reported to NMFS shall include: the amount of fuel/propellant remaining in main and header tanks, vehicle orientation upon landing and height of the explosive event above the surface of the water, debris catalog generation, and any other data that can corroborate whether the assumptions about the explosion and area of impact (physically and acoustically) were appropriate.
4. Any documentation of ESA-listed species pre- and post-landing, per items 4 and 5 under General Conservation Measures.

2.3 Activities Caused by the Action

Because the Starship-Super Heavy launch vehicle is designed to be a reusable transportation system, which is capable of carrying reusable payloads of up to 165 t (150 MT) and expendable payloads of up to 276 t (250 MT), there are various activities that will occur because of FAA's licensing of Starship-Super Heavy launch and reentry operations. These activities include, but are not necessarily limited to, launching satellites and capsules (or other payloads, and subsequent reentry of those satellites, capsules, and payloads later in time) and DoD projects (e.g., using Starship to explore rapid global mobility). Activities that use Starship-Super Heavy capabilities are more than likely to occur once the launch vehicle is fully reusable (after October 2030). Exact projects, missions, and payloads that may affect ESA-listed or proposed species and their designated or proposed critical habitat are currently unknown and may require separate consultation or conference.

Anomalies and mishaps have also occurred and may continue to occur as a result of FAA's licensing of Starship-Super Heavy launch and reentry operations. An *anomaly* is any condition during a licensed activity "that deviates from what is standard, normal, or expected, during the verification or operation of a system, subsystem, process, facility, or support equipment" and a *mishap* means "any event, or series of events associated with a licensed or permitted activity resulting in any of the following: (1) a fatality or serious injury; (2) a malfunction of a safety-critical system; (3) a failure of the licensee's or permittee's safety organization, safety operations, safety procedures; (4) high risk, as determined by the FAA, of causing a serious or fatal injury to any space flight participant, crew, government astronaut, or member of the public; (5) substantial damage, as determined by the FAA, to property not associated with licensed or

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permitted activity; (6) unplanned substantial damage, as determined by the FAA, to property associated with licensed or permitted activity; (7) unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity; (8) the impact of hazardous debris outside the planned landing site or designated hazard area; or (9) failure to complete a launch or reentry as planned as reported in" the licensee's mission information (14 CFR §401.7). At the time of this reinitiation, SpaceX had conducted ten flights of Starship-Super Heavy. The first three flights resulted in mishaps to both vehicles within the action area considered in the ESA section 7 consultations conducted for the flights. The most recent flights, Flights 7 and 8, resulted in mishaps to Starship around the Caribbean, and Flight 9 resulted in a Super Heavy anomaly with debris traveling outside the debris area previously considered in OPR-2025-00164. Mishaps occurred due to a variety of reasons related to engine failure, propellant leaks, and vehicle malfunctions, and were characterized by the vehicle(s) exploding at altitude, with debris entering the ocean. As SpaceX works towards a fully reusable vehicle, mishaps are expected to continue.

2.4 Stressors Resulting from the Components of the Proposed Action

In this section, the direct or indirect modifications to the land, water, or air caused by an action are identified stressors. This section identifies all of the stressors that may affect listed species, as well as the sources of those stressors. Some stressors may have multiple sources. Likewise, multiple sources may combine to create a stressor that would not exist if only one of the sources were present. The following is a summarization of stressors that are reasonably certain to be caused by this action:

1. Sonic booms and impulse noise generated during launches and landings;
2. Direct impact by fallen objects (radiosonde, Super Heavy, Starship, interstage, debris);
3. Impacts from unrecovered debris;
4. Impacts from pollution (vessel and vehicle emissions, propellant);
5. Vessel presence, strike, and noise;
6. Aircraft overflight;
7. In-air acoustic effects from vehicle landings and explosive events;
8. Vibration, heat, and debris from launches;
9. Heat from vehicle landings and explosive events; and
10. Underwater acoustic effects from explosive events.

3. ACTION AREA

Action area means "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The action area is defined by the extent of the environmental changes the stressors cause on the physical environment (e.g., land, air or water, detailed in the previous section). The action area includes portions of the Gulf of Mexico (non-U.S. waters), Gulf of America, another area in the Atlantic Ocean, Indian Ocean, North Pacific Ocean, and South Pacific Ocean (see Figures 1–5) where Super Heavy and/or Starship will be expended until full reusability is achieved. The action area also includes waters between the Super Heavy and Starship landing areas and shore (except for in the Indian Ocean), where vessels are expected to transit between ports and landing locations for surveillance or recovery of launch vehicle components. These are coastal waters off the Hawaiian archipelago,

Southern California (south of the Santa Maria River), Mexico, Central America, Peru, Chile, Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, and North Carolina. They do not include ports or waters that occur within or adjacent to the critical habitats of ESA-listed anadromous fishes, and where those species aggregate for spawning, recruitment, and other important life functions.

The action area also includes waters where mishaps may occur. Based on limited information on where mishaps have previously occurred, NMFS estimated an additional area where mishaps may occur in the future based on limited knowledge of debris areas and trajectories from previous flights (Figure 6). We note that mishaps have occurred shortly after launch, and it is expected that mishaps could occur within the Gulf and Atlantic Ocean portions of the action area downrange of the launch sites. In this reinitiation, we expand the Gulf portion of the action area to encompass the entire Gulf of America and Gulf of Mexico (non-U.S. waters), based on new debris information provided by FAA and SpaceX after the completion of activities initially considered under consultation OPR-2025-00164.

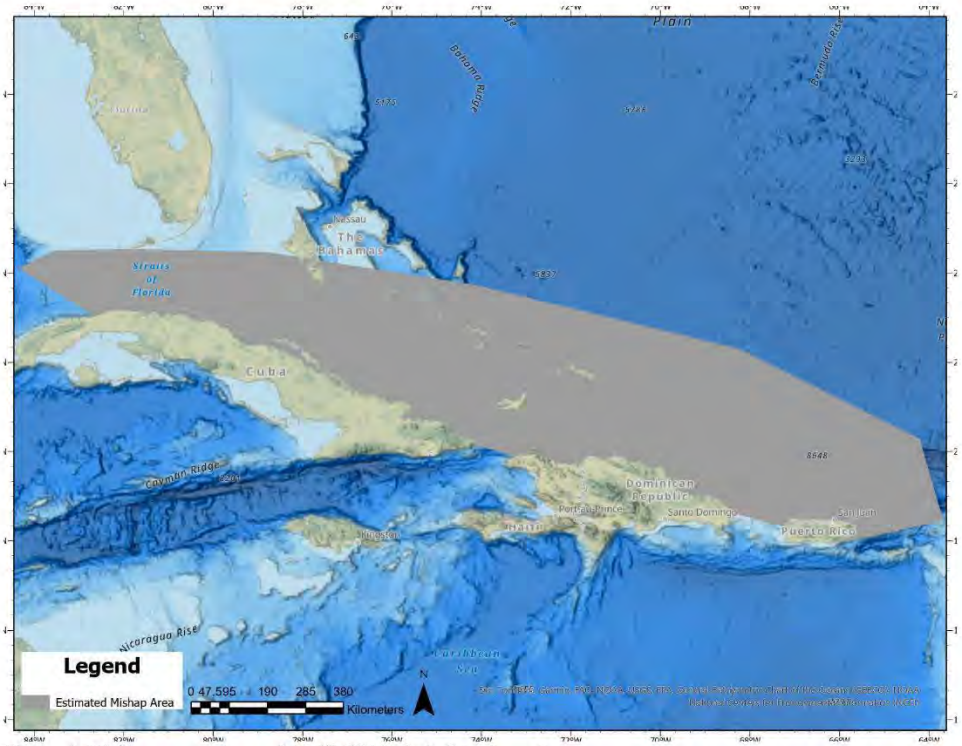

Figure 6. Mishap area estimated by NMFS included in the action area.

4. Species and Critical Habitat that May be Affected by the Proposed Action

The ESA allows for three general determinations for listed species and critical habitat: 1) no effect, 2) may affect, not likely to adversely affect (NLAA), and 3) may affect, likely to adversely affect (LAA). Action agencies, prior to requesting ESA consultation, determine whether their proposed action may affect ESA-listed or proposed species or their designated or proposed critical habitat. Generally, a "no effect" determination means there is no plausible exposure or response to stressors generated by the proposed action for any ESA-listed or proposed species or designated or proposed critical habitat. A "no effect" determination does not require consultation. Any scenario where there is a plausible exposure to stressors generated by the action, no matter how unlikely, is considered "may affect." For any action that "may affect" an ESA-listed species or its designated critical habitat, the action agency shall consult with the Services under section 7(a)(2) of the ESA. An action agency is also required to confer with the Services on any effects to proposed species or proposed critical habitat if those effects are likely to jeopardize the continued existence of the species, or destroy or adversely modify the proposed critical habitat. However, action agencies may voluntarily confer with the Services for all proposed species or proposed critical habitat in the action area when the action may affect those proposed entities without rising to a level requiring us to confer.

Table 1. Species and critical habitat present in the action area

Species	ESA Status	Critical Habitat	Recovery Plan
Blue Whale (*Balaenoptera musculus*)	E – 35 Fed. Reg. 18319	-- --	07/1998 11/2020
False Killer Whale (*Pseudorca crassidens*) – Main Hawaiian Islands Insular DPS	E – 77 Fed. Reg. 70915	83 Fed. Reg. 35062	86 Fed. Reg. 60615 10/2021
Fin Whale (*Balaenoptera physalus*)	E – 35 Fed. Reg. 18319	-- --	75 Fed. Reg. 47538 07/2010
Gray Whale (*Eschrichtius robustus*) – Western North Pacific DPS	E – 35 Fed. Reg. 18319	-- --	-- --
Humpback Whale (*Megaptera novaeangliae*) – Central America DPS	E – 81 Fed. Reg. 62259	86 Fed. Reg. 21082	11/1991 06/2022 (Outline)
Humpback Whale (*Megaptera novaeangliae*) – Mexico DPS	T – 81 Fed. Reg. 62259	86 Fed. Reg. 21082	11/1991 06/2022 (Outline)

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Species	ESA Status	Critical Habitat	Recovery Plan
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 Fed. Reg. 12024	81 Fed. Reg. 4837	70 Fed. Reg. 32293 08/2004
North Pacific Right Whale (*Eubalaena japonica*)	E – 73 Fed. Reg. 12024	73 Fed. Reg. 19000**	78 Fed. Reg. 34347 06/2013
Sei Whale (*Balaenoptera borealis*)	E – 35 Fed. Reg. 18319	-- --	12/2011
Sperm Whale (*Physeter macrocephalus*)	E – 35 Fed. Reg. 18319	-- --	75 Fed. Reg. 81584 12/2010
Rice's Whale (*Balaenoptera ricei*)	E – 84 Fed. Reg. 15446 and 86 Fed. Reg. 47022	88 Fed. Reg. 47453 (Proposed)	09/2020 (Outline)
Guadalupe Fur Seal (*Arctocephalus townsendi*)	T – 50 Fed. Reg. 51252	-- --	-- --
Hawaiian Monk Seal (*Neomonachus schauinslandi*)	E – 41 Fed. Reg. 51611	80 Fed. Reg. 50925	72 Fed. Reg. 46966 2007
Green Turtle (*Chelonia mydas*) – Central North Pacific DPS	T – 81 Fed. Reg. 20057	88 Fed. Reg. 46572 (Proposed)	63 Fed. Reg. 28359 01/1998
Green Turtle (*Chelonia mydas*) – East Indian-West Pacific DPS	T – 81 Fed. Reg. 20057	-- --	-- --
Green Turtle (*Chelonia mydas*) – East Pacific DPS	T – 81 Fed. Reg. 20057	88 Fed. Reg. 46572 (Proposed)	63 Fed. Reg. 28359 01/1998
Green Turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 Fed. Reg. 20057	63 Fed. Reg. 46693 88 Fed. Reg. 46572 (Proposed)	10/1991 – U.S. Atlantic
Green Turtle (*Chelonia mydas*) – North Indian DPS	T – 81 Fed. Reg. 20057	-- --	-- --
Green Turtle (*Chelonia mydas*) – South Atlantic DPS	T – 81 Fed. Reg. 20057	88 Fed. Reg. 46572 (Proposed)	10/1991 – U.S. Atlantic
Green Turtle (*Chelonia mydas*) –	T – 81 Fed. Reg. 20057	-- --	-- --

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Species	ESA Status	Critical Habitat	Recovery Plan
Southwest Indian DPS			
Hawksbill Turtle (*Eretmochelys imbricata*)	E – 35 Fed. Reg. 8491	63 Fed. Reg. 46693	57 Fed. Reg. 38818 08/1992 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 Fed. Reg. 28359 05/1998 – U.S. Pacific
Kemp's Ridley Turtle (*Lepidochelys kempii*)	E – 35 Fed. Reg. 18319	-- --	03/2010 – U.S. Caribbean, Atlantic, and Gulf of Mexico 09/2011
Leatherback Turtle (*Dermochelys coriacea*)	E – 35 Fed. Reg. 8491	44 Fed. Reg. 17710 77 Fed. Reg. 4170	10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 Fed. Reg. 28359 05/1998 – U.S. Pacific
Loggerhead Turtle (*Caretta caretta*) – North Indian Ocean DPS	E – 76 Fed. Reg. 58868	-- --	-- --
Loggerhead Turtle (*Caretta caretta*) – North Pacific Ocean DPS	E – 76 Fed. Reg. 58868	-- --	63 Fed. Reg. 28359
Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 Fed. Reg. 58868	79 Fed. Reg. 39855	74 Fed. Reg. 2995 10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 05/1998 – U.S. Pacific 01/2009 – Northwest Atlantic
Loggerhead Turtle (*Caretta caretta*) – South Pacific Ocean DPS	E – 76 Fed. Reg. 58868	-- --	-- --

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Species	ESA Status	Critical Habitat	Recovery Plan
Loggerhead Turtle (*Caretta caretta*) – Southeast Indo-Pacific Ocean DPS	T – 76 Fed. Reg. 58868	-- --	-- --
Loggerhead Turtle (*Caretta caretta*) – Southwest Indian Ocean DPS	T – 76 Fed. Reg. 58868	-- --	-- --
Olive Ridley Turtle (*Lepidochelys olivacea*) – All Other Areas/Not Mexico's Pacific Coast Breeding Colonies	T – 43 Fed. Reg. 32800	-- --	-- --
Olive Ridley Turtle (*Lepidochelys olivacea*) – Mexico's Pacific Coast Breeding Colonies	E – 43 Fed. Reg. 32800	-- --	63 Fed. Reg. 28359
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS	E – 77 Fed. Reg. 5913	82 Fed. Reg. 39160	02/2012 (Outline)
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Chesapeake Bay DPS	E – 77 Fed. Reg. 5880	82 Fed. Reg. 39160**	02/2012 (Outline)
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – South Atlantic DPS	E – 77 Fed. Reg. 5913	82 Fed. Reg. 39160	02/2012 (Outline)
Giant Manta Ray (*Manta birostris*)	T – 83 Fed. Reg. 2916	-- --	12/2019 (Outline)
Green Sturgeon (*Acipenser medirostris*) – Southern DPS	T – 71 Fed. Reg. 17757	74 Fed. Reg. 52300**	8/2018
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	T – 56 Fed. Reg. 49653	68 Fed. Reg. 13370	09/1995

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Species	ESA Status	Critical Habitat	Recovery Plan
Nassau Grouper (*Epinephelus striatus*)	T – 81 Fed. Reg. 42268	89 Fed. Reg. 126	8/2018 (Outline)
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	T – 83 Fed. Reg. 4153	-- --	89 Fed. Reg. 56865 7/2024
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Central and Southwest Atlantic DPS	T – 79 Fed. Reg. 38213	-- --	-- --
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Eastern Pacific DPS	E – 79 Fed. Reg. 38213	-- --	-- --
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Indo-West Pacific DPS	T – 79 Fed. Reg. 38213	-- --	-- --
Shortnose Sturgeon (*Acipenser brevirostrum*)	E – 32 Fed. Reg. 4001	-- --	63 Fed. Reg. 69613 12/1998
Smalltooth Sawfish (*Pristis pectinata*) – U.S. portion of range DPS	E – 68 Fed. Reg. 15674	74 Fed. Reg. 45353*	74 Fed. Reg. 3566 01/2009
Steelhead Trout (*Oncorhynchus mykiss*) – South-Central California Coast DPS	T – 71 Fed. Reg. 834	70 Fed. Reg. 52487**	78 Fed. Reg. 77430
Steelhead Trout (*Oncorhynchus mykiss*) – Southern California DPS	E – 71 Fed. Reg. 834	70 Fed. Reg. 52487**	77 Fed. Reg. 1669
Black Abalone (*Haliotis cracherodii*)	E – 74 Fed. Reg. 1937	76 Fed. Reg. 66805	85 Fed. Reg. 5396
Boulder Star Coral (*Orbicella franksi*)	T – 79 Fed. Reg. 53851	88 Fed. Reg. 54026	03/2015 (Outline)
Elkhorn Coral (*Acropora palmata*)	T – 79 Fed. Reg. 53851	73 Fed. Reg. 72210	80 Fed. Reg. 12146
Lobed Star Coral (*Orbicella annularis*)	T – 79 Fed. Reg. 53851	88 Fed. Reg. 54026	03/2015 (Outline)

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Species	ESA Status	Critical Habitat	Recovery Plan
Mountainous Star Coral (*Orbicella faveolata*)	T – 79 Fed. Reg. 53851	88 Fed. Reg. 54026	03/2015 (Outline)
Pillar Coral (*Dendrogyra cylindrus*)	E – 89 Fed. Reg. 101993	88 Fed. Reg. 54026	03/2015 (Outline)
Rough Cactus Coral (*Mycetophyllia ferox*)	T – 79 Fed. Reg. 53851	88 Fed. Reg. 54026	03/2015 (Outline)
Staghorn Coral (*Acropora cervicornis*)	T – 79 Fed. Reg. 53851	73 Fed. Reg. 72210	80 Fed. Reg. 12146
White Abalone (*Haliotis sorenseni*)	E – 66 Fed. Reg. 29046	66 Fed. Reg. 29046 (Not Prudent)	10/2008
Sunflower Sea Star (*Pycnopodia helianthoides*)	T – 88 Fed. Reg. 16212 (Proposed)	-- --	-- --

Fed. Reg. = *Federal Register*; E = Endangered; T = Threatened; DPS = Distinct Population Segment
* Designated critical habitat overlaps with the action area but the action will have no effect on any PBFs
** Designated critical habitat does not overlap with the action area

Table 2. Physical or Biological Features (PBFs) of designated or proposed critical habitat (CH) present in the action area that may be affected by the proposed action

Designated or Proposed Critical Habitat	PBFs
False Killer Whale – Main Hawaiian Islands Insular DPS	Currently designated CH: Main Hawaiian Islands – waters 45 m to 3,200 m depth Designated CH PBFs: 1. Adequate space for movement and use within shelf and slope habitat 2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth 3. Waters free of pollutants of a type and amount harmful to Main Hawaiian Islands Insular DPS false killer whales 4. Sound levels that would not significantly impair false killer whales' use or occupancy
Humpback Whale – Central America DPS	Currently Designated CH: California – marine habitat within portions of the California Coastal Ecosystem Designated CH PBFs:

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Designated or Proposed Critical Habitat	PBFs
	1. Prey species, primarily euphausiids (*Thysanoessa, Euphausia, Nyctiphanes,* and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth
Humpback Whale – Mexico DPS	Currently Designated CH: California – marine habitat within portions of the California Coastal Ecosystem Designated CH PBFs: 1. Prey species, primarily euphausiids (*Thysanoessa, Euphausia, Nyctiphanes,* and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea pallasii*), capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth
Hawaiian Monk Seal	Currently Designated CH: Northwestern Hawaiian Islands – all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and including marine habitat through the water's edge, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, out to the 200-m depth contour line around the following 10 areas: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island Main Hawaiian Islands – marine habitat from the 200-m depth contour line, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, through the water's edge 5 m into the terrestrial environment from the shoreline between identified boundary points on the islands of: Ka'ula, Ni'ihau, Kaua'i, O'ahu, Maui Nui (including Kaho'olawe, Lana'i, Maui, and Moloka'i), and Hawai'i Designated CH PBFs: 1. Marine areas from 0 to 200 m in depth that support adequate prey quality and quantity for juvenile and adult monk sea foraging

Designated or Proposed Critical Habitat	**PBFs**
North Atlantic Right Whale	Currently Designated CH: Southeastern U.S. Calving Area – Cape Fear, North Carolina to approximately 27 NM below Cape Canaveral, Florida Designated CH PBFs: 1. Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale 2. Sea surface temperatures from a minimum of 7°C, and never more than 17°C
Hawksbill Turtle	Currently Designated CH: Coastal waters surrounding Mona and Monito Islands, Puerto Rico Designated CH PBFs: PBFs of hawksbill turtle critical habitat are not precisely defined; however, critical habitat was designated to provide protection for important foraging and sheltering coral reef habitat
Leatherback Turtle	Currently Designated CH: California coast – Point Arena to Point Arguello east of the 3,000-m depth contour Designated CH PBFs: 1. Occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (e.g., *Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks
Loggerhead Turtle – Northwest Atlantic Ocean DPS	Currently Designated CH: Northwest Atlantic Ocean DPS range – neritic (nearshore reproductive, foraging, winter, breeding, and migratory) and *Sargassum* habitat Designated CH PBFs: 1. Nearshore Reproductive Habitat -- 2. Foraging Habitat – (1) Sufficient prey availability and quality, such as benthic invertebrates, including crabs (spider, rock, lady, hermit, blue, horseshoe), mollusks, echinoderms and sea pens 3. Winter Habitat -- 4. Breeding Habitat – (1) High densities of reproductive male and female loggerheads

Designated or Proposed Critical Habitat	PBFs
	5. Constricted Migratory Habitat – (1) Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas 6. *Sargassum* Habitat – (1) *Sargassum* in concentrations that support adequate prey abundance and cover; (2) Available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and (3) Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., >10 m depth
Atlantic Sturgeon – Carolina DPS	Currently Designated CH: Aquatic habitat in the following rivers of North Carolina and South Carolina: Roanoke, Tar-Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee, Black, Santee, North Santee, South Santee, Cooper, and Bull Creek Designated CH PBFs: Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (1) unimpeded movement of adults to and from spawning sites; (2) seasonal and physiologically depends movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and (3) staging, resting, or holding of subadults and spawning condition adults
Atlantic Sturgeon – South Atlantic DPS	Currently Designated CH: Aquatic habitat in the following rivers of South Carolina, Georgia, and Florida: Edisto, Combahee-Salkehatchie, Savannah, Ogeechee, Altamaha, Ocmulgee, Oconee, Satilla, and St. Marys Designated CH PBFs: Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (1) unimpeded movement of adults to and from spawning sites; (2) seasonal and physiologically depends movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and (3) staging, resting, or holding of subadults and spawning condition adults
Gulf Sturgeon	Currently Designated CH: Gulf of America – river, estuarine, and marine habitat

Designated or Proposed Critical Habitat	PBFs
	Designated CH PBFs: 1. Abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, molluscs and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages 2. Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages 3. Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats
Nassau Grouper	Currently Designated CH: Puerto Rico – Desecheo Island, Northeast, Vieques Island, Isla De Culebra/Culebrita U.S. Virgin Islands – St. Thomas, St. John Florida – Big Pine Key to Geiger Key, Key West, New Ground Shoal Spawning Sites – Grammanik Bank and Hind Bank, and Riley's Hump Designated CH PBFs: 1. Recruitment and developmental habitat – Areas from nearshore to offshore necessary for recruitment, development, and growth of Nassau grouper containing a variety of benthic types that provide cover from predators and habitat for prey, consisting of the following: (1) Nearshore shallow subtidal marine nursery areas with substrate that consists of unconsolidated calcareous medium to very coarse sediments and shell and coral fragments and may also include cobble, boulders, whole corals and shells, or rubble mounds, to support larval settlement and provide shelter from predators during growth and habitat for prey; (2) Intermediate hardbottom and seagrass areas in closer proximity to the nearshore shallow subtidal marine nursery areas that provide refuge and prey resources for juvenile fish; (3) Offshore linear and patch reefs in close proximity to intermediate hardbottom and seagrass areas that contain multiple benthic types to provide shelter from predation during maturation and habitat for prey; and (4) Structures between the subtidal nearshore area and the intermediate hardbottom and seagrass area and the offshore reef area to support juveniles and adults as movement corridors that include temporary refuge that reduces predation

Designated or Proposed Critical Habitat	PBFs
	risk as Nassau grouper move from nearshore to offshore habitats 2. Spawning habitat --
Black Abalone	Currently Designated CH: California – rocky intertidal and subtidal habitat from the Mean Higher High Water line to a depth of 6 m relative to the Mean Lower Low Water line, and coastal marine waters encompassed by these areas from Del Mar Landing Ecological Reserve to the Palos Verdes Peninsula, as well as on the Farallon Islands, Año Nuevo Island, San Miguel Island, Santa Rosa Island, Santa Cruz Island, Anacapa Island, Santa Barbara Island, and Santa Catalina Island Designated CH PBFs: 1. Suitable water quality including temperature, salinity, pH, and other chemical characteristics necessary for normal settlement, growth, behavior, and viability
Boulder Star Coral	Currently Designated CH: Florida – Government Cut, Miami-Dade County to Dry Tortugas (0.5–40 m) Puerto Rico – All islands (0.5–90 m) U.S. Virgin Islands – St. Thomas and St. John (0.5–90 m) Designated CH PBFs: Sites that support the normal function of all life stages of the corals, including reproduction, recruitment, and maturation. These sites are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column: 1. Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae 2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae 3. Marine waters with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function
Elkhorn Coral	Currently Designated CH: Florida – Government Cut, Miami-Dade County to Key West, Monroe County (Mean Low Water Line to 30 m); Dry Tortugas (Mean Low Water Line to 30 m) Puerto Rico – All islands (<30 m depth) U.S. Virgin Islands – St. Thomas and St. John (<30 m depth)

Designated or Proposed Critical Habitat	PBFs
	Designated CH PBFs: Substrate of suitable quality and availability (natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover) to support larval settlement and recruitment, and reattachment and recruitment of asexual fragments
Lobed Star Coral	Currently Designated CH: Florida – Government Cut, Miami-Dade County to Dry Tortugas (0.5–20 m) Puerto Rico – All islands (0.5–20 m) U.S. Virgin Islands – St. Thomas and St. John (0.5–20 m) Designated CH PBFs: Sites that support the normal function of all life stages of the corals, including reproduction, recruitment, and maturation. These sites are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column: 1. Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae 2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae 3. Marine waters with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function
Mountainous Star Coral	Currently Designated CH: Florida – Government Cut, Miami-Dade County to Dry Tortugas (0.5–40 m) Puerto Rico – All islands (0.5–90 m) U.S. Virgin Islands – St. Thomas and St. John (0.5–90 m) Designated CH PBFs: Sites that support the normal function of all life stages of the corals, including reproduction, recruitment, and maturation. These sites are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column: 1. Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae 2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae

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Designated or Proposed Critical Habitat	PBFs
	3. Marine waters with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function
Pillar Coral	Currently Designated CH: Florida – Government Cut, Miami-Dade County to Dry Tortugas (1–25 m) Puerto Rico – All islands (1–25 m) U.S. Virgin Islands – St. Thomas and St. John (1–25 m) Designated CH PBFs: Sites that support the normal function of all life stages of the corals, including reproduction, recruitment, and maturation. These sites are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column: 1. Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae 2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae 3. Marine waters with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function
Rough Cactus Coral	Currently Designated CH: Florida – Broward County to Dry Tortugas (5–40 m) Puerto Rico – All islands (5–90 m) U.S. Virgin Islands – St. Thomas and St. John (5–90 m) Designated CH PBFs: Sites that support the normal function of all life stages of the corals, including reproduction, recruitment, and maturation. These sites are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column: 1. Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae 2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae 3. Marine waters with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function
Staghorn Coral	Currently Designated CH:

Designated or Proposed Critical Habitat	PBFs
	Florida – Government Cut, Miami-Dade County to Key West, Monroe County (Mean Low Water Line to 30 m); Dry Tortugas (Mean Low Water Line to 30 m) Puerto Rico – All islands (<30 m depth) U.S. Virgin Islands – St. Thomas and St. John (<30 m depth) Designated CH PBFs: Substrate of suitable quality and availability (natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover) to support larval settlement and recruitment, and reattachment and recruitment of asexual fragments
Green Turtle – Central North Pacific DPS	Currently Proposed CH: Hawaiian Archipelago – all nearshore waters from the Mean High Water line to 20 m depth of Hawai'i, Maui, Kaho'olawe, Lana'i, Moloka'i, O'ahu, Kaua'i, Lalo/French Frigate Shoals, Kamole/Laysan Island, Kapou/Lisianski Island, Manawai/Pearl and Hermes Atoll, Kuaihelani/Midway Atoll, and Hōlanikū/Kure Atoll. These areas contain reproductive and benthic foraging/resting essential features Proposed CH PBFs: 1. Benthic foraging/resting feature: from the Mean High Water line to 20 m depth, underwater refugia (e.g., caves, reefs, protective outcroppings, submarine cliffs, and "potholes") and food resources (i.e., seagrass, marine algae, and/or marine invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction
Green Turtle – East Pacific DPS	Currently Proposed CH: California – from the Mexico border to and including North San Diego Bay, all nearshore areas from the Mean High Water line to 10 km offshore. These areas contain the migratory essential feature California – all nearshore areas from the Mean High Water line to 20 m depth, from and including San Diego Bay to and including Santa Monica Bay (except for the area between Oceanside and San Onofre) and surrounding Catalina Island. These areas contain benthic foraging/resting essential features Proposed CH PBFs: 1. Benthic foraging/resting feature: from the Mean High Water line to 20 m depth, underwater refugia (e.g., caves, reefs, protective outcroppings, submarine cliffs, and "potholes") and food resources (i.e., seagrass, marine algae, and/or marine

Designated or Proposed Critical Habitat	PBFs
	invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction
Green Turtle – North Atlantic DPS	Currently Designated CH: Culebra Island, Puerto Rico – waters surrounding the island of Culebra from the Mean High Water line to 5.6 km Designated CH PBFs: PBFs of green turtle critical habitat are not precisely defined; however, critical habitat was designated to provide protection for important developmental and resting/sheltering habitats Currently Proposed CH: Florida – all nearshore areas from the Mean High Water line to 20 m depth. These areas contain reproductive, migratory, benthic foraging/resting, and surface-pelagic foraging/resting essential features Texas – from the Mexico border to and including Galveston Bay, all nearshore areas from the Mean High Water line to 20 m depth. These areas contain benthic foraging/resting essential features North Carolina – from the South Carolina border to but not including Albemarle and Currituck Sounds, all nearshore areas from the Mean High Water line to 20 m depth. These areas contain benthic foraging/resting essential features Gulf of America and Atlantic Ocean – in the Gulf of America, surface-pelagic areas from 10 m depth to the outer boundary of the U.S. Exclusive Economic Zone (EEZ). In the Atlantic Ocean, surface-pelagic areas from 10 m depth to the outer boundary of the U.S. EEZ, with the exception of areas north of Cape Canaveral, where the nearshore boundary follows the edge of the Gulf Stream. These areas contain surface-pelagic foraging/resting essential features Proposed CH PBFs: 1. Reproductive feature: sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by the U.S. Fish and Wildlife Service, to allow for the transit, mating, and interesting of reproductive individuals, and the transit of post-hatchlings 2. Migratory feature: from the Mean High Water line to 20 m depth, sufficiently unobstructed waters that allow for unrestricted transit of reproductive individuals between benthic foraging/resting and reproductive areas

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Designated or Proposed Critical Habitat	PBFs
	3. Benthic foraging/resting feature: from the Mean High Water line to 20 m depth, underwater refugia (e.g., caves, reefs, protective outcroppings, submarine cliffs, and "potholes") and food resources (i.e., seagrass, marine algae, and/or marine invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction 4. Surface-pelagic foraging/resting feature: convergence zones, frontal zones, surface-water downwelling areas, the margins of major boundary currents, and other areas that result in concentrated components of the *Sargassum*-dominated drift community, as well as the currents which carry turtles to *Sargassum*-dominated drift communities, which provide sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles, and which are located in sufficient water depth (at least 10 m) to ensure offshore transport via ocean currents to areas which meet forage and refugia requirements
Green Turtle – South Atlantic DPS	Currently Proposed CH: St. Croix, St. Thomas, and St. John – nearshore waters from the mean high water line to 20 m depth. St. Croix nearshore waters contain reproductive and benthic foraging/resting essential features. St. Thomas and St. John nearshore waters contain benthic foraging/resting essential features Proposed CH PBFs: 1. Reproductive feature: sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by the U.S. Fish and Wildlife Service, to allow for the transit, mating, and interesting of reproductive individuals, and the transit of post-hatchlings 2. Benthic foraging/resting feature: from the Mean High Water line to 20 m depth, underwater refugia (e.g., caves, reefs, protective outcroppings, submarine cliffs, and "potholes") and food resources (i.e., seagrass, marine algae, and/or marine invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction
Rice's Whale	Currently Proposed CH:

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Designated or Proposed Critical Habitat	PBFs
	Gulf of America – continental shelf and slope associated waters between the 100-m isobaths to the 400-m isobath Proposed CH PBFs: 1. Sufficient density, quality, abundance, and accessibility of small demersal and vertically migrating prey species, including scombriformes, stomiiformes, myctophiformes, and myopsida 2. Marine water with (i) elevated productivity, (ii) bottom temperatures of 10–19°C, and (iii) levels of pollutants that do not preclude or inhibit any demographic function 3. Sufficiently quiet conditions for normal use and occupancy, including intraspecific communication, navigation, and detection or prey, predators, and other threats

CH = critical habitat; PBFs = physical or biological features; DPS = distinct population segment
-- The action will have no effect on PBFs

4.1 May Affect, Not Likely to Adversely Affect

Once we have determined the action may affect ESA-listed or proposed species or their designated or proposed critical habitat, the next step is differentiating between stressors that are NLAA and LAA for each listed species and critical habitat in the action area. An action warrants a NLAA finding when its effects are completely beneficial, discountable, or insignificant. Completely beneficial effects have an immediate positive effect without any adverse effects to the species or habitat. Completely beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected, albeit positively. Discountable effects are those that could occur while an ESA-listed species is in the action area but, because of the intensity, magnitude, frequency, duration, or timing of the stressor, exposure to the stressor is extremely unlikely to occur. Insignificant effects relate to the response of exposed individuals where the response, in terms of an individual's growth, survival, or reproduction, would be immeasurable or undetectable, or an impact to the conservation value of a PBF would be immeasurable or undetectable. For stressors that meet these criteria for completely beneficial, discountable, or insignificant, the appropriate conclusion is NLAA.

To assist in reaching a determination, we perform a two-step assessment that considers all of the stressors identified in Section 2.4 of this opinion and all of the species and critical habitats identified in Table 1 to understand the likelihood of the stressors having an effect on the ESA-listed or proposed species or their designated or proposed critical habitat. First, we consider whether it is likely that a listed species or critical habitat is exposed to a stressor or there is a reasonable expectation of the stressor and an individual or habitat co-occurring. If we conclude that exposure of a species or critical habitat to a stressor caused by the proposed action or activity is discountable, we must also conclude it is NLAA. However, if exposure is probable, the second step is to evaluate the probability of a response to the stressor. When all stressors of

an action are found to be NLAA for a listed species or a critical habitat, we conclude informal consultation for that species or critical habitat. Likewise, if a stressor associated with this action is found to be NLAA for all listed species and all critical habitats, there is no need to continue analyzing the consequences of that stressor in the Analysis of Effects. Where the negative effects to any species or critical habitat or from any stressor to those species or critical habitat are found to exceed the standards of insignificant or discountable, we must analyze those consequences in the Analysis of Effects.

4.1.1 Stressors Not Likely to Adversely Affect Species or Critical Habitat

This section identifies the stressors that are NLAA for every ESA-listed species and their designated or proposed critical habitat in the action area and will not be analyzed further in this opinion.

4.1.1.1 Sonic Booms and Impulse Noise Generated During Launches and Landings

Sonic booms generated by Super Heavy and Starship landings are expected to be a maximum of 21 and 4 psf, respectively. A recent study also recorded a sonic boom of less than 1 psf from the interstage landing (Gee et al. 2024). An overpressure of 1 psf is similar to a thunderclap. Boom intensity, in terms of psf, is greatest under the flight path and progressively weakens with horizontal distance away from the flight path. Acoustic energy in the air does not effectively cross the air-water boundary and most of the sound energy is reflected off the water's surface (Richardson et al. 1995). Previous research conducted by the U.S. Air Force determined that a peak pressure of 12 pounds per square inch (psi) in the water would be needed to meet the acoustic threshold at which harassment of marine mammals and sea turtles may occur from impulsive sound. Rather than responding primarily to sound pressure, invertebrates mainly detect particle motion and can sense local water movements (Solé et al. 2023). This detection is limited, as particle motion diminishes rapidly with distance from the sound source, making the impact of noise on invertebrates likely less than the impact on marine mammals and sea turtles. ESA-listed fishes have a slightly lower acoustic threshold for harassment than marine mammals and sea turtles (FHWG 2008); however, to produce even 12 psi in water, a surface (in-air) pressure of approximately 900 psf is needed. The researchers also note that a sonic boom of 50 psf at the ocean surface is rare (U.S. Air Force Research Laboratory 2000). Thus, it would take a much greater sonic boom than will be generated by either Super Heavy or Starship to create an acoustic impact underwater that could cause a measurable response in ESA-listed species exposed to the noise.

Impulse noise from vehicle launches and landings may affect ESA-listed species' hearing underwater. Noise from a launch is unlikely to effectively cross the air-water boundary, as previously discussed. The likelihood that an animal occurs at the same time and place as a Super Heavy or Starship landing, and would be exposed to sound generated by the landing, is expected to be extremely unlikely given relatively low species densities, large areas over which either vehicle may be expended, and the short duration (only a few seconds) of landings. Therefore, any effect from the sonic booms or impulse noise on ESA-listed species while underwater would be insignificant or discountable.

ESA-listed marine mammals and sea turtles in the action area could be exposed to the overpressures from sonic booms and impulse noise in the air when they are surfacing to breathe. However, the chance of both events happening at the same time (i.e., an animal surfacing and a sonic boom/impulse noise occurring) is extremely low, considering the duration of the sonic boom is less than 1 second (less than 300 milliseconds) and the duration of an ocean landing is less than 1 minute. ESA-listed marine mammals and sea turtles may be exposed to in-air noise from launches, which lasts approximately 3 minutes (FAA 2024a). However, marine mammals and sea turtles typically surface for only a few seconds. Therefore, any effect from the sonic booms or impulse noise on ESA-listed marine mammals and sea turtles at the surface of the water would be discountable because exposure of these animals to the stressor is extremely unlikely to occur.

Given the low overpressures and short duration of the sonic booms or impulse noise described above, effects to designated or proposed critical habitat with acoustic-related PBFs (Rice's whale, see Table 2), will be so small as to be immeasurable. Therefore, effects from sonic booms or impulse noise to designated or proposed critical habitat is insignificant.

In summary, the potential effects to ESA-listed species from sonic booms and impulse noise are discountable or insignificant. The potential effects to designated and proposed critical habitat from sonic booms and impulse noise are insignificant. We conclude that impacts from sonic booms and impulse noise to ESA-listed species and designated or proposed critical habitat in the action area because of activities covered under this consultation may affect, but are not likely to adversely affect, ESA-listed species or their designated or proposed critical habitat.

4.1.1.2 Direct Impact by Fallen Objects

Radiosondes, Super Heavy, Starship, and associated debris (with a Super Heavy or Starship in-flight breakup, impact breakup, or mishap) falling and landing in the Gulf, Atlantic Ocean, Indian Ocean, Hawaii and Central North Pacific, Northeast and Tropical Pacific, and South Pacific portions of the action area, and estimated mishap area, have the potential to affect ESA-listed species. The primary concern is direct impact from these objects striking an ESA-listed species. An object striking an ESA-listed species may result in injury or mortality to the individuals struck.

Super Heavy Version 3 and Starship Version 3 are still extremely small relative to the in-water area in which either vehicle could land (see Figures 1–5) and relative to the area over which species are distributed in the Gulf of Mexico (non-U.S. waters), Gulf of America, Atlantic, Indian, North Pacific, and South Pacific oceans. The likelihood that a vehicle strikes an ESA-listed species can be estimated by multiplying the species density by the area of the vehicle. Super Heavy Version 3 measures approximately 263 ft (80 m) by 30 ft (9 m), is larger than Starship, and has an area of approximately 7,890 square feet (ft^2; 720 square meters [m^2]) or 0.000283 square miles (mi^2; 0.00072 square kilometer [km^2]). Because NMFS estimates that the probability a vehicle will land in a specific location within a portion of the action area is equal across that portion, and each portion, of the action area (based on the best available information), we used the highest monthly mean species density across all portions of the action area as a proxy for all species considered in this consultation. The highest monthly mean species density is

0.834 Northwest Atlantic Ocean DPS loggerhead turtles per km^2, which occurs in an extremely small area of the Gulf portion of the action area. The species density, 0.834 individuals per km^2, multiplied by the vehicle area, 0.00072 km^2, results in an extremely small number of individuals that may be exposed to a direct impact from a falling object (0.0006).

There may be up to 25 soft water landings of each vehicle, and 20 landings with explosive events of each vehicle. It is extremely unlikely both vehicles would land in the same exact place (i.e., it is extremely unlikely that both would land in the small area where loggerhead turtle densities are highest). However, without information on landing locations of either vehicle, we estimate the likelihood of 90 total landings hitting an ESA-listed species by multiplying the total number of landings by 0.0006 individuals. This results in an estimated 0.05 individuals exposed to direct impact by falling objects over the period covered by this opinion. Thus, the likelihood that an ESA-listed species will be in the exact location at the exact same time that a Super Heavy or Starship landing occurs is extremely unlikely, and thus, discountable. Debris pieces from an in-flight breakup, impact breakup (for which debris is expected to be contained within 0.6 mi [1 km] of the landing location), or mishap of either stage will be smaller than the stage itself. Radiosondes are also much smaller than either stage. Thus, the likelihood of debris or a radiosonde striking an ESA-listed species will be even smaller than that of Super Heavy or Starship striking an ESA-listed species.

The likelihood of the interstage striking an ESA-listed species is the same as what was considered in OPR-2024-02422 (pages 14–16) because there are no proposed changes to interstage activities considered in that consultation. Using the same methodology as above, NMFS determined it is extremely unlikely an ESA-listed species will be directly struck by the interstage as it falls to the sea surface or by debris from its impact with the sea surface based on the interstage landing location, number of interstage landings, and species densities (NMFS 2024b).

Falling debris from a mishap may affect ESA-listed corals if debris sinks and lands directly on a coral. New information indicates that Starship debris from Flight 7 (debris around the Turks and Caicos Islands) and Flight 8 (debris around The Bahamas) mishaps occurred within the species ranges of ESA-listed corals. Current best available information suggests that coral distribution in the Bahamas and Turks and Caicos region is relatively sparse (Chollett et al. 2022; NMFS 2022a; Schill et al. 2021). Using The Nature Conservancy's Caribbean Reef Explorer tool and data (Chollett et al. 2022; Schill et al. 2021), we calculated the coral reef area within the best-estimated Flight 7 and Flight 8 expected debris areas, as provided by SpaceX. Coral reefs made up approximately 1.5% and 2.9% of the Flight 7 and Flight 8 expected debris areas, respectively. Further, the Flight 7 and Flight 8 expected debris areas overlapped with less than 1% of all Caribbean coral reef areas. Given the small proportion of coral reefs within the expected debris areas, and that debris from a mishap is expected to be spread out and not concentrated in a specific area, the likelihood that debris from a mishap directly strikes an ESA-listed coral is extremely unlikely.

Falling objects may affect the following designated or proposed critical habitat present in areas where falling objects may occur: North Atlantic right whale, hawksbill turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, Nassau grouper, boulder star coral, elkhorn coral, lobed star

coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, North Atlantic DPS and South Atlantic DPS of green turtle, and Rice's whale (Table 2).

Falling objects may affect PBFs related to the availability of benthic substrate or refugia (e.g., caves, boulders), because a direct impact may reduce the availability of that habitat feature, which applies to: hawksbill turtle, Northwest Atlantic Ocean DPS of loggerhead turtle *Sargassum* habitat, Nassau grouper, corals, and North Atlantic DPS and South Atlantic DPS of green turtle (benthic foraging/resting feature and surface-pelagic foraging/resting feature). Super Heavy and Starship are relatively small (hundreds of square meters) compared to the critical habitats for the Northwest Atlantic Ocean DPS loggerhead turtle and North Atlantic DPS green turtle (thousands to hundreds of thousands of square kilometers). If a Super Heavy and Starship landing results in debris, the debris pieces will be smaller than either vehicle. For hawksbill turtle, Nassau grouper, and coral critical habitat, falling objects are only expected to occur if there is a mishap. In that case, the objects would be widely dispersed and scattered within an area much larger than the critical habitat area, given the high altitude at which the mishap occurs. Thus, the likelihood that falling objects directly impact benthic substrate and refugia/cover would be extremely unlikely.

Falling objects may also disturb the sea surface as they impact the ocean, and disturb the seafloor as they settle, and affect PBFs related to calm conditions and water quality (sediment), which apply to the North Atlantic right whale and corals. Objects that are affecting the ocean surface are temporary, with the moment of impact lasting only seconds, and would not result in sea surface conditions more than Force 4 on the Beaufort Wind Scale for more than the duration of the actual impact. Sediment may be suspended by objects falling and hitting the seafloor, and affect water quality and the amount of sediment on top of corals. However, if debris impacts the seafloor in proximity to corals, the sediment would only be displaced temporarily, affecting water quality, but would settle after the debris stops moving; thus, water quality conditions would return to normal. It is extremely unlikely that the displaced sediment would completely cover the coral habitat because of the estimated location of debris (see above paragraph on falling debris from a mishap), and because sediment suspended in the water column will be dispersed by currents and water movement. Thus, effects of falling objects on surface conditions and water quality would be so small as to be immeasurable and, therefore, insignificant.

Falling objects may also temporarily displace prey species as they sink through the water column and temporarily affect PBFs related to prey availability as prey move away from the object (hawksbill turtle, Northwest Atlantic Ocean DPS of loggerhead turtle foraging habitat and *Sargassum* habitat, Nassau grouper, North Atlantic DPS and South Atlantic DPS of green turtle proposed benthic foraging/resting feature and surface-pelagic foraging/resting feature, and Rice's whale). However, the temporary sinking of debris or vehicles is not expected to affect the overall density, abundance, availability, or accessibility of prey in a manner that would measurably affect prey populations. Thus, the effect from falling objects on critical habitat would be insignificant.

In summary, the potential effects to ESA-listed species from a direct impact by falling objects are discountable. The potential effects to designated and proposed critical habitat from falling objects are discountable or insignificant. We conclude that direct impacts from falling objects to

ESA-listed species and designated or proposed critical habitat in the action area because of activities covered under this consultation may affect, but are not likely to adversely affect, ESA-listed species and designated or proposed critical habitat.

4.1.1.3 Impacts from Unrecovered Debris

Unrecovered debris (from Super Heavy, Starship, weather balloons, and radiosondes) may affect ESA-listed species and their designated or proposed critical habitat.

Based on new available information from SpaceX (K. Tice, SpaceX, pers. comm. to E. Chou, NOAA Fisheries Office of Protected Resources, August 4, 2025), debris from Starship or Super Heavy could include stainless steel, thermal (heat) tiles and matting (Starship), Composite Overwrapped Pressure Vessels (COPVs), cork, plastic, and adhesive. Stainless steel fragments are expected to sink due to their density. While it is possible that a stainless steel sheet may float under certain sea conditions, it is likely to eventually sink due to wave action. Thermal tiles are only part of Starship and not Super Heavy. Thermal tiles and matting are made of silica and are expected to float. A U.S. Environmental Protection Agency Hazardous Waste Test Method (SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure) was conducted on the thermal tiles and matting. The test found no risk of toxic substances leaching into the marine environment. COPVs are cylindrical structures that consist of a composite material wrapped around a metallic liner. COPVs are filled with inert gas and will most likely float if they do not become waterlogged. Cork is used as an insulator and is buoyant. Thus, if not fully incinerated during a mishap or breakup, it will float. Plastic is likely to be incinerated by heat generated during a mishap or breakup, but it is possible for some plastic to survive to reach the ocean. The adhesive used throughout the vehicle is a silicone-based sealant which, when cured, has the texture and density of rubber. If the adhesive is not incinerated along with the component it is sealed to, it will likely float.

NMFS is aware that debris was generated during the mishaps and anomalies of Flights 7, 8 (for which we received debris information), and 9 that were likely not recovered. Debris from the Flight 8 Starship mishap near the Bahamas included a washed up COPV, intact thermal tiles, and approximately 10 trash bags and 250 lbs (113.4 kg) of small fragmented debris, a majority of which were likely thermal tiles and matting (K. Tice, SpaceX, pers. comm. to E. Chou, NOAA Fisheries Office of Protected Resources, August 5, 2025). Most debris were approximately one inch (in; 2.54 centimeters [cm]) in diameter and some pieces were 6 in (15.24 cm) in diameter. No large or metallic debris were recovered. It is not clear from SpaceX what the characteristics were of the debris that sank, but it is expected that the debris would consist of heavyweight composite or metallic pieces. Debris from the Flight 9 Super Heavy anomaly traveled approximately 18.6–19.3 mi or 30–31 km before washing ashore on Mexico's beaches. It is not yet clear from SpaceX what types of debris were confirmed to have originated from Super Heavy.

Unrecovered debris may be ingested by ESA-listed species foraging in the action areas. Nearly all ingested debris is plastic (Alzugaray et al. 2020; de Carvalho et al. 2015; Im et al. 2020; Jacobsen et al. 2010; Rodriguez et al. 2022; Rosel et al. 2021; Schuyler et al. 2014a; Werth et al. 2024; Wilcox et al. 2018). In a recent global review on ingested marine debris, a majority of

mortalities in marine mammals were caused by ingestion of film-like plastic (e.g., plastic bags), plastic fragments (hardness not specified), rope/nets, and fishing debris (Roman et al. 2021). For sea turtles, a majority of mortalities were caused by ingestion of hard plastic, film-like plastic, and fishing debris (Roman et al. 2021). Plastics are also the main type of debris ingested by fishes (Cliff et al. 2002; Germanov et al. 2018).

Given the lack of detailed information on Starship and Super Heavy debris, and in particular what types of floating debris survived the Flight 7, 8, and 9 mishaps and anomalies, it is difficult to assess the impacts of unrecovered debris on ESA-listed species in a robust way. However, based on the aforementioned studies on debris ingestion, it appears unlikely that ESA-listed species would ingest the following Starship and/or Super Heavy debris types: stainless steel, thermal tiles and matting, and COPVs. Cork, plastic, and adhesive would likely float if not destroyed during a mishap, anomaly, or in-flight breakup (i.e., an explosion). Given that plastic is flammable, it is likely that any plastic on Starship or Super Heavy would be incinerated during a mishap or anomaly, and would not survive to the ocean. Cork is a well-known insulation material, especially for thermal insulation, and studies show that cork and composite cork have relatively low flammability and may be useful in fire retardants and thermal protection (Bahrani and Hashempour 2020; Benhalima and Dehane 2020; Piperopoulos et al. 2025; Zhai et al. 2020). However, SpaceX expects that a majority of cork is expected to be fully consumed (i.e., destroyed) during an explosion (K. Tice, SpaceX, pers. comm. to E. Chou, NOAA Fisheries Office of Protected Resources, August 4, 2025). Absent expert knowledge about cork and the specific cork that is used on Starship-Super Heavy, NMFS has reviewed and adopts the analysis provided by SpaceX of how cork on the launch vehicle is expected to behave during an explosion. SpaceX also expects that most adhesive, while on its own might float, would be destroyed along with whatever material it was sealed to.

We do not expect debris to travel beyond the ocean areas already considered in this consultation. For larger open ocean basins such as the Atlantic, Indian, and Pacific Oceans, it is difficult to determine with any degree of certainty where floating debris may travel, outside of the action area already considered in this consultation. If floating debris were to travel outside of the action area, it is reasonable to expect that debris would be widely dispersed over time by surface winds and currents. Floating debris may enter "garbage patches" (e.g., the Great Pacific garbage patch) formed by gyres, such as the East Pacific gyre, North Atlantic gyre, or Indian Ocean gyre. However, it is not likely that Starship or Super Heavy debris will contribute significantly to these garbage patches, given that they are already hundreds to millions of square kilometers in size (e.g., Leal Filho et al. 2021). It is unlikely, given the large expanse of ocean, distribution over which ESA-listed species may occur and be foraging in those areas, and relatively small addition Starship and Super Heavy debris to the overall debris in the ocean, that ESA-listed species would encounter a piece of Starship or Super Heavy debris and ingest it. Debris may be transported throughout the Gulf of America, Gulf of Mexico (non-U.S. waters), and up the U.S. Atlantic coast by the Loop Current. As such, floating debris is likely to be dispersed throughout the Gulf or dispersed off the U.S. Atlantic, where, as previously mentioned, Starship or Super Heavy debris is expected to become widely dispersed, and would not occur in high concentrations. Thus, we consider it extremely unlikely that meaningful amounts of debris would travel beyond the areas already considered in this consultation. Therefore, it is extremely unlikely, and, therefore, discountable, that radiosondes, Super Heavy, Starship, and interstage debris, the

majority of which are heavy-weight metals or composite materials like carbon fiber that will sink immediately due to their weight, would be ingested by ESA-listed species.

Latex weather balloons undergo "brittle fracture" at altitude, where the rubber shatters along grain boundaries of crystallized segments and the balloon bursts. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989; Cullis et al. 2017). As these small strands descend through the air and back to the ocean, their distribution is influenced by changes in atmospheric pressure and wind, which disperses the strands before they land on the surface of the ocean where they are further dispersed due to surface currents and wind. These latex fragments float on the surface of the water and start to degrade, eventually sinking due to the weight from biofouling (Burchette 1989; Foley 1990; Thompson et al. 2004). Out of 12 categories of ingested marine debris, balloons/latex were one of the least common types of ingested debris, and were recorded in fewer than 10 sea turtles compared to the largest category, film-like plastic, which was recorded in over 300 sea turtles (Roman et al. 2021). Given the small balloon shreds from the use of weather balloons as part of the proposed action are likely to be scattered and not concentrated, and they should only be available in the upper portions of the water column on the order of weeks, the potential for exposure of ESA-listed species to these shreds is extremely low and, therefore, discountable.

Unrecovered debris may also affect PBFs related to water/passage obstruction and water depth: Northwest Atlantic Ocean DPS of loggerhead turtle constricted migratory habitat and *Sargassum* habitat, Carolina DPS and South Atlantic DPS of Atlantic sturgeon, Gulf sturgeon, and North Atlantic DPS of green turtle reproductive feature, migratory feature, and surface-pelagic foraging/resting feature of proposed critical habitat (Table 2). Unrecovered debris (sunk or floating debris) could create obstructions to waterways, or affect water depth if they land in shallow areas where the size of the debris blocks the water column. Based on the available information from FAA and SpaceX, Super Heavy and Starship may land intact and sink in a horizontal orientation (unless the vehicle landing results in debris, in which case, the debris pieces would be smaller than either Super Heavy or Starship). When Super Heavy and Starship are horizontal, the maximum height is 30 ft (9 m). Thus, the vehicles could obstruct areas or affect water depth in areas 30 ft (9 m) or shallower. Unrecovered floating debris, for example, COPVs, could obstruct access to specific habitats like upstream spawning habitats. However, this would be a temporary impact because an obstruction of a waterway is a clear navigational hazard (and would likely be a navigational hazard even if a portion of the water column was blocked by debris), and SpaceX would be required to remove any debris. Thus, the effects would be temporary and geographically constrained, not expected to impact the habitat suitability of critical habitat in the long term, and would be too small to measure and, thus, insignificant.

In summary, the potential effects to ESA-listed species from unrecovered debris are discountable. The potential effects to designated critical habitat from unrecovered debris are insignificant. We conclude that impacts from unrecovered debris to ESA-listed species and designated critical habitat in the action area because of activities covered under this consultation may affect, but are not likely to adversely affect ESA-listed species and their designated or proposed critical habitat.

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4.1.1.4 Impacts from Pollution

Pollution such as vessel pollutants and the launch vehicle propellant and emissions may affect ESA-listed species and their designated or proposed critical habitat.

Pollutants emitted by vessels used during Starship-Super Heavy surveillance or recovery operations can include exhaust (carbon dioxide, nitrogen oxides, and sulfur oxides), and fuel or oil spills or leaks. These pollutants may affect air-breathing ESA-listed species such as marine mammals and sea turtles. Although vessels may transit through areas where ESA-listed species are expected to occur in higher numbers or densities (e.g., close to shore, critical habitat), it is unlikely that pollutants in the air would have a measurable impact on ESA-listed marine mammals or sea turtles given the relatively short duration of vessel operations (approximately five days for each launch with a recovery), dispersion of pollutants in the air, and the brief amount of time that marine mammals and sea turtles spend at the water's surface to breathe. Thus, the effects of pollutants in the water on ESA-listed species due to the proposed action will be so small as to be immeasurable. Therefore, the effects to ESA-listed species from pollutants from vessel activities are insignificant.

Emissions from launching and landing each stage include nitrogen oxides, carbon monoxide, and other greenhouse gases (FAA 2024a). Stages and payloads (such as satellites launched via Starship) that burn up upon reentry also release vaporized metal particles. Recently, researchers have studied how these emissions and particles associated with rocket launches and reentries can lead to ozone depletion and cause detrimental effects to climate and ecosystems (Dallas et al. 2020; Ferreira et al. 2024; Kokkinakis and Drikakis 2022; Maloney et al. 2022; Murphy et al. 2023; Ross et al. 2004; Ryan et al. 2022). This may affect ESA-listed species because climate can drive range and distribution shifts in ESA-listed species and their prey (Record et al. 2019a). For a given 25 Starship-Super Heavy launches (and associated operations) from the Boca Chica Launch Site, an estimated 107,301 t (97,342 MT) of carbon dioxide equivalent is expected per year (FAA 2024a). Twenty-five launches is approximately one-sixth of the maximum number of launches expected annually, and the estimated amount of carbon dioxide equivalent is less than approximately two hundred-thousandths (0.00002) of the annual carbon dioxide equivalent emission rate of the United States (FAA 2024a). We currently do not have sufficient information on the magnitude of activities that will be caused by the action (e.g., satellites reentering and burning up in the atmosphere; see Section 2.3) to determine whether effects to ESA-listed species will be more than insignificant. At present, the effects to ESA-listed species from launch and reentry activities of Starship-Super Heavy are immeasurable and thus insignificant, as well as being extremely small compared to the global level of greenhouse gas emissions.

Residual propellant (LOX and LCH_4) may remain on Super Heavy and Starship (82 t [74 MT] and 111 t [101 MT], respectively). During Starship-Super Heavy Flight 3 and Flight 4, SpaceX verified the amount of residual propellant in each vehicle: Flight 3 Super Heavy contained 104 t (94 MT) of residual propellant and Starship contained 62 t (56 MT) of residual propellant; and Flight 4 Super Heavy contained 49 t (44 MT) of residual propellant and Starship contained 13 t (12 MT) of residual propellant (K. Condell, SpaceX, pers. comm. to E. Chou, NMFS OPR, October 18, 2024). SpaceX noted that both Super Heavy and Starship did not complete the planned flights during Flight 3, and, therefore, had higher estimated residual propellant than if

the flights were completed (such as during Flight 4); thus, the estimated residual propellant is a conservative estimate. Propellant amounts for subsequent flights were not provided. LOX and LCH_4 are not hazardous and will be vented to the atmosphere following landing of either vehicle (FAA 2024). ESA-listed species that surface to breathe (marine mammals and sea turtles) could be exposed to the vented residual propellant. Given the limited number of times either stage will be expended (and residual propellant would be vented), dispersion of vented propellant due to weather conditions such as wind, and limited amount of time ESA-listed marine mammals and sea turtles spend at the surface to breathe, ESA-listed species are extremely unlikely to be exposed to residual propellant in the air, meaning the effects of this stressor are discountable.

In the event that Super Heavy or Starship residual propellant ends up in the ocean, residual propellant is expected to evaporate or be diluted relatively quickly due to surface currents and ocean mixing. It is unlikely that residual propellant from either vehicle measurably contributes to the overall pollutant levels in the action area given the limited number of times either stage will be expended (and residual propellant would reach the ocean), and the large action area. The effects of residual propellant in the ocean on ESA-listed species are immeasurable and, thus, insignificant.

Vessel pollution may affect designated or proposed critical habitats that have PBFs related to water quality, including those of the Main Hawaiian Islands Insular DPS of false killer whale, Gulf sturgeon, black abalone, and Rice's whale. Pollutants from vehicles may also affect the water quality PBF of Rice's whale proposed critical habitat (Table 2). As previously discussed, pollutants are expected to evaporate and quickly become diluted, limiting any impacts to a temporary duration. Given the limited use of vessels and brief exposure to pollutants, the effect of pollution on water quality PBFs will be so small as to be immeasurable. Thus, the effects of pollution on water quality-related PBFs of designated or proposed critical habitat are insignificant.

In summary, the potential effects to ESA-listed species from pollution are discountable or insignificant. The potential effects to designated and proposed critical habitat from pollution are insignificant. We conclude that impacts from pollution to ESA-listed species and designated or proposed critical habitat in the action area because of activities covered under this consultation may affect, but are not likely to adversely affect ESA-listed species and their designated or proposed critical habitat.

4.1.1.5 Vessel Presence, Strike, and Noise

ESA-listed species may be affected by vessel transit and operations in all portions of the action area (except the Indian Ocean) during the proposed action. Vessel presence may disturb animals, vessel strike may result in injury or mortality, and vessel noise may cause disturbance because of elevated noise levels. The duration of vessel operations lasts approximately five days for each launch with a recovery. Vessel operations only apply to pre-launch surveillance and post-launch recovery (i.e., vessels are not active the entire day). The proposed action has a limited amount of vessel activity, especially compared to the amount of recreational and commercial vessel traffic across the action area. Given the relatively small contribution of the vessels associated with the

proposed action to the overall vessel activity, effects from vessel presence are expected to be so minor that they cannot be meaningfully evaluated and are thus insignificant.

The potential for a vessel striking an ESA-listed species is unlikely because the proposed action consists of relatively little vessel use. Furthermore, ESA-listed marine mammals, sea turtles, and fish may spend time at or near the ocean surface but generally spend most of their time underwater where they would not be exposed to vessel strikes. A vessel grounding in an area where corals, black abalone, or the proposed sunflower sea star occur would be extremely unlikely because there is no planned vessel activity in coral reef areas, and because a vessel grounding has not occurred during any vessel activities related to the proposed action thus far. Implementation of the conservation measures listed in Section 2.2 further reduce the potential for vessel strike. Given vessel strike avoidance measures, vessel speed restrictions when the vessel is in proximity to certain ESA-listed species, presence of dedicated observers monitoring for ESA-listed species, and additional measures such as compliance with vessel speed rules for critically endangered species (North Atlantic right whale), vessel strikes are considered extremely unlikely to occur. Therefore, ESA-listed species' exposure to vessel strike is discountable.

Noise from vessels may produce an acoustic disturbance or otherwise affect ESA-listed species that spend time near the surface, such as marine mammals, sea turtles, and pelagic fishes, which may generally disrupt their behavior. Studies have shown that vessel operation can result in changes in the behavior of marine mammals, sea turtles, and fishes (Hazel et al. 2007b; Holt et al. 2009; Luksenburg and Parsons 2009; Noren et al. 2009; Patenaude et al. 2002a; Richter et al. 2003b; Smultea et al. 2008a). However, vessel noise will not exceed that of larger commercial shipping vessels and will only be temporary (approximately five days for each launch with a recovery, and only used for pre-launch surveillance and post-launch recovery) compared to the constant presence of commercial vessels. Additionally, while not specifically designed to do so, several aspects of the conservation measures will minimize effects associated with vessel acoustic disturbance to ESA-listed species (e.g., maintaining distance from protected species, slowing to 10 kt or less around certain species and in specific areas; see Section 2.2). Given the conservation measures and the relatively small contribution of the vessels associated with the proposed action to the overall soundscape, effects from vessel noise are expected to be so minor that they cannot be meaningfully evaluated and are thus insignificant.

Vessel presence may affect designated or proposed critical habitat with prey-related PBFs, including critical habitat for the Main Hawaiian Islands Insular DPS of false killer whale, Central America DPS and Mexico DPS of humpback whale, Hawaiian monk seal, leatherback turtle, Northwest Atlantic DPS of loggerhead turtle foraging habitat and *Sargassum* habitat, Gulf sturgeon, and proposed Central North Pacific DPS, East Pacific DPS, and North Atlantic DPS of green turtle (benthic foraging/resting feature and surface-pelagic foraging/resting feature), and Rice's whale (Table 2). Vessels may temporarily displace prey for the duration of the vessel transit through an area. However, limited and temporary vessel use is not expected to measurably affect the distribution, density, quantity, quality, or availability of prey. Therefore, effects from vessels to designated or proposed critical habitat are insignificant.

Given the limited use and low sound levels of vessel operations described above, effects to designated or proposed critical habitat with acoustic-related PBFs (Main Hawaiian Islands

Insular DPS of false killer whale and Rice's whale, see Table 2) will be so small as to be immeasurable.

Vessel noise may also affect the available space for movement and use within shelf and slope habitat for the Main Hawaiian Islands Insular DPS of false killer whale. In the final rule designating Main Hawaiian Islands Insular DPS of false killer whale critical habitat, long-term acoustic disturbance was identified as an obstacle to whale movement. However, given the limited use and temporary duration of vessel operations, the contribution of vessel noise due to the proposed action compared to the overall soundscape will be so small as to be immeasurable and, thus, insignificant.

In summary, the potential effects to ESA-listed species from vessel presence, strike and noise are discountable or insignificant. The potential effects to designated and proposed critical habitat from vessel presence and noise are insignificant. We conclude that impacts from vessel presence, strike and noise to ESA-listed species and designated or proposed critical habitat in the action area because of activities covered under this consultation may affect, but are not likely to adversely affect ESA-listed species and their designated or proposed critical habitat.

4.1.1.6 Aircraft Overflight

Noise from aircraft overflight may enter the water, but, as stated in relation to sonic booms and impulse noise, very little of that sound is transmitted into water. Sound intensity produced at high altitudes is reduced when it reaches the water's surface. At lower altitudes, the perceived noise will be louder, but it will decrease rapidly as the aircraft moves away. ESA-listed species that occur at or very near the surface (e.g., marine mammals, sea turtles, and fish) at the time of an overflight could be exposed to some level of elevated sound. There could also be a visual stimulus from the overflight that could potentially lead to behavioral response. Both noise and visual stimulus impacts would be temporary and only occur if an individual is surfacing or very close to the surface at the same time an aircraft is flying over.

Studies have shown minor behavioral effects (e.g., longer time to first vocalization, abrupt dives, shorter surfacing periods, breaching, tail slaps) in marine mammals exposed to repeated fixed wing aircraft overflights (Patenaude et al. 2002b; Richter et al. 2003a; Smultea et al. 2008b; Würsig et al. 1998). However, most of these responses occurred when the aircraft was below altitudes of approximately 250 m, which is lower than the altitude to be flown by aircraft during surveillance for the activities considered in this consultation. Species-specific studies on the reaction of sea turtles to fixed wing aircraft overflight are lacking. Based on sea turtle sensory biology (Bartol and Musick 2002), sound from low-flying aircraft could likely be heard by a sea turtle at or near the ocean surface. Sea turtles might be able to detect low-flying aircraft via visual cues such as the aircraft's shadow, similar to the findings of Hazel et al. (2007a) regarding watercraft, potentially eliciting a brief reaction such as a dive or lateral movement. However, considering that sea turtles spend a significant portion of their time underwater and the low frequency and short duration of surveillance flights, the probability of exposing an individual to an acoustically or visually-induced stressor from aircraft momentarily flying overhead would be very low. The same is relevant for ESA-listed fishes in the action area, considering their limited time near the surface and brief aircraft overflight.

Given the temporary use and limited amount of acoustic energy that enters the water from aircraft activities described above, effects to designated or proposed critical habitat with acoustic-related PBFs (Main Hawaiian Islands Insular DPS of false killer whale and Rice's whale, see Table 2) will be so small as to be immeasurable and are therefore insignificant.

Given the limited and temporary behavioral responses documented in available research, the potential effects to ESA-listed species from aircraft overflight are insignificant. The potential effects to designated and proposed critical habitat from aircraft overflight are insignificant. We conclude that impacts from aircraft overflight to ESA-listed species and designated or proposed critical habitat in the action area because of activities covered under this consultation may affect, but are not likely to adversely affect ESA-listed species and their designated or proposed critical habitat.

4.1.1.7 In-Air Acoustic Effects from Vehicle Landings and Explosive Events

ESA-listed species that surface to breathe (marine mammals and sea turtles) may be exposed to the in-air acoustic effects from a Starship or Super Heavy landing or explosive event. To be exposed to this stressor, ESA-listed marine mammals and sea turtles would have to be in the exact same place at the exact same time that Starship or Super Heavy lands, or an explosive event subsequently occurs. ESA-listed marine mammals and sea turtles spend very little time at the surface, and generally only spend a few seconds to breathe before diving back underwater. Landings, whether they result in an explosive event or not, of Starship and Super Heavy will only occur 90 times in the Gulf and Atlantic Ocean portions of the action area, and only 45 times (for Starship) in the Indian Ocean, Hawaii and Central North Pacific, Northeast and Tropical Pacific, and South Pacific portions of the action area before the launch vehicle is fully reusable. Therefore, given the limited number of landings and explosive events, and the large areas over which ESA-listed species can be distributed, it is extremely unlikely that ESA-listed species will be exposed to in-air acoustic effects from vehicle landings and explosive events and, thus, the effects are discountable.

In-air acoustic effects from vehicle landings and explosive events may affect acoustic-related PBFs of proposed critical habitat (Rice's whale, see Table 2). However, because explosive events will only occur in a small portion of Rice's whale critical habitat, and the transmission of acoustic energy across the air-water boundary is not effective, and the effects on acoustic PBFs would be so small as to be immeasurable and, thus, insignificant.

We conclude that in-air acoustic effects from vehicle landings and explosive events to ESA-listed species in the action area because of activities covered under this consultation are discountable. We also conclude that effects to proposed critical habitat from in-air acoustic effects from vehicle landings and explosive events are insignificant. Therefore, in-air acoustic effects from vehicle landings and explosive events may affect, but are not likely to adversely affect ESA-listed species or proposed critical habitat.

4.1.1.8 Vibration, Heat, and Debris from Launches

NMFS estimated a maximum of 32 launches for the remainder of 2025 (September–December), 69 launches in 2026, 145 launches in 2027, and 49 launches in 2028 (up to April 14), for the duration of the current license (see Section 2.1). During previous launches, vibration, heat, and debris were recorded impacting a radius of approximately 0.7 mi (1.1 km), 0.6 mi (1 km) and 0.3 mi (0.5 km), respectively, from the launch site (FAA 2024b). This information is limited because not all monitoring information is available, and, of the information that is available, monitoring only occurred for a handful of launches. Although FAA did not include these stressors in the 2024 Biological Assessment (ManTech SRS Technologies Inc. 2024), the estimated radius of impact extends to the ocean and may affect ESA-listed species that could occur in the immediate vicinity of the launch sites, including the additional SLC-37 launch site, in the Gulf and Atlantic Ocean portions of the action area. The addition of SLC-37 does not change the species that may be affected by launches, which includes the North Atlantic right whale, North Atlantic DPS of green turtle (Atlantic Ocean portion of the action area), Kemp's ridley turtle, leatherback turtle (Atlantic Ocean portion of the action area), Northwest Atlantic Ocean DPS of loggerhead turtle, and smalltooth sawfish (Atlantic Ocean portion of the action area).

Vibration from Starship-Super Heavy launches is likely only to affect smalltooth sawfish because fish are especially able to detect particle motion. Vibration monitoring of previous launches only occurred on land, but determined that a majority of the energy was distributed through the air and not the ground (FAA 2024b). Thus, based on the limited information, we believe that any effects to smalltooth sawfish from launch vibrations will be so small as to be immeasurable and, thus, insignificant.

Monitoring of heat plumes from Starship-Super Heavy launches observed temperatures of approximately 300°F (149°C) at the Boca Chica Launch Site, approximately 212°F (100°C) within a 0.3-mi (0.5-km) radius surrounding the launch site, and approximately 90°F (32°C) (ambient temperature during some seasons) within a 0.6-mi (1-km) radius surrounding the launch site. Water has a significantly higher specific heat capacity (the amount of heat that needs to be added to one unit of mass of a substance to cause an increase of one unit in temperature) than air, meaning it takes much more energy to raise the temperature of water than to raise the temperature of air. Thus, we expect that ocean temperatures are not affected by launches as significantly as the surrounding air. Additionally, ESA-listed marine mammals, sea turtles, and fishes spend a majority of their time underwater compared to at or just above the surface (when breathing, in the case of marine mammals and sea turtles), and water temperatures below the surface are unlikely to be changed by the heat plume from launches. Thus, based on the limited information, we believe that species' exposure to heat plumes from Starship-Super Heavy launches is extremely unlikely and, thus, discountable.

On June 6, 2024, the Coastal Bend Bays & Estuaries Program monitored debris from a Starship-Super Heavy launch and effects to shorebird nests. They observed dust and small debris emanating out from the engine thrust to approximately 1,411 ft (430 m) away, where the further monitored nest was located (LeClaire and Newstead 2024). FAA (2024) states that the report suggests a "gravel plume" consisting of small particles of mud, sand, and gravel, could travel at least 0.3 mi (0.5 km) from the launch site. Thus, it is reasonable to expect that the gravel plume

will also enter the water where ESA-listed species may occur. Launch debris are small in size ("pea-sized"; LeClaire and Newstead 2024) and will be scattered across a radius of at least 0.3 mi (0.5 km) from the launch site. Thus, based on the limited information available, we believe that any effects to ESA-listed species in the water would be so small as to be immeasurable and, thus, insignificant.

Heat from Starship-Super Heavy launches may also affect designated critical habitats with PBFs related to water temperature for the North Atlantic right whale. However, because we expect ocean temperatures would not be significantly affected by launch heat plumes, it is extremely unlikely that the PBF will be affected and, thus, the effects are discountable.

We conclude that vibration, heat, and debris effects from Starship-Super Heavy launches to ESA-listed species in the action area because of activities covered under this consultation are discountable or insignificant. We also conclude that effects to designated critical habitat from heat plumes associated with launches are discountable. Therefore, vibration, heat, and debris from launches may affect, but are not likely to adversely affect, ESA-listed species or designated critical habitat.

4.1.1.9 Heat from Vehicle Landings and Explosive Events

Heat from a vehicle landing (produced by engines during the landing burn) or explosive event may affect ESA-listed marine mammals, sea turtles, and fishes. An explosive event would result in a temporary but significant increase in temperatures at the surface of the ocean because of the burning of propellant. To be exposed to this stressor, ESA-listed species would have to be in the exact same place at the exact same time that Starship or Super Heavy lands or an explosive event subsequently occurs. ESA-listed species spend a vast majority of time underwater, and it is unlikely species would occur at the surface at the same time as a landing or explosive event. Additionally, Super Heavy and Starship landings will occur 50 times, and explosive events 40 times, in the Gulf and Atlantic Ocean portions of the action area (and fewer in other portions of the action area where only Starship landings will occur) before the launch vehicle is fully reusable in 2030. Therefore, given the limited number of landings and explosive events and limited time ESA-listed marine mammals and sea turtles in particular spend at the surface, it is extremely unlikely that ESA-listed species will be exposed to heat from vehicle landings and explosive events.

Heat from vehicle landings and explosive events may also affect designated or proposed critical habitat with PBFs related to water temperature for North Atlantic right whale and Rice's whale. Sea surface temperatures in North Atlantic right whale critical habitat would be significantly affected if an explosive event were to occur within the critical habitat. However, the increase in temperature would be temporary, lasting minutes while the explosion consumes the remaining propellant, and, thus, the effects would be so small as to be immeasurable and, thus, insignificant. We expect that sea surface temperatures will return to temperatures prior to the explosive event once the event ends. Bottom temperatures (for proposed Rice's whale critical habitat) are not expected to be significantly affected by vehicle landings and explosive events because the water depth for proposed Rice's whale critical habitat is between 328–1,312 ft (100–

400 m), and it is extremely unlikely that heat from the surface would travel to those depths and, thus, effects are discountable.

We conclude that the effects of heat from vehicle landings and explosive events to ESA-listed species in the action area because of activities covered under this consultation are discountable. We also conclude that effects to designated or proposed critical habitat from heat associated with landings and explosive events are discountable or insignificant. Therefore, heat from vehicle landings and explosive events may affect, but is not likely to adversely affect, ESA-listed species or designated or proposed critical habitat.

4.1.2 Species Not Likely to be Adversely Affected

In addition to the potential stressors that are not likely to adversely affect ESA-listed species discussed above in Section 4.1.1, other stressors (i.e., underwater acoustic effects from explosive events) resulting from the proposed action, may affect, but are not likely to adversely affect a majority of ESA-listed species that may be present in the action area. This section identifies the ESA-listed species for which underwater acoustic effects from explosive events are NLAA and are not analyzed further in this opinion.

4.1.2.1 ESA-Listed Marine Mammals

The ESA-listed marine mammal species that are not likely to be adversely affected by explosive events due to the proposed action are: blue whale, Main Hawaiian Islands Insular DPS of false killer whale, fin whale, Western North Pacific DPS of gray whale, Central America DPS and Mexico DPS of humpback whale, North Atlantic right whale, North Pacific right whale, sei whale, sperm whale, Rice's whale, Guadalupe fur seal, and Hawaiian monk seal.

NMFS uses acoustic thresholds to predict how an animal's hearing will be affected by sound exposure (see NMFS's Acoustic Technical Guidance website). Acoustic thresholds differ based on marine mammal hearing groups (Table 3) because not all marine mammal species have identical hearing or susceptibility to noise-induced hearing loss. Marine mammal hearing groups are also used to establish marine mammal auditory weighting functions.

Table 3. Marine mammal hearing groups (NMFS 2024a)

Hearing Group	Generalized Hearing Range
Low-frequency (LF) cetaceans	7 Hz to 36 kHz
High-frequency (HF) cetaceans	150 Hz to 160 kHz
Very High-frequency (VHF) cetaceans	200 Hz to 165 kHz
Phocid pinnipeds (PW)	40 Hz to 90 kHz
Otariid pinnipeds (OW)	60 Hz to 68 kHz

Hz = Hertz; kHz = kiloHertz

To calculate potential exposure of ESA-listed species (marine mammals and sea turtles) to the underwater acoustic effects of explosive events for both Starship and Super Heavy, SpaceX calculated the ensonified area (area filled with sound) resulting from a Starship and Super Heavy

explosive event, and multiplied the ensonified area by available species densities to get an estimated number of animals exposed.

To calculate the ensonified area, SpaceX used a hemispherical model, estimating that half of the explosive weight on each vehicle will be directed towards the water and the other half released into the air. The model assumes an explosive weight of approximately 10,966 lb (4,974 kg) for Starship (half of approximately 21,929 lb or 9,947 kg) and 7,275 lb (3,330 kg) for Super Heavy (half of 14,551 lb or 6,660 kg) will enter the water. The model also considered the distance above the ocean's surface at which the explosive event will occur (14.8 ft or 4.5 m for Starship and 9.8 ft or 3 m for Super Heavy), and a transmission coefficient of 0.0326, to calculate the peak sound pressure level (SPL_{peak}) for both vehicle explosions. The SPL_{peak} for a Starship explosive event is 267.7 decibels referenced to a pressure of one microPascal (dB re 1µPa), and the SPL_{peak} for a Super Heavy explosive event is 270.7 dB re 1µPa. Using these SPL_{peak} values, SpaceX calculated the ensonified areas within which species could respond to the underwater acoustic stressor as a circle, using spherical spreading (generally used for deeper waters, where the sound waves propagate away from the source uniformly in all directions compared to cylindrical spreading where the sound waves cannot propagate uniformly in all directions because the sound will hit the sea surface or seafloor). Measurable responses are not anticipated outside of the ensonified areas identified below for each ESA-listed marine mammal for a Super Heavy and Starship explosive event (Table 4).

Table 4. ESA-listed marine mammals in the action area, hearing group, and minimum threshold for a response; and associated ensonified areas related to the underwater acoustic effects from a Super Heavy or Starship explosive event within which there could be a response

Species	Hearing Group	Minimum Threshold to Response* (dB re 1µPa)	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)
Blue Whale	Low-frequency	216	0.9338	0.4625
False Killer Whale – Main Hawaiian Islands Insular DPS	High-frequency	224	N/A	0.0733
Fin Whale	Low-frequency	216	0.9338	0.4625
Guadalupe Fur Seal	Otariid	224	N/A	0.0733
Hawaiian Monk Seal	Phocid	217	N/A	0.37
Humpback Whale – Central America DPS	Low-frequency	216	N/A	0.4625

Humpback Whale – Mexico DPS	Low-frequency	216	N/A	0.4625
North Atlantic Right Whale	Low-frequency	216	0.9338	0.4625
Rice's Whale	Low-frequency	216	0.9338	0.4625
Sei Whale	Low-frequency	216	0.9338	0.4625
Sperm Whale	High-frequency	224	0.148	0.0733

* Note SPL_{peak} thresholds are used
dB re 1µPa = decibels referenced to a pressure of one microPascal; km^2 = square kilometers
N/A = Not Applicable; Super Heavy explosive events will not occur where these species may occur

To estimate the number of exposures resulting from an explosive event, SpaceX multiplied the maximum species densities in each relevant portion of the action area by the ensonified areas. However, NMFS review of the species densities for the Gulf and Atlantic Ocean portions of the action area determined that there were discrepancies in the maximum densities used, and that there was not enough information on the Super Heavy landing area more than 1 NM from shore. FAA and SpaceX did not have information on whether vehicle landings and explosive events would occur in greater number or probability in certain areas (e.g., nearer to the launch site). Thus, based on the best available information on landing or explosive event locations, NMFS estimated there is an equal probability of a landing or explosion anywhere within each portion of the action area. Based on this assumption, the maximum species density is not an accurate representation of species densities across the action area. Thus, NMFS determined the maximum monthly mean density for each marine mammal species in the Gulf and Atlantic Ocean portions of the action area, and used those densities to estimate the number of exposures. All other portions of the action area use the species density identified by FAA and SpaceX.

Information provided by FAA and SpaceX included Super Heavy landings and explosive events 1–5 NM from shore "directly east" of the Boca Chica Launch Site, LC-39A, and SLC-37. However, a specific area, which is needed to determine species density, was not provided. Thus, NMFS used the best available information on vehicle landings 1–5 NM from shore, which is between 100 mi (161 km) north and 100 mi (161 km) south of the Boca Chica Launch Site, and between 50 mi (80 km) north and 50 mi (80 km) south of LC-39A and SLC-37 (the same area as Starship landings and explosive events 1–5 NM from shore), to determine marine mammal densities.

Because the portions of the action area where explosive events could occur cover large swaths of the ocean, for some portions of the action area, multiple density datasets were used to have data coverage over as much of the action area as possible. For marine mammals, the best available density data in the Indian Ocean were obtained from the U.S. Navy's Final Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency (SURTASS LFA) Sonar in 2019 (U.S. Navy 2019). Areas modeled in U.S. Navy (2019) do not completely cover the Indian Ocean portion of the action area, but the modeled area of Northwest Australia, does overlap with the eastern portion of the Indian Ocean portion of the action area. It is worth noting that the Northwest Australia modeled area is based on data from the Eastern Tropical Pacific (U.S. Navy

2019). This is because survey data in the Indian Ocean are limited or non-existent, while the Eastern Tropical Pacific has been extensively surveyed for marine mammals and is an area with similar oceanographic and ecological characteristics as the Northwest Australia modeled area (U.S. Navy 2019). Marine mammal density data for the South Pacific portion of the action area were not available. The following marine mammal density datasets were used for each action area (Table 5). Species densities and estimated numbers of exposures that would amount to more than insignificant (i.e., that would be enough to be meaningfully measured) are summarized in Tables 6–10 (excluding the South Pacific portion of the action area because no density data were available). Note that estimated exposures may not match the exact product of the density and ensonified area due to rounding.

Table 5. Marine mammal density data sources for each portion of the action area

Portion of the Action Area	Density Data Sources
Gulf	Roberts et al. (2023); Garrison et al. (2023a)
Atlantic Ocean	Roberts et al. (2023); Roberts et al. (2016); Roberts et al. (2024)*
Indian Ocean	U.S. Navy (2019)**
Hawaii and Central North Pacific	Becker et al. (2022b); Becker et al. (2021); Bradford et al. (2020); Forney et al. (2015); Forney et al. (2012)
Northeast and Tropical Pacific	Becker et al. (2020); Becker et al. (2022a); Forney et al. (2015); Ferguson and Barlow (2003); Forney et al. (2020)
South Pacific	Not available

* North Atlantic right whale densities were determined by using the most recent dataset (2010–2019), as suggested by the authors

** Densities were only available for blue, fin, and sperm whales

Table 6. ESA-listed marine mammal densities in the Gulf portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Super Heavy and 20 Starship explosive events

Species	Maximum Monthly Mean Density (individuals per km^2)	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)	Exposures for 20 Super Heavy Explosive Events	Exposures for 20 Starship Explosive Events	Estimated Number of Exposures more than Insignificant
Rice's Whale	0.000024	0.93	0.46	0.00045	0.00022	0.00067
Sperm Whale	0.00499	0.15	0.07	0.0148	0.0073	0.022

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that Rice's whales and sperm whales in the Gulf portion of the action area

will be exposed to underwater acoustic effects from up to 20 Super Heavy and 20 Starship explosive events and, thus, these effects are discountable (Table 6).

Table 7. ESA-listed marine mammal densities in the Atlantic Ocean portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Super Heavy and 20 Starship explosive events

Species	Maximum Monthly Mean Density (individuals per km^2)	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)	Exposures for 20 Super Heavy Explosive Events	Exposures for 20 Starship Explosive Events	Estimated Number of Exposures more than Insignificant
Blue Whale	0.0000122	0.93	0.46	0.00022	0.00011	0.000341
Fin Whale	0.000095	0.93	0.46	0.00177	0.00088	0.002653
North Atlantic Right Whale	0.000014	0.93	0.46	0.00026	0.00013	0.000389
Sei Whale	0.00014	0.93	0.46	0.00268	0.0013	0.004005
Sperm Whale	0.00528	0.15	0.07	0.0156	0.0077	0.023366

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that blue, fin, North Atlantic right, sei, and sperm whales in the Atlantic Ocean portion of the action area will be exposed to underwater acoustic effects from up to 20 Super Heavy and 20 Starship explosive events and, thus, these effects are discountable (Table 7).

Table 8. ESA-listed marine mammal densities in the Indian Ocean portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Starship explosive events

Species	Maximum Density (individuals per km^2)	Ensonified Area (km^2)	Estimated Number of Exposures more than Insignificant
Blue Whale	0.0000281	0.46	0.00026
Fin Whale	0.0008710	0.46	0.008
Sperm Whale	0.002362	0.07	0.003

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that blue, fin, and sperm whales in the Indian Ocean portion of the action area will be exposed to underwater acoustic effects from up to 20 Starship explosive events and, thus,

these effects are discountable (Table 8). There are very little data on sei whales that may occur in the action area. Based on data from the Ocean Biodiversity Information System's Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP; Halpin et al. 2009), there have been observations of sei whales off Northwest Australia, near the eastern boundary of the Indian Ocean portion of the action area. However, sei whales generally prefer more temperate waters than those that make up the majority of the Indian Ocean portion of the action area, and have been detected between 40° and 50° South in the southern Indian Ocean and in the Southern Ocean (Miyashita et al. 1995; Calderan et al. 2014). Therefore, we expect that sei whale densities in the Indian Ocean portion of the action area will be lower than the available densities of blue, fin, and sperm whales. In addition, given the small ensonified area within which more than insignificant responses are expected for sei whales, we believe that the estimated number of exposures that would elicit a measurable response in sei whales would be lower than that for blue, fin, and sperm whales (Table 8).

Table 9. ESA-listed marine mammal densities in the Hawaii and Central North Pacific portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Starship explosive events

Species	Maximum Density (individuals per km^2)	Ensonified Area (km^2)	Estimated Number of Exposures more than Insignificant
Blue Whale	0.00006	0.46	0.00055
False Killer Whale – Main Hawaiian Islands Insular DPS	0.000568	0.07	0.0008
Fin Whale	0.00008	0.46	0.00074
Hawaiian Monk Seal	0.00004	0.37	0.0003
Sei Whale	0.00016	0.46	0.0015
Sperm Whale	0.007734	0.07	0.01

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that blue whales, Main Hawaiian Islands Isular DPS false killer whales, fin whales, Hawaiian monk seals, sei whales, and sperm whales in the Hawaii and Central North Pacific portion of the action area will be exposed to underwater acoustic effects from up to 20 Starship explosive events and, thus, these effects are discountable (Table 9).

Table 10. ESA-listed marine mammal densities in the Northeast and Tropical Pacific portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Starship explosive events

Species	Maximum Density (individuals per km^2)	Ensonified Area (km^2)	Estimated Number of Exposures more than Insignificant
Blue Whale	0.004515	0.46	0.04
Fin Whale	0.003897	0.46	0.036

Guadalupe Fur Seal	0.06283	0.07	0.088
Humpback Whale – Central America DPS	0.002713	0.46	0.025
Humpback Whale – Mexico DPS	0.003747	0.46	0.034
Sei Whale	0.0001	0.46	0.0009
Sperm Whale	0.003829	0.07	0.005

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that blue whales, fin whales, Guadalupe fur seals, humpback whales, sei whales, and sperm whales in the Northeast and Tropical Pacific portion of the action area will be exposed to underwater acoustic effects from up to 20 Starship explosive events and, thus, these effects are discountable (Table 10).

There were no density estimates available for ESA-listed marine mammals in the South Pacific portion of the action area; however, the South Pacific portion of the action area is located far from shore, where ESA-listed marine mammals are not expected to occur in high numbers. Sperm whales are known to congregate in waters around the Galápagos Archipelago (Eguiguren et al. 2021), but the Galápagos are more than 250 NM from the South Pacific portion of the action area. Thus, we do not expect ESA-listed marine mammals to occur in high numbers or congregate within the South Pacific portion of the action area.

In summary, given the low estimated exposures that could amount to an effect beyond insignificant, the small size of ensonified areas within which measurable responses would be expected, and anticipated densities of ESA-listed marine mammals, we believe that ESA-listed marine mammals are extremely unlikely to be exposed to underwater acoustic effects from vehicle explosive events, and, therefore, the effects are discountable.

We conclude that the proposed action may affect, but is not likely to adversely affect ESA-listed blue whale, Main Hawaiian Islands Insular DPS of false killer whale, fin whale, Western North Pacific DPS of gray whale, Central America DPS and Mexico DPS of humpback whale, North Atlantic right whale, North Pacific right whale, sei whale, sperm whale, Rice's whale, Guadalupe fur seal, and Hawaiian monk seal.

4.1.2.2 ESA-Listed Sea Turtles

The ESA-listed sea turtle species that are not likely to be adversely affected by underwater acoustic effects from explosive events due to the proposed action are: Central North Pacific DPS, East Indian-West Pacific DPS, East Pacific DPS, North Indian DPS, South Atlantic DPS, and Southwest Indian DPS of green turtle, hawksbill turtle, leatherback turtle, North Indian Ocean DPS, North Pacific Ocean DPS, South Pacific Ocean DPS, Southeast Indo-Pacific Ocean DPS, and Southwest Indian Ocean DPS of loggerhead turtle, and all other areas/not Mexico's Pacific coast breeding colonies and Mexico's Pacific coast breeding colonies of olive ridley turtle. The North Atlantic DPS of green turtle, Kemp's ridley turtle, and Northwest Atlantic Ocean DPS of loggerhead turtle are discussed in Sections 4.2 and 6.

Using the same methodology described for marine mammals in Section 4.1.2.1, SpaceX estimated the number of sea turtle exposures that would be more than insignificant. Insignificant responses are anticipated outside of the ensonified areas identified for each ESA-listed sea turtle species for a Super Heavy and Starship explosive event. The ensonified areas are the same across all sea turtle species because all sea turtle species belong to the same hearing group and have the same minimum threshold to a response (SPL_{peak} 226 dB re 1µPa). The ensonified area for a Super Heavy explosive event is 0.0934 km^2 and the ensonified area for a Starship explosive event is 0.0463 km^2.

Similar to marine mammal densities (see Section 4.1.2.1), NMFS found discrepancies in the maximum sea turtle densities used to estimate the number of exposures in the Gulf and Atlantic Ocean portions of the action area. Because FAA and SpaceX did not have information on whether vehicle landings and explosive events would occur in greater number or probability in certain areas (e.g., nearer to the launch site), NMFS estimated there is an equal probability of a landing or explosion anywhere within each portion of the action area. Based on this assumption, the maximum species density is not an accurate representation of species densities across the action area. Thus, NMFS determined the maximum monthly mean density for each sea turtle species in the Gulf and Atlantic Ocean portions of the action area, and used those densities to estimate the number of exposures. All other portions of the action area use the species density identified by FAA and SpaceX. Additionally, because a specific area was not provided to determine species densities associated with Super Heavy explosive events 1–5 NM from shore in the Gulf and Atlantic Ocean portions of the action area, NMFS determined species densities 1–5 NM from shore, between 100 mi (161 km) north and 100 mi (161 km) south of the Boca Chica Launch Site, and between 50 mi (80 km) north and 50 mi (80 km) south of LC-39A and SLC-37.

The following sea turtle density datasets were used for each action area (Table 11). Species densities and estimated number of exposures that would amount to more than insignificant are summarized in Tables 12–15 (excluding the Indian Ocean and South Pacific portions of the action area because no density data were available). Experts noted caveats with the data used to determine sea turtle densities on the U.S. East Coast (DiMatteo et al. 2024; W. Piniak, NMFS OPR pers. comm. to E. Chou, NMFS OPR, March 19, 2025), including but not limited to: limitations in detecting turtles smaller than 16 in (40 cm) during surveys, apparent discrepancies in the estimated population abundance used to calculate densities, and the assumption of a Gulf species correction factor for the Atlantic. Despite these caveats, DiMatteo et al. (2024b) still represents the best available information on sea turtle densities along the U.S. East Coast. Note that estimated exposures may not match the exact product of the density and ensonified area due to rounding.

Table 11. Sea turtle density data sources for each portion of the action area

Portion of the Action Area	Density Data Sources
Gulf	Garrison et al. (2023b)
Atlantic Ocean	DiMatteo et al. (2024b)
Indian Ocean	Not available
Hawaii and Central North Pacific	U.S. Navy (2024)

Northeast and Tropical Pacific	U.S. Navy (2024)
South Pacific	Not available

Table 12. ESA-listed sea turtle densities in the Gulf portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Super Heavy and 20 Starship explosive events

Species	Maximum Monthly Mean Density (individuals per km^2)	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)	Exposures for 20 Super Heavy Explosive Events	Exposures for 20 Starship Explosive Events	Estimated Number of Exposures more than Insignificant
Green Turtle	0.018254	0.093	0.046	0.0341	0.0169	0.051
Leather-back Turtle	0.019504	0.093	0.046	0.03643	0.01806	0.0545

km^2 = square kilometers
Note: no densities were available for hawksbill turtles. The Kemp's ridley turtle and Northwest Atlantic Ocean DPS of loggerhead turtle are analyzed in Section 6.

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that green and leatherback turtles in the Gulf portion of the action area will be exposed to underwater acoustic effects from up to 20 Super Heavy and 20 Starship explosive events and, thus, these effects are discountable (Table 12). Hawksbill turtles nest at low densities throughout the southern Gulf (April–September; Cuevas et al. 2019) and wider Caribbean region (Piniak and Eckert 2011), with infrequent nesting in southern Texas and Florida (Eckert and Eckert 2019; Valverde and Holzwart 2017). Based on telemetry data compiled by The State of the World's Sea Turtles (SWOT 2022) and sightings recorded in the OBIS-SEAMAP database, hawksbill turtles are rare in the Gulf portion of the action area. Thus, it is extremely unlikely that hawksbill turtles will be exposed to underwater acoustic effects of up to 20 Super Heavy and 20Starship explosive events so these effects would be discountable.

Table 13. ESA-listed sea turtle densities in the Atlantic Ocean portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Super Heavy and 20 Starship explosive events

Species	Maximum Monthly Mean Density (individuals per km^2)	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)	Exposures for 20 Super Heavy Explosive Events	Exposures for 20 Starship Explosive Events	Estimated Number of Exposures more than Insignificant
Kemp's Ridley Turtle	0.00883	0.093	0.046	0.01649	0.00817	0.024665

Leather-back Turtle	0.02812	0.093	0.046	0.0525	0.02604	0.078583

km^2 = square kilometers
Note: no densities were available for hawksbill turtles. The North Atlantic DPS of green turtle and Northwest Atlantic Ocean DPS of loggerhead turtle are analyzed in Section 6.

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that Kemp's ridley and leatherback turtles in the Atlantic Ocean portion of the action area will be exposed to underwater acoustic effects from up to 20 Super Heavy and 20 Starship explosive events and, thus, these effects are discountable (Table 13). It is also extremely unlikely that hawksbill turtles, for which there are no density estimates, will be exposed to the underwater acoustic effects of up to 20 Super Heavy and 20 Starship explosive events. Hawksbill turtles are relatively rare in the Atlantic Ocean portion of the action area, and only occasional nesting has been documented off Florida and North Carolina (Finn et al. 2016; NMFS and USFWS 2013c). Based on data from (SWOT 2022) and sightings recorded in OBIS-SEAMAP, hawksbill turtles are rare in the Atlantic Ocean portion of the action area. Thus, underwater acoustic effects to hawksbill turtles are discountable.

Data on sea turtles in the middle of ocean basins is limited because of challenging conditions and logistics of conducting surveys offshore. North Indian Ocean DPS, Southwest Indian Ocean DPS, and East Indian-West Pacific DPS of green turtles may occur in the Indian Ocean portion of the action area. Nesting beaches occur in countries near the western and eastern boundaries of the Indian Ocean portion of the action area, and coastlines much further north (NMFS 2007; Seminoff et al. 2015). These DPSs of green turtles forage mainly in seagrass beds found in coastal waters, but may move into and transit through oceanic zones.

Southwest Indian Ocean DPS, Southeast Indo-Pacific DPS, and North Indian Ocean DPS of loggerhead turtles may occur in the Indian Ocean portion of the action area. Foraging areas for these DPSs of loggerhead turtles are generally coastal (Rees et al. 2010; Harris et al. 2018; Robinson et al. 2018). Juveniles in the North Indian Ocean may undertake trans-equatorial movements (Dalleau et al. 2014). In fact, the few sighting records of ESA-listed sea turtles within the Indian Ocean portion of the action area are of a tagged loggerhead turtle migrating north-south through the westernmost portion of the Indian Ocean portion of the action area (Halpin et al. 2009; Dalleau et al. 2014). Southwest Indian Ocean DPS individuals also migrate between foraging and nesting areas, though these migration corridors are generally close to shore (Harris et al. 2015; Harris et al. 2018) and outside of the Indian Ocean portion of the action area. The Southeast Indo-Pacific DPS generally forages off coastal Western Australia to Indonesia (Casale et al. 2015).

Olive ridley turtles appear to be most abundant in coastal waters of the northern Indian Ocean (NMFS 2014b), although satellite tagging of one individual showed movement to waters deeper than 656 ft (200 m; Rees et al. 2012). Hawksbill turtles in the eastern Indian Ocean generally forage in waters less than 328 ft (100 m) deep (Fossette et al. 2021). Leatherback turtles occur throughout the Indian Ocean (Hamann et al. 2006; Nel 2012). Satellite tagging of post-nesting leatherback turtles in South Africa showed that less than half of the tagged individuals moved

south and then east into oceanic waters of the Indian Ocean, below the Indian Ocean portion of the action area (Robinson et al. 2016). Leatherback nesting populations in the southwest Indian Ocean (e.g., South Africa) and northeast Indian Ocean (e.g., Sri Lanka, Andaman Islands) total approximately 100 nesting females, and between 100–600 nesting females per year, depending on the island, respectively (Hamann et al. 2006). The number of nesting females (the only population estimates available) is relatively small given the large Indian Ocean portion of the action area. Therefore, we expect that densities of ESA-listed sea turtles in the Indian Ocean portion of the action area will be lower than the available densities of blue, fin, and sperm whales (Table 8). In addition, given the small ensonified area within which significant responses would be expected for ESA-listed sea turtles, we believe that the estimated number of exposures that would be more than insignificant for ESA-listed sea turtles will be lower than that for blue, fin, and sperm whales.

Table 14. ESA-listed sea turtle densities in the Hawaii and Central North Pacific portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Starship explosive events

Species	Density (individuals per km^2)	Ensonified Area (km^2)	Estimated Number of Exposures more than Insignificant
Green Turtle	0.00027	0.046	0.0003
Hawksbill Turtle	0.00005	0.046	0.00005
Leatherback Turtle	0.00115	0.046	0.001
Loggerhead Turtle	0.00184	0.046	0.002
Olive Ridley Turtle	0.00178	0.046	0.002

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that green, hawksbill, leatherback, loggerhead, and olive ridley turtles in the Hawaii and Central North Pacific portion of the action area will be exposed to underwater acoustic effects from up to 20 Starship explosive events and, thus, these effects are discountable (Table 14).

Table 15. ESA-listed sea turtle densities in the Northeast and Tropical Pacific portion of the action area and calculations for the estimated number of exposures that would amount to more than insignificant for up to 20 Starship explosive events

Species	Density (individuals per km^2)	Ensonified Area (km^2)	Estimated Number of Exposures more than Insignificant
Green Turtle	0.00	0.046	0
Leatherback Turtle	0.001	0.046	0.001
Loggerhead Turtle	0.00	0.046	0

km^2 = square kilometers

Given the low estimated number of exposures that would amount to more than insignificant, it is extremely unlikely that green, leatherback, and loggerhead turtles in the Northeast and Tropical

Pacific portion of the action area will be exposed to underwater acoustic effects from up to 20 Starship explosive events and, thus, these effects are discountable (Table 15). There have been no documented hawksbill turtle nests off the U.S. West Coast, and a majority of nesting occurs in Mexico, El Salvador, Nicaragua, Panama and Ecuador (Rguez-Baron et al. 2019). There is a small (< 20 females) nesting population in the Northwestern Hawaiian Islands; however, observations of hawksbill turtles in Hawaii are rare (Chaloupka et al. 2008; Van Houtan et al. 2012). Most juveniles and adults use nearshore habitats (Rguez-Baron et al. 2019). Olive ridley turtles are also rare in offshore areas of the Northeast and Tropical Pacific portion of the action area, likely because occurrence is typically associated with warmer waters further south (Eguchi et al. 2007; Montero et al. 2016). Therefore, hawksbill and olive ridley turtles are not expected to occur in high numbers or densities in the Northeast and Tropical Pacific portion of the action area, meaning they are unlikely to be exposed to the underwater acoustic effects from Starship explosive events, so exposure would be extremely unlikely to occur and the effects discountable.

There were no available density data, and limited data overall, for ESA-listed sea turtles in the South Pacific portion of the action area. Seminoff et al. (2015) summarized nesting sites for all DPSs of green turtles, including the DPSs that may occur in the South Pacific portion of the action area, which are the Central South Pacific DPS and East Pacific DPS. There are no nesting sites of the Central South Pacific DPS of green turtles within or near the South Pacific portion of the action area; thus, we expect that Central South Pacific DPS green turtles do not occur in high numbers or congregate within the South Pacific portion of the action area. The two primary nesting sites of the East Pacific DPS of green turtle are at Michoacán, Mexico and the Galápagos Islands, Ecuador (Seminoff et al. 2015). Neither occurs near the South Pacific portion of the action area, nor do any of the nesting sites monitored in Seminoff et al. (2015). Therefore, we expect that the East Pacific DPS of green turtle does not occur in high numbers or congregate within the South Pacific portion of the action area. Loggerhead, olive ridley, and hawksbill turtles are relatively rare in offshore waters where the South Pacific portion of the action area is located (OBIS-SEAMAP). Thus, we expect that loggerhead, olive ridley, and hawksbill turtles do not occur in high numbers or congregate within the South Pacific portion of the action area. Leatherback turtles transit to the South Pacific from nesting sites in Mexico and Costa Rica to forage, and are expected to transit through and search for prey within the South Pacific portion of the action area (Bailey et al. 2012a; Bailey et al. 2012b; Benson et al. 2015). However, given the relatively large area where leatherbacks have been documented (e.g., see Bailey et al. 2012a) compared to the size of the South Pacific portion of the action area, as well as patchy distribution of prey in offshore areas, movement of individual leatherbacks searching for prey aggregations, and the limited number of times Starship could explode, we expect it is extremely unlikely a leatherback turtle will be exposed to the underwater acoustic effects from Starship explosive events.

In summary, given the low estimated exposures that could amount to an effect beyond insignificant and small ensonified areas within which measurable responses could occur, we expect that ESA-listed sea turtles are extremely unlikely to be exposed to underwater acoustic effects from vehicle explosive events. Thus, effects from underwater acoustic effects from explosive events on ESA-listed sea turtles are discountable.

We conclude that the proposed action may affect, but is not likely to adversely affect ESA-listed Central North Pacific DPS, East Indian-West Pacific DPS, East Pacific DPS, North Indian DPS, South Atlantic DPS, and Southwest Indian DPS of green turtle, hawksbill turtle, leatherback turtle, North Indian Ocean DPS, North Pacific Ocean DPS, South Pacific Ocean DPS, Southeast Indo-Pacific Ocean DPS, and Southwest Indian Ocean DPS of loggerhead turtle, and all other areas/not Mexico's Pacific coast breeding colonies and Mexico's Pacific coast breeding colonies of olive ridley turtle.

4.1.2.3 ESA-Listed Fishes

The ESA-listed fish species that are not likely to be adversely affected by underwater acoustic effects from explosive events due to the proposed action are: Carolina DPS, Chesapeake Bay DPS, and South Atlantic DPS of Atlantic sturgeon, giant manta ray, Southern DPS of green sturgeon, Gulf sturgeon, Nassau grouper, oceanic whitetip shark, Central and Southwest Atlantic DPS, Eastern Pacific DPS, and Indo-West Pacific DPS of scalloped hammerhead shark, shortnose sturgeon, U.S. portion of range DPS of smalltooth sawfish, and South-Central California Coast DPS and Southern California DPS of steelhead trout.

Species that spend a majority of time in or congregate in coastal waters (from the coast to the continental shelf edge) and rivers such as the Carolina DPS, Chesapeake Bay DPS, and South Atlantic DPS of Atlantic sturgeon, Southern DPS of green sturgeon, Gulf sturgeon, Nassau grouper, Central and Southwest Atlantic DPS, Eastern Pacific DPS, and Indo-West Pacific DPS of scalloped hammerhead shark (although scalloped hammerhead shark may occur off the continental shelf edge, the approximate species range does not overlap with portions of the action area where explosive events will occur), shortnose sturgeon, U.S. portion of range DPS of smalltooth sawfish, and South-Central California Coast DPS and Southern California DPS of steelhead trout, are not expected to be adversely affected by underwater acoustic effects from Super Heavy or Starship explosive events. These species are not expected to occur in high numbers or densities in areas where Super Heavy or Starship explosive events are likely to occur. Additionally, based on NMFS's physical injury acoustic thresholds for large fish (> 2 grams), the ensonified area from a Super Heavy or Starship explosion is 9.34 km^2 and 4.63 km^2, respectively. Given the relatively small ensonified areas compared to the size of each portion of the action area, the limited number of explosive events, and the infrequent or rare occurrence of these species in areas where there could be an explosion, it is extremely unlikely these species will be exposed to underwater acoustic effects of Super Heavy or Starship explosive events. Thus, the effects are discountable.

Oceanic whitetip sharks are caught in the yellowfin tuna fishery in the Gulf and Northwest Atlantic Ocean. In the 1950s, during exploratory tuna surveys, nearly 400 oceanic whitetip sharks were caught, relative to only five caught in the 1990s during the commercial yellowfin tuna fishery in the Gulf (Baum and Myers 2004). Although Young et al. (2018) estimate oceanic whitetip shark abundance declined about 4% between 1992 and 2005, there was a significant historic decline in abundance (88% in the Gulf; FAO 2012). Young et al. (2018) conclude that oceanic whitetip sharks are now relatively rare in the Northwest Atlantic and Gulf.

The Flower Garden Banks National Marine Sanctuary serves as a nursery habitat for giant manta ray, given multiple studies on the prevalence of juvenile giant manta rays within the Sanctuary (Childs 2001; Stewart et al. 2018a; Stewart et al. 2018b). A buffer of 20 NM from the Flower Garden Banks National Marine Sanctuary will be implemented for any Super Heavy landings and potential explosive events to avoid the sanctuary. Based on sightings and survey data of giant manta ray along the U.S. East Coast and Gulf from 1925–2020, Farmer et al. (2022a) modeled the probability of occurrence for giant manta rays in the Gulf and Northwest Atlantic. Farmer et al. (2022a) modeled higher probabilities of occurrence nearshore compared to areas offshore. Overall, we do not expect oceanic whitetip sharks and giant manta rays to occur in high numbers or densities within the Gulf and Atlantic Ocean portions of the action area. Given the low probabilities of occurrence, relatively small ensonified areas within which measurable responses could be expected, and the limited number of times Super Heavy may explode in either portion of the action area, oceanic whitetip shark and giant manta ray exposure to the underwater acoustic effects of explosive events in the Gulf and Atlantic Ocean portions of the action area is extremely unlikely and, thus, discountable.

Very little data exist on oceanic whitetip sharks in the Indian Ocean portion of the action area. Most come from fisheries bycatch data, collected by the Indian Ocean Tuna Commission, and there are no quantitative stock assessments for the oceanic whitetip shark. Oceanic whitetip sharks are generally found offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deep waters, and prefer warm (> 68°F or 20°C; Bonfil et al. 2008) open ocean waters between 10° North and 10° South latitude, which overlaps with the Indian Ocean portion of the action area (NMFS 2017c). Oceanic whitetip sharks have been caught in tuna purse seine fisheries adjacent to the western boundary of the Indian Ocean portion of the action area (Lopetegui-Eguren et al. 2022), and have also been caught in the Spanish longline swordfish fishery (Ramos-Cartelle et al. 2012) that overlaps the Indian Ocean portion of the action area. However, the majority of oceanic whitetip sharks caught as bycatch in the Indian Ocean were caught between latitudes 0° and 10° South, outside of the Indian Ocean portion of the action area. Oceanic whitetip shark bycatch within the Indian Ocean portion of the action area is likely higher than what would be expected with standard survey data, because fishing vessels put out bait that attracts predators like the oceanic whitetip shark. Anecdotal reports suggest that oceanic whitetip sharks have become rare throughout most of the Indian Ocean over the past 20 years (IOTC 2015). Giant manta rays are generally found in coastal waters in the Indian Ocean, outside of the Indian Ocean portion of the action area (Kashiwagi et al. 2011; Kitchen-Wheeler 2010; Miller and Klimovic 2017). Given the small ensonified area within which measurable responses could be expected and the limited number of Starship explosive events, we believe that the estimated number of exposures that would be more than insignificant for ESA-listed oceanic whitetip sharks and giant manta rays will be lower than that for blue, fin, and sperm whales (Table 8).

Oceanic whitetip shark and giant manta ray occurrence within the Hawaii and Central North Pacific portion of the action area were estimated from the NMFS Pacific Islands Regional Office's Protected Resources Division fisheries observer data. Data from 2023, the most recent year with complete data, were obtained from the Hawai'i deep-set long line fisheries observer data. There were 452 interactions with oceanic whitetip sharks and two interactions with giant manta rays in 2023. The deep-set long line fishery operates year-round and had a 17.41%

average observer coverage in 2023 (between one in five or one in six fishing trips had an observer on board). This is likely higher than what would be expected with standard survey data, because fishing vessels put out bait that attracts predators like the oceanic whitetip shark. These are also observations, not targeted surveys to identify species densities in an area. These observations occurred over 12 months, representing individuals moving in and out of the action area, and are not representative of densities at any particular time of year. The Hawai'i deep-set long line fishery only overlaps a relatively small portion of the Hawaii and Central North Pacific portion of the action area, which is over 38 million mi^2 (10 million km^2) in size. Thus, given the low estimated number of possible exposures of oceanic whitetip shark and giant manta ray in the action area, small ensonified area within which measurable responses could be expected, and the limited number of Starship explosive events, it is extremely unlikely that the oceanic whitetip shark and giant manta ray would be exposed to underwater acoustic effects from Starship explosive events in the Hawaii and Central North Pacific portion of the action area.

Expected occurrence of oceanic whitetip sharks and giant manta rays in the Northeast and Tropical Pacific portion of the action area is similar to that in the Hawaii and Central North Pacific portion of the action area. Young et al. (2018) synthesize information from multiple studies showing a clear decline of approximately 80–95% in catches of oceanic whitetip sharks in fisheries operating in the Eastern Pacific. Giant manta rays are relatively scarce throughout the Northeast and Tropical Pacific portion of the action area except for the southeast corner of the action area, which overlaps with Isla Clarión of Mexico's Revillagigedo National Park (Revillagigedo Archipelago). Revillagigedo National Park is Mexico's largest fully protected marine reserve. Giant manta rays aggregate at the Revillagigedo National Park and Bahia de Banderas (Banderas Bay), Mexico with estimated populations of 1,172 and > 400 individuals, respectively (Cabral et al. 2023; Domínguez-Sánchez et al. 2023; Gómez-García et al. 2021; Harty et al. 2022). Tagged giant manta rays appeared to move between four main sites: the Gulf, Banderas Bay, Barra de Navidad, and the three eastern-most islands of Revillagigedo National Park (Rubin et al. 2024). Isla Clarión, which is the only island of Revillagigedo National Park that overlaps the Northeast and Tropical Pacific portion of the action area, was not one of the sites that tagged giant manta rays based on the Rubin et al. (2024) study. It appears giant manta rays do not frequent Isla Clarión to the same degree as the other islands in the Revillagigedo National Park, as giant manta ray cleaning sites (where animals aggregate in larger numbers) are located near the other three islands (Cabral et al. 2023; Rubin et al. 2024; Stewart et al. 2016). Thus, we do not expect oceanic whitetip sharks or giant manta rays to occur in high numbers or densities within the Northeast and Tropical Pacific portion of the action area. In addition, given the small ensonified area within which measurable responses could be expected and the limited number of Starship explosive events, it is extremely unlikely that oceanic whitetips sharks and giant manta rays will be exposed to the underwater acoustic effects of Starship explosive events and thus discountable.

In the South Pacific, oceanic whitetip sharks have also undergone a 80–95% decline in population abundance (Hall and Roman 2013). Oceanic whitetip sharks in the South Pacific portion of the action area are expected to be scarce and widely distributed, with no aggregations of sharks in large numbers or densities. The giant manta ray population is estimated at 22,316 individuals off Ecuador (Harty et al. 2022). Coastal aggregations of giant manta rays have been observed off the coast of Ecuador, and movements documented between foraging and cleaning

aggregation sites, northern Peru, and the Galapagos Islands (Andrzejaczek et al. 2021; Burgess 2017). Thus, giant manta ray are not expected to occur in the South Pacific portion of the action area in high numbers or densities. In addition, given the small ensonified area within which non-insignificant responses could be expected for ESA-listed oceanic whitetip sharks and giant manta rays and the limited number of Starship explosive events, it is extremely unlikely that oceanic whitetips sharks and giant manta rays will be exposed to the underwater acoustic effects of Starship explosive events.

In summary, given the relatively sparse occurrence of ESA-listed fishes across the action area, small ensonified areas within which measurable responses could occur, and limited number of explosive events, we expect that ESA-listed fishes are extremely unlikely to be exposed to underwater acoustic effects from vehicle explosive events. Thus, effects from underwater acoustic effects from explosive events on ESA-listed fishes are discountable.

We conclude that the proposed action may affect, but is not likely to adversely affect ESA-listed Carolina DPS, Chesapeake Bay DPS, and South Atlantic DPS of Atlantic sturgeon, giant manta ray, Southern DPS of green sturgeon, Gulf sturgeon, Nassau grouper, oceanic whitetip shark, Central and Southwest Atlantic DPS, Eastern Pacific DPS, and Indo-West Pacific DPS of scalloped hammerhead shark, shortnose sturgeon, U.S. portion of range DPS of smalltooth sawfish, and South-Central California Coast DPS and Southern California DPS of steelhead trout.

4.1.2.4 ESA-Listed Invertebrates

The ESA-listed invertebrates that are not likely to be adversely affected by underwater acoustic effects from explosive events due to the proposed action are: black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, white abalone, and the proposed sunflower sea star.

Black abalone occur along the coast from Point Arena, California to Northern Baja California, Mexico in waters from the high intertidal zone to about 20 ft (6 m) depth (VanBlaricom et al. 2009). Because the range and distribution of black abalone is restricted to coastal waters, it is extremely unlikely that black abalone will be exposed to underwater acoustic effects from explosive events, which will occur offshore in the Northeast and Tropical Pacific portion of the action area. The distribution and range of white abalone is similarly restricted to coastal waters 16.4–196.9 ft (5–60 m) in depth off southern California and Baja California (NMFS 2018b), and exposure to underwater acoustic effects from offshore explosive events will be extremely unlikely. Boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, and staghorn coral occur in coastal areas (from the coast to continental shelf edge) throughout the Caribbean (NMFS 2022b). The range of these coral species does not overlap with either the Gulf or Atlantic Ocean portions of the action area where explosive events will occur. Thus, it is extremely unlikely that ESA-listed corals will be exposed to underwater acoustic effects from explosive events. The proposed sunflower sea star occurs in coastal waters from the Aleutian Islands to Baja California, and is most commonly found in waters less than 82 ft (25 m) deep, and rare in waters deeper than 394 ft (120 m; Lowry et al. 2022). Because the proposed sunflower sea star does not occur where explosive events will occur, it is extremely

unlikely that the proposed sunflower sea star will be exposed to underwater acoustic effects from explosive events.

In summary, given the range and distribution of ESA-listed invertebrates across the action area, we expect that ESA-listed invertebrates are extremely unlikely to be exposed to underwater acoustic effects from explosive events. Thus, underwater acoustic effects from explosive events on ESA-listed invertebrates are discountable.

We conclude that the proposed action may affect, but is not likely to adversely affect ESA-listed black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, white abalone, and the proposed sunflower sea star.

4.1.3 Critical Habitat Not Likely to be Adversely Affected

This section identifies the designated or proposed critical habitat for which effects are NLAA from stressors resulting from the proposed action and are not analyzed further in this opinion. Critical habitats that are not likely to be adversely affected by the proposed action include the designated critical habitats of the Main Hawaiian Islands Insular DPS of false killer whale, Central America DPS and Mexico DPS of humpback whale, Hawaiian monk seal, North Atlantic right whale, hawksbill turtle, leatherback turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, Carolina DPS and South Atlantic DPS of Atlantic sturgeon, Gulf sturgeon, Nassau grouper, black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, and the proposed critical habitats of the Central North Pacific DPS, East Pacific DPS, North Atlantic DPS, and South Atlantic DPS of green turtle, and Rice's whale.

Designated critical habitat for the Main Hawaiian Islands Insular DPS of false killer whale may be affected, but is not likely to be adversely affected by the following stressors: vessel presence, vessel noise, vessel pollution, and aircraft overflight. Vessel presence may affect PBFs related to prey species of sufficient quantity and availability. Vessels may temporarily displace prey while the vessel transits through an area; however, limited and temporary vessel use is not expected to measurably affect the quantity, quality, or availability of prey. Pollution from vessels may affect the PBF: waters free of pollutants of a type and amount harmful to Main Hawaiian Islands Insular false killer whales. Given the limited use of vessels and the short amount of time action-related vessels will be in use, pollution is not expected to measurably affect the water quality, or increase the health risks in a manner that would be harmful to Main Hawaiian Islands Insular false killer whales. Vessel noise and aircraft overflight may affect PBFs: adequate space for movement and use within habitats, and sound levels that would not significantly impair false killer whales' use or occupancy. However, vessel and aircraft noise will be temporary and aircraft noise is extremely limited given that acoustic energy does not effectively cross the air-water boundary, and is not expected to measurably affect false killer whale movement, space use, or occupancy. Thus, effects from stressors from vessel and aircraft use on Main Hawaiian Islands Insular DPS of false killer whale critical habitat are too small to measure and thus insignificant.

Designated critical habitat for the Central America DPS and Mexico DPS of humpback whale may be affected, but is not likely to be adversely affected by the following stressor: vessel presence. Vessels may temporarily displace prey for the duration the vessel transits through an area; however, limited vessel use and the short amount of time action-related vessels will be in use are not expected to measurably affect the quality, abundance, or accessibility of prey. Thus, the effect from vessel presence on the Central America DPS and Mexico DPS of humpback whale critical habitat is expected to be too small to measure and thus insignificant.

Designated critical habitat for the Hawaiian monk seal may be affected, but is not likely to be adversely affected by the following stressor: vessel presence. Vessels may temporarily displace prey for the duration the vessel transits through an area; however, limited vessel use is not expected to measurably affect the quality or quantity of prey. Thus, the effect from vessel presence on the Hawaiian monk seal critical habitat is insignificant.

Designated critical habitat for the North Atlantic right whale may be affected, but is not likely to be adversely affected by the following stressors: direct impact from fallen objects, heat from launches, and heat from vehicle landings and explosive events. Falling objects, especially large objects like Starship and Super Heavy, hitting the ocean surface may temporarily affect calm conditions. However, impacts would only be in the immediate vicinity of the fallen object, and conditions would return to normal shortly after impact. Heat from launches, landings, and explosive events may affect sea surface temperatures. However, the increase in sea surface temperature would also be temporary and temperatures would return to normal shortly after the launch, landing, or explosive event. Temporary heat from these activities is not expected to affect North Atlantic right whale critical habitat conditions to an extent that would be measurable. Thus, the effects from stressors on North Atlantic right whale critical habitat are insignificant.

Designated critical habitat for the hawksbill turtle may be affected, but is not likely to be adversely affected by the following stressor: direct impact by fallen objects. Direct impact by fallen objects may affect the function of the designated critical habitat, including coral reef habitat for food and shelter. However, falling objects are only expected to affect hawksbill turtle critical habitat if there is a mishap. In that case, the objects would be widely dispersed and scattered within an area much larger than the critical habitat area, given the high altitude at which the mishap occurs. Thus, the likelihood that falling objects directly impact the habitat would be extremely unlikely and discountable.

Designated critical habitat for the leatherback turtle may be affected, but is not likely to be adversely affected by the following stressor: vessel presence. Vessels may temporarily displace prey for the short time the vessel transits through an area; however, limited vessel use is not expected to measurably affect the condition, distribution, diversity, abundance, or density of prey. Thus, the effect from vessel presence on the leatherback turtle critical habitat is insignificant.

Designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtle may be affected, but is not likely to be adversely affected by the following stressors: direct impact by fallen objects, unrecovered debris, and vessel presence. Designated critical habitat of the

Northwest Atlantic Ocean DPS of loggerhead turtle is categorized into different habitat types, each with their own set of PBFs. The habitat types that may be affected, but are not likely to be adversely affected by the proposed action include: foraging habitat, constricted migratory habitat, and *Sargassum* habitat. Breeding habitat is discussed in Sections 4.2.4 and 6. Direct impact by fallen objects may affect PBFs related to adequate cover. The area of critical habitat that Super Heavy, Starship, or associated debris could impact as it falls through the water column is relatively small (hundreds of square meters or less) compared to the area over which *Sargassum* habitat can be distributed (hundreds of thousands of square kilometers). Thus, it would be extremely unlikely that the amount of available cover in this critical habitat unit would be measurably affected by falling objects.

Unrecovered debris may affect PBFs related to passage conditions and water depth. Unrecovered debris could create obstructions to passageways or affect water depth if they land in shallow areas where the size of the debris blocks the water column. Based on the available information from FAA and SpaceX, Super Heavy and Starship may land intact and sink in a horizontal orientation (unless the vehicle landing results in debris, in which case, the debris pieces would be smaller than either Super Heavy or Starship). When Super Heavy and Starship are horizontal, the maximum height is 30 ft (9 m). Thus, the vehicles could obstruct areas or affect water depth in areas 30 ft (9 m) or shallower. However, this would be a temporary impact because the obstruction of a waterway is a clear navigational hazard (and would likely be a navigational hazard if a portion of the water column was blocked by debris), and SpaceX would be required to remove the obstruction. Super Heavy and Starship are relatively small compared to the size of critical habitat units of each species considered here, and the vehicle or debris would only temporarily obstruct a portion of the critical habitat related to passage and depth. Thus, the effects would not be expected to affect the long-term conditions of critical habitat.

Direct impact by fallen objects and vessel presence may affect PBFs related to prey availability. Vessels and falling objects may temporarily displace prey for the short time the vessel transits through an area or the object sinks through the water column; however, the duration of these stressors is brief (on the order of days or less), limited to the immediate vicinity of the vessel or object, and is not expected to measurably affect the condition, distribution, diversity, abundance, or density of prey. Thus, the effects from stressors on the Northwest Atlantic Ocean DPS of loggerhead turtle critical habitat (foraging habitat, constricted migratory habitat, and *Sargassum* habitat) are discountable or insignificant.

Designated critical habitat for the Carolina DPS and South Atlantic DPS of Atlantic sturgeon may be affected, but is not likely to be adversely affected by the following stressor: unrecovered debris. Unrecovered debris may affect the PBF on unobstructed migratory pathways and passage between habitats. However, if unrecovered floating debris were large enough or in large enough quantities to obstruct access, it is likely that the debris would be a navigational hazard and would require removal. Thus, the effect of unrecovered debris on the Carolina DPS and South Atlantic DPS of Atlantic sturgeon critical habitat is expected to be too small to measure and are insignificant.

Designated critical habitat for the Gulf sturgeon may be affected, but is not likely to be adversely affected by the following stressors: vessel presence, vessel pollution, and unrecovered debris.

Vessel presence may affect prey abundance and displace prey for the duration the vessel transits through the area; however, given the limited use of vessels and duration of activities requiring vessels, vessels are not expected to measurably affect the abundance of prey. Vessel pollution may affect the water quality PBF of Gulf sturgeon critical habitat. Pollutants are expected to evaporate and quickly become diluted, limiting any impacts to a temporary duration. Given the limited use of vessels and limited number of times either vehicle can be expended in the ocean, vessel pollution is not expected to measurably affect water quality of Gulf sturgeon critical habitat. Unrecovered debris may affect the unobstructed migratory pathways and passage between habitats PBFs. However, if unrecovered floating debris were large enough, or in large enough quantities to obstruct access, it is likely that the debris would be a navigational hazard and would require removal. Thus, effects from stressors on Gulf sturgeon critical habitat are insignificant.

Designated critical habitat for Nassau grouper may be affected, but is not likely to be adversely affected by the following stressors: direct impact by fallen objects and vessel presence. Falling objects may directly affect benthic habitat and habitat used for shelter. However, the debris that could occur in Nassau grouper critical habitat would result from a mishap, in which case, the debris would be widely dispersed and scattered across an area significantly larger than the area of the critical habitat. The likelihood that a falling object directly hits benthic habitat would be extremely unlikely. Vessel presence may affect prey abundance by temporarily displacing prey for the short time the vessel transits through an area. However, limited and temporary vessel use is not expected to measurably affect the condition, distribution, diversity, abundance, or density of prey. Thus, the effect from stressors on Nassau grouper critical habitat is either discountable or insignificant.

Designated critical habitat for black abalone may be affected, but is not likely to be adversely affected by the following stressor: vessel pollution. Pollution from vessels may affect the water quality PBF of black abalone critical habitat. Given the limited and temporary use of vessels, pollution is not expected to measurably affect water quality of black abalone critical habitat. Thus, the effect from vessel pollution on black abalone critical habitat is insignificant.

Designated critical habitat for boulder star coral, lobed star coral, mountainous star coral, pillar coral, and rough cactus coral may be affected, but is not likely to be adversely affected by the following stressor: direct impact by fallen objects. Falling objects may directly affect substrate; however, it is extremely unlikely that debris from a mishap will occur within coral critical habitat (see Section 4.1.1.2). Falling objects may disturb the sediment at the seafloor as they settle, and affect water quality and the amount of sediment that settles on top of the reef. If debris impacts the seafloor in proximity to ESA-listed corals, the sediment would be temporarily resuspended, and would be dispersed by currents and water movement while in the water column. Water quality would be temporarily affected, only near the fallen object, and would return to normal conditions shortly after the object has settled. It is extremely unlikely that the displaced sediment would be of adequate volume to cover the coral habitat. Thus, the effect from direct impact by fallen objects on boulder star coral, lobed star coral, mountainous star coral, pillar coral, and rough cactus coral are discountable.

Designated critical habitat for elkhorn coral and staghorn coral may be affected, but is not likely to be adversely affected by the following stressor: direct impact by falling objects. Substrate quality and availability may be affected by falling objects; however, falling objects would only be present near critical habitat if there is a mishap. In that case, the objects would be widely dispersed within an area much larger than the critical habitat area, making it extremely unlikely critical habitat would be affected. Thus, the effect from direct impact by falling objects on elkhorn coral and staghorn coral critical habitat is discountable.

Proposed critical habitat for the Central North Pacific DPS and East Pacific DPS of green turtle may be affected, but is not likely to be adversely affected by the following stressor: vessel presence. Proposed critical habitat for the Central North Pacific DPS and East Pacific DPS of green turtle is categorized into different habitat types, each of which has its own set of PBFs. The PBFs within the habitat type that may be affected, but is not likely to be adversely affected by the proposed action is the benthic foraging/resting feature. Vessel use may affect the PBF related to food resources (i.e., prey), as it may temporarily displace prey for the short time the vessel transits through an area. However, limited and temporary vessel use is not expected to measurably affect the condition, distribution, diversity, abundance, or density of prey. Thus, the effect from vessel presence on Central North Pacific DPS and East Pacific DPS of green turtle proposed critical habitat is insignificant.

Proposed critical habitat for the North Atlantic DPS of green turtle may be affected, but is not likely to be adversely affected by the following stressors: direct impact by fallen objects, unrecovered debris, and vessel presence. Proposed critical habitat for the North Atlantic DPS of green turtle is categorized into different habitat units, each of which has its own set of PBFs. The PBFs within the habitat units that may be affected, but are not likely to be adversely affected by the proposed action include reproductive, migratory, benthic foraging/resting, and surface-pelagic foraging/resting. Direct impact by fallen objects may affect the availability of refugia. The area of critical habitat that Super Heavy, Starship, or associated debris could affect as it falls through the water column is relatively small (hundreds of square meters or less) compared to the area of benthic foraging/resting and surface-pelagic foraging/resting habitat (hundreds of thousands of square kilometers). Thus, it would be extremely unlikely that the amount of refugia would be affected by falling objects. Unrecovered debris may affect PBFs related to unobstructed waters and water depth. Unrecovered debris could create obstructions or affect water depth if they land in shallow areas where the size of the debris blocks the water column, as described above. The vehicles could obstruct areas or affect water depth in areas 30 ft (9 m) or shallower. However, this would be a temporary impact because an obstruction of a waterway is a clear navigational hazard, and SpaceX would be required to remove any obstruction. The size of Super Heavy and Starship are relatively small compared to the area of proposed critical habitat of this DPS, and would only temporarily obstruct a portion of the proposed critical habitat. Thus, the effects would not be expected to measurably affect the conditions of proposed critical habitat. Direct impact by fallen objects may affect PBFs related to refugia and prey resources. Falling objects and vessel presence may temporarily displace prey for the duration the object moves through the water column or vessels transit through the area. This is temporary and localized, and not expected to measurably affect the condition, distribution, diversity, abundance, or density of prey. Thus, effects from stressors on North Atlantic DPS of green turtle proposed critical habitat are discountable or insignificant.

Proposed critical habitat for the South Atlantic DPS of green turtle may be affected, but is not likely to be adversely affected by the following stressors: direct impact by fallen objects and unrecovered debris. Proposed critical habitat for the South Atlantic DPS of green turtle is categorized into different habitat units, each of which has its own set of PBFs. The PBFs within the habitat units that may be affected, but are not likely to be adversely affected by the proposed action include reproductive and benthic foraging/resting. Direct impact by fallen objects may affect the availability of refugia. For South Atlantic DPS green turtle proposed critical habitat, falling objects are only expected to occur if there is a mishap. In that case, the objects would be widely dispersed and scattered within an area much larger than the proposed critical habitat area (only 303 square kilometers), given the high altitude at which the mishap occurs. Thus, it would be extremely unlikely that the amount of refugia would be affected by falling objects. Direct impact by fallen objects may also affect PBFs related to food resources. Falling objects may temporarily displace prey for the duration the object moves through the water column. This is temporary and localized, and not expected to measurably affect the condition, distribution, diversity, abundance, or density of prey. Unrecovered debris may affect PBFs related to unobstructed waters. Unrecovered debris could create obstructions if they land in shallow areas where the size of the debris blocks the water column. However, this would be a temporary impact because an obstruction of a waterway is a clear navigational hazard, and SpaceX would be required to remove any obstruction. Thus, the effects would not be expected to measurably affect the conditions of proposed critical habitat. Thus, effects from stressors on South Atlantic DPS of green turtle proposed critical habitat are discountable or insignificant.

Proposed critical habitat for Rice's whale may be affected, but is not likely to be adversely affected by the following stressors: sonic booms and impulse noise, direct impact by fallen objects, vessel presence, vessel and vehicle pollution, vessel noise, aircraft overflight, in-air acoustic effects from vehicle landings and explosive events, heat from vehicle landings and explosive events, and underwater acoustic effects from explosive events. Acoustic-related stressors (sonic booms, impulse noise, vessel noise, in-air acoustic effects from vehicle landings and explosive events, and underwater acoustic effects from explosive events) may affect the PBF related to sufficiently quiet conditions for normal use and occupancy. Given the limited number of times and short duration that these activities will occur, in addition to the ineffective transmission of acoustic energy across the air-water boundary, these stressors are not expected to measurably affect acoustic conditions long-term. Direct impact by fallen objects and vessel presence may temporarily displace prey for the duration the object moves through the water column or vessels transit through an area. Given the temporary duration of those activities, these stressors are not expected to measurably affect the density, quality, abundance, or accessibility of prey. Vessel and vehicle pollution may affect the PBF related to the level of pollutants in marine water. However, given the limited vessel activity and number of times Starship and Super Heavy will be expended in a manner that facilitates pollutants entering the ocean and dispersion of pollutants in the ocean (i.e., explosive event), we expect the effects of vessel and vehicle pollution on proposed critical habitat will be so small as to be immeasurable. Heat from vehicle landings and explosive events may temporarily affect surface temperatures; however, the increase in temperature is extremely unlikely to affect the bottom temperature range specified in the PBF. Thus, effects from stressors on Rice's whale proposed critical habitat are discountable or insignificant.

We conclude the proposed action may affect, but is not likely to adversely affect designated or proposed critical habitats of the Main Hawaiian Islands Insular DPS of false killer whale, Central America DPS and Mexico DPS of humpback whale, Hawaiian monk seal, North Atlantic right whale, hawksbill turtle, leatherback turtle, Northwest Atlantic Ocean DPS of loggerhead turtle (with the exception of breeding habitat), Carolina DPS and South Atlantic DPS of Atlantic sturgeon, Gulf sturgeon, Nassau grouper, black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, Central North Pacific DPS, East Pacific DPS, North Atlantic DPS, and South Atlantic DPS of green turtle, and Rice's whale.

4.2 Status of the Species and Critical Habitat Likely to be Adversely Affected

The remainder of this opinion examines the status of each species and critical habitat that is likely to be adversely affected by the remaining stressor resulting from the proposed action: underwater acoustic effects from explosive events (Kemp's ridley turtle and Northwest Atlantic Ocean DPS of loggerhead turtle in the Gulf portion of the action area, North Atlantic DPS of green turtle and Northwest Atlantic Ocean DPS of loggerhead turtle in the Atlantic Ocean portion of the action area, and designated critical habitat of Northwest Atlantic Ocean DPS loggerhead turtle – breeding critical habitat). The status is an assessment of the abundance, recent trends in abundance, survival rates, life stages present, limiting factors, and sub-lethal or indirect changes in population trends such as inter-breeding period, shifts in distribution or habitat use, and shifts in predator distribution that contribute to the extinction risk that the listed species face. The status of each species below is described in terms of life history, threats, population dynamics, critical habitat, and recovery planning. The status of each critical habitat is described in terms of the PBFs essential to the conservation of the species; the status, function, and extent of those PBFs based on best available scientific and commercial data; and the conservation needs of the species in terms of habitat to support a recovered population.

The information used in each of these sections is based on parameters considered in documents such as status reviews, recovery plans, and listing decisions and based on the best available scientific and commercial information. This section informs the description of the species' likelihood of both survival and recovery in terms of their "reproduction, numbers, or distribution" as described in 50 CFR §402.02. This section also examines the condition of critical habitat throughout the species' range, evaluates the conservation value of the various components of the habitat (e.g., watersheds, ocean basins, and coastal and marine environments) that make up the designated area, and discusses the function of the essential PBFs that help to form that conservation value. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on the NMFS OPR web site (https://www.fisheries.noaa.gov/species-directory/threatened-endangered).

4.2.1 Life History Common to Green, Kemp's Ridley, and Loggerhead Turtles

ESA-listed sea turtles in the Gulf and Atlantic portions of the action area undergo the same general life stages: adult females nest and lay multiple clutches on coastal beaches, eggs are