Addendum to the October 2021 Biological Assessment for the SpaceX Starship-Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas Addressing Operation of a Deluge System

OCTOBER 2023

Introduction

In October 2021, the Federal Aviation Administration (FAA) prepared a Biological Assessment (BA) for the SpaceX Starship-Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas (FAA 2021). The BA supported Endangered Species Act (ESA) Section 7 interagency consultation between the FAA and the United States Fish and Wildlife Service (USFWS). The BA evaluated the effects to ESA-listed species and designated or proposed critical habitat of FAA's proposed issuance of commercial space licenses or permits to SpaceX. The USFWS issued a Biological and Conference Opinion (BCO) and Incidental Take Statement (ITS) for this action on May 12, 2022.

This Addendum to the BA evaluates the effects of an activity not fully considered in the October 2021 BA or the May 2022 BCO: the operation of a deluge system at the Vertical Launch Area (VLA). This Addendum also evaluates a new environmental baseline based on conditions after the test launch of the Starship-Super Heavy launch vehicle on April 20, 2023.

The action area defined in the October 2021 BA and May 2022 BCO, which approximates the extent of sonic boom impacts, extends approximately 13 miles around the VLA. This action area remains applicable to this Addendum.

Deluge System Components and Operation

Following the April 20, 2023 launch, SpaceX: (1) reinforced its launch pad foundation with thicker concrete and additional piles; and (2) installed steel plates over the foundation. Both of these actions are designed to protect against the potential of a pad breakup or a large dust cloud. The steel plates include a water-cooling element (i.e., deluge system) that can be activated to protect the steel plates during an engine ignition event and allow reusability of the steel plates.

SpaceX proposes to activate the deluge system during engine static fires and vehicle launches. Approximately 358,000 gallons of non-contaminated water would be pushed from ground tanks into the steel plates and released through holes in the plating. The deluge system would apply a large amount of water to rapidly cool and create a barrier between the steel plate and rocket exhaust that will help to absorb sound energy and heat produced by the rocket engines and would allow the steel plate to be reused.

Components

The deluge system includes the following physical components constructed within the boundary of the VLA. The physical components of the deluge system will not require an expansion of the VLA beyond the area previously considered in the October 2021 BA and May 2022 BCO. The effects of construction activities within the VLA boundary are already considered in prior consultations. The deluge system components are described here for context and to aid in understanding how the system will be operated.

Water Storage: A reliable water source is required to provide the necessary volume, flow, and pressure for the deluge system. Water sources could include potable water from trucks from the nearby town of Brownsville, clean water generating processes offsite, or collected rainwater. The deluge system water will be stored in water storage tanks located within one or more of the tank farm areas of the VLA.

Press Tank: The press tank is a storage tank pressurized with nitrogen gas at 3,000 pounds per square inch (psi). The press tank is connected to the water storage tank(s) to provide the driving force to expel the water when the deluge system is activated.

Pumping System and Piping Network: A system of pumps will move water from the water storage tanks to the piping network of the deluge system. The pumps provide the necessary pressure to ensure effective water distribution. The piping network is a series of interconnected pipes that distribute water throughout the deluge system. The piping network is designed to deliver the required amount of water to the launch pad and rocket.

Control System and Valves: The control system is used to activate and deactivate the deluge system and includes sensors, actuators, and a central control unit to monitor water levels, pressures, and system status. It allows operators to activate or deactivate the deluge system, adjust flow rates, and receive alarms or notifications regarding system performance or anomalies. Control valves are installed within the piping network to regulate the flow of water at various sections of the deluge system. These valves allow for manual or automated control over the distribution of water to different areas as required. Flow meters monitor and measure the amount of water being supplied by the deluge system. This information helps in maintaining the desired flow rates and ensuring adequate water supply.

Water Containment: Most of the water applied during deluge operations will be captured by containment structures within the VLA. These containment structures include gutters, a retention basin below the launch pad, one or more retention ponds, and berms. SpaceX has constructed retention areas within the VLA with a total capacity of 276, 000 gallons (Figure 1). Additional ponds may be constructed with potential capacity of 30,000 gallons. These containment structures also collect storm water within the VLA. Water captured by the containment structures and meeting water quality standards established by the Texas Commission on Environmental Quality (TCEQ) will be used to refill the water storage tanks to minimize the amount of potable water needed to be trucked in. Applicable TCEQ standards are included in Appendix A. Water that does not meet TCEQ quality standards will be removed from the containment structures and hauled to an industrial wastewater treatment facility outside the VLA.

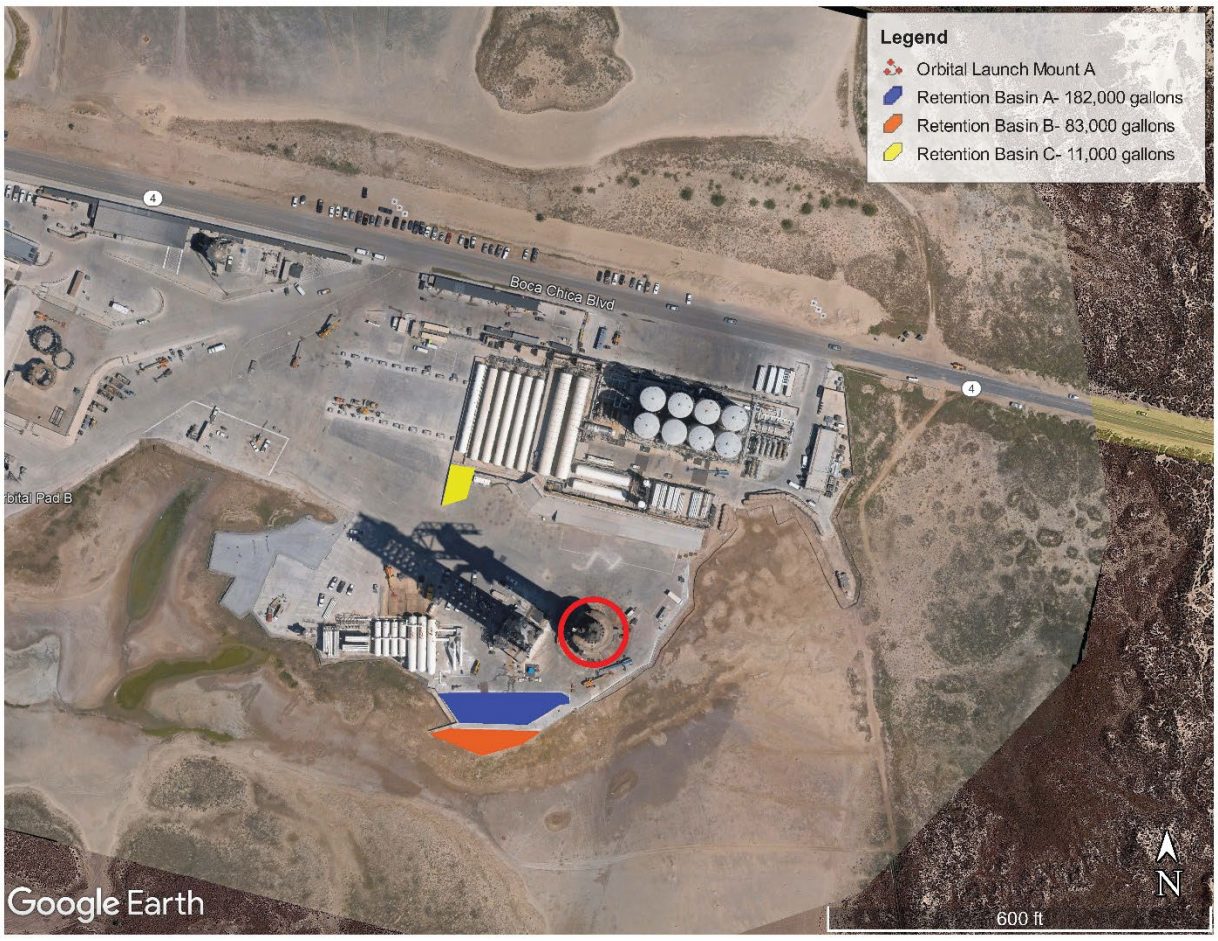


Figure 1 Existing Retention Pond Locations

Operation

The deluge system would be activated during each ignition event on the orbital launch pad including engine ignition tests and vehicle launches. The October 2021 BA and May 2022 BCO contemplate annual operations of up to [10] launches per year (see May 2022 BCO: Table 2). Each launch is associated with an estimated two static fire engine tests. The planned additional orbital launch mount will also include a deluge system and containment; however, design is not yet final. The construction of the additional orbital launch mount will not affect planned operational cadence. No deluge system is planned for the existing suborbital launch mount. Therefore, the deluge system may operate up to 30 times per year.

The deluge system would be activated immediately prior to an engine ignition event, allowing water to flow from the storage tanks, through the piping network, to the spray nozzles at the launch pad. Five seconds prior to ignition, water would begin discharging. Most of this pre-ignition water would be captured by the containment structures. In the event that stormwater runoff is collected in the retention pond, the retained water would be released in accordance with SpaceX's SWPPP prior to launch operations. The amount of water applied during activation of the deluge system will differ depending on the type of ignition event. It is estimated that approximately 72,000 gallons of water would be used for each static fire, and approximately 132,000 gallons of water for each launch event; however, for the purposes of this analysis, it is assumed that 358,000 gallons, the maximum volume of water available in

the tanks, could be used. In addition, 3,000 gallons of detonation suppression water (described below) would also be used during each operation. The peak flowrate would be between 100,000 gallons per minute and 260,000 gallons per minute.

Water applied during operation of the deluge system would disperse in the following ways. For the purposes of this assessment, it assumed that the maximum amount of water could be dispersed by a combination of all dispersal methods described below. Based on modeled and collected data from the deluge tests, most of the water prior to engines startup and following engine shutdown would be collected in the retention areas or pushed out and 92% of the of the water would vaporize when engines are on. The exact proportion of the water involved in each mode of dispersal may vary with the specific conditions of each ignition event.

Overland Sheet Flow: Some of the deluge water would disperse over land as sheet flow. Most of the sheet flow will be contained within the VLA by the water containment structures and confined to the existing developed area of the VLA. It is possible that some sheet flow would either evade or overwhelm the containment structures and enter into the areas immediately adjacent to the developed area of the VLA. It is expected that most of the sheet flow would not travel beyond the expanded, unconstructed area of VLA boundary.

Push Out: During an ignition event, some of the water applied by the deluge system could be pushed by the rocket thrust past the containment structures beyond the boundary of the existing developed area of the VLA. Similar to the possible extent of overland sheet flow, it is expected that pushed water would infiltrate the areas immediately adjacent to the site, or flow into adjacent water bodies. The exact volume of water that may be pushed away and the distance that it will carry is likely to vary with the specific conditions of each ignition event.

Vaporization: The heat and the thrust from the rocket fire would quickly vaporize most of the water applied by the deluge system and would generate a cloud of steam and aerosolized mist. Based on the amount of water, the heat of the plume is expected to dissipate quickly, and the majority of the vapor cloud is expected to take the form of aerosolized mist near the VLA. The vapor cloud would extend over the land and into the air as it is energized by the heat of the rocket plume. The temperature of the vapor cloud would depend on the temperature of the heat plume. With the addition of the water, the distance the heat travels is expected to be less than analyzed in the October 2021 BA and May 2022 BCO. It is expected that the vapor cloud would disperse within five minutes of an engine ignition event. As a conservative estimate, SpaceX expects the maximum extent of the vapor cloud to be no greater than the extent of the heat plume: the 0.6-mile radius analyzed in the October 2021 BA and May 2022 BCO. Since the vaporization would occur from the thrust and heat of the vehicle, it is not expected water vapor would form beyond the extent of the modeled plume. The fate of the vapor cloud as it cools would be either evaporation or condensation.

Evaporation: Water can be considered evaporated when it transitions from a liquid to a gas and becomes dispersed in the air, contributing to the overall moisture content of the atmosphere. The specific point at which water vapor is considered to have evaporated into the atmosphere is not well-defined, as evaporation is an ongoing process influenced by various factors such as temperature, humidity, and air currents. It is possible that most or all of the vapor cloud would evaporate instead of condense, and would remain in the atmosphere instead of falling back to the surrounding area.

Condensation: As the vapor cloud begins to cool, water molecules come together to form liquid droplets. Condensation may create clouds in the air or fog near the ground. Condensed water may fall as rain or form dew on vegetation and other surfaces. Though, the expectation of the range of impacts would be a 0.2-mile radius based on recorded data described below, weather conditions for future operations may vary from those conditions observed during the April test flight, such as winds, humidity, and temperature, therefore a conservative 0.6-mile radius is used to as the potential distance of the extent of the condensation directly attributable to condensation of the vapor cloud. Beyond that distance, evaporated water from the vapor cloud would be greatly dispersed and mingled with other atmospheric moisture.

Ablation: Launch mount structures, flame deflectors, noise suppression systems, framing, and mobile launch platforms are common steel components used across the rocket launch and testing industry. During engine ignition of the Starship/Super Heavy, surfaces of the steel infrastructure can experience ablation. Ablation is the mechanical erosion of steel from the surface of the metal as result of exposure to heat and force and is a common consequence from launch vehicle plumes on launch infrastructure[1]. The Starship-Super Heavy plume when in contact with the steel divertor could ablate up to 190 pounds of steel per launch. Relative to launch systems that use different solid propellant systems with high metal content, like the Space Shuttle and the Space Launch System, the metal from ablation associated with Starship is extremely minimal. The minimal nature of any steel ablation associated with Starship relative to other systems would have no significant environmental effect. There has never been any previous analysis or modeling done to quantify and assess metals from ablation of steel launch pad infrastructure. Nonetheless, impacts from metals from the plumes of solid rocket boosters (SRBs) used on the Space Shuttle have been analyzed by the National Aeronautics and Space Administration (NASA)[2] and are a reasonable proxy to determine the significance of minimal steel ablation. SRBs are made up of a solid propellant mixture consisting of ammonium perchlorate, aluminum, and iron oxide that react to produce hot gases at high speed creating thrust which resulted in deposition of metals from the plume of the vehicle. Starship-Super Heavy is powered by Raptor engines which use liquid oxygen and liquid methane as propellants, not SRBs. As such, for Starship-Super Heavy, no metals are present nor would be produced from the combustion of these propellants. The ablation from the steel plating is not a consequence of a chemical reaction from the vehicle but rather a localized event occurring when the plume contacts the stainless-steel plate compromised of chromium, nickel, and iron. This ablation results in substantially lower levels than are produced by the full burning of the SRBs.

During launch of the Space Shuttle, the SRBs caused acid and particulate deposition around the launch pad in both the near- and far-fields. This deposition was made up primarily of aluminum oxide and hydrogen chloride, occurring due to atomization of the deluge water by the turbulence of the launch vehicle exhaust. As analyzed in the *Ecological Impacts of the Space Shuttle Program at John F. Kennedy Space Center*[2] and *Final Constellation Programmatic Environmental Impact Statement*[3], near-field impacts (launch pad to approximately 1 mile) were generally within the immediate vicinity of the launch complex[2]. Far-field deposition was dependent on atmospheric and meteorological conditions and generally was within a few miles of the launch complex, but some launches did result in deposition across Kennedy Space Center and/or Cape Canaveral Space Force Station. The Space Shuttle exhaust had 28,048 kilograms (61,835 pounds) of aluminum-based metals and 14,000 kilograms (30,864 pounds) of hydrogen chloride (NASA 2014).

[1] https://www.faa.gov/sites/faa.gov/files/space/environmental/nepa_docs/Antares_V2_FINAL_SEA.pdf
[2] https://ntrs.nasa.gov/citations/20140012489
[3] https://netspublic.grc.nasa.gov/main/207909main_Cx_PEIS_final.pdf

Post-launch soil analysis found aluminum, copper, iron, lead, manganese, and zinc. Zinc concentrations above background levels were due to the large amounts of corrosion control materials on the launch pads and mobile service platform services, as SRB exhaust blasts were known to strip the coating off these exposed surfaces[2]. This type of stripping is not present for Starship-Super Heavy launches.

Near-field impacts to vegetative communities varied by strata, but generally shrubs and small trees were eliminated by repeated defoliation more rapidly than forbs and graminoids. Near-field impacts to dunes occurred from some launches, but vegetation recovery was nearly complete within six months. Impacts to the dunes were found to be infrequent and cumulative changes in vegetation did not occur. NASA found far-field deposition to be sufficiently dispersed and variable launch-to-launch that successive launches seldom affected the same areas. No changes in plant community composition or structure due to cumulative effects of far-field deposition were seen**Error! Bookmark not defined.Error! Bookmark not defined.**.

No federally listed threatened or endangered species were directly identified as being killed as a result of a launch event. Results of monitoring launch impacts have shown no long-term macro-scale negative responses. Ecological communities persisted through the duration of the Space Shuttle program with no dramatic change in species composition or distribution**Error! Bookmark not defined.**.

Unlike the Space Shuttle, no heavy metals are present in the Starship/Super Heavy rocket plume. Metals could be ablated from the steel divertor and deluge plate and intermix with the Starship-Super Heavy plume and deluge water during launch. However, the potential 190 pounds of heavy metals (approximately 18% chromium, 74% iron, and 8% nickel) makes up less than 0.3 percent of the heavy metals (aluminum compounds) seen during Space Shuttle launches. The Boca Chica Launch site is further from bodies of water than Launch Complex 39A and B, reducing the potential for both near- and far-field impacts to aquatic species. Vegetative communities at Boca Chica are primarily wetland plants such as salt grass and shore grass, which would be expected to have similar impacts as those seen during the Space Shuttle program.

SpaceX sampled the deluge water used during the August 6 and August 25, 2023 static fire testing events at the Boca Chica launch pad (Table 1). Trace amounts of arsenic, barium, fluoride, and nitrate were present in the results and comparable to the quantities found in the potable source water. Higher levels of chromium, zinc, (components of stainless steel) aluminum, iron, and total suspended solids were seen in the initial tests. However, this was most likely due to remnants of stainless steel remaining in the deflector after being manufactured and residual rust in the water holding tanks and associated piping. Levels of chromium, aluminum, iron, zinc, and total suspended solids have since decreased dramatically with the second test showing below the numeric effluent limitations found in TCEQ's Industrial Stormwater multi-sector general permit. It is not expected the deluge water would contain any pollutants during future operations.

The amount of ablation would vary during each ignition event but is not expected to exceed 190 lbs. The metal components of the steel could remain localized to the launch pad, captured in the deluge water and retained onsite, or dispersed in vapor the plume. Prior to and following a launch event, SpaceX would sample the soil, water and air adjacent to the launch pad for components of stainless steel including but not limited to total chromium, iron, and nickel.

Based on the deluge water results, NASA's monitoring and analysis during and after the Space Shuttle program, and the chemical properties associated with SRB's and Starship's different propellants, the amount of metal in Starship-Super Heavy exhaust plume from the minimal amount of ablation on the stainless divertor would have no long-term negative effects to ecological communities and have no significant impact on biological resources, water resources, or soils and geology.

Table 1. Analytical results from Water Deluge Sampling

Parameter	Potable Source Water	Sample Event 2 Static fire (off pad)	Sample Event 2 Static fire (retention pond)	Sample Event 4 Static fire (off pad)	Sample Event 4 Static fire (retention pond)	Sample Event 4 Static fire central outfall	
Date	8/18/2023	**8/6/2023**	**8/6/2023**	**8/25/2023**	**8/25/2023**	**8/25/2023**	**Units**
Arsenic, Total	0.00305	0.00156	0.00194	0.00583	ND	0.00657	**mg/L**
Barium, Total	0.169	0.0945	0.611	0.0922	0.122	0.113	**mg/L**
Cadmium, Total	ND	ND	ND	ND	0.00321	0.00237	**mg/L**
Chromium, Total	0.00122	ND	0.00675	0.00585	0.00697	0.0066	**mg/L**
Copper, Total	0.00602	0.00865	0.0233	0.00471	0.0155	0.00705	**mg/L**
Lead, Total	ND	ND	0.001	ND	ND	ND	**mg/L**
Mercury, Total	ND	0.363	0.224	ND	ND	ND	**ug/L**
Selenium, Total	ND	0.00226	ND	0.014	ND	0.0173	**mg/L**
DW Nitrate-Nitrogen Total	0.305	1.57	0.291	1.07	0.369	0.483	**mg/L**
DW Nitrite-Nitrogen, Total	ND	0.283	0.327	0.0634	0.0503	0.15	**mg/L**
Fluoride	0.643	1.34	0.72	0.805	0.61	0.525	**mg/L**
Cyanide, total	0.006	0.112	0.0414	0.0414	0.299	0.0336	**mg/L**
Laboratory pH	7.9	7.5	8.4	8.1	8.2	7.4	**SU**
Total Alkalinity (as CaCO3)	118	69.7	90	112	115	163	**mg/L**
Total Hardness (as CaCO3)	260	460	250	603	240	560	**mg/L**
Aluminum, Total	0.0614	0.415	0.833	0.218	0.951	0.952	**mg/L**
Calcium	68.8	152	66.8	149	69.5	143	**mg/L**
Copper, Total	0.00608	0.0085	0.0208	0.00506	0.0133	0.00839	**mg/L**
Iron, Total	0.0687	13.6	7.93	0.15	0.619	0.35	**mg/L**
Manganese, Total	0.00393	0.289	0.163	0.0179	0.0262	0.0223	**mg/L**
Sodium	136	618	143	792	135	517	**mg/L**
Zinc, Total	0.00721	0.0077	0.383	0.00695	0.18	0.0821	**mg/L**
Chloride	143	881	147	1070	152	4080	**mg/L**

Parameter	Potable Source Water	Sample Event 2 Static fire (off pad)	Sample Event 2 Static fire (retention pond)	Sample Event 4 Static fire (off pad)	Sample Event 4 Static fire (retention pond)	Sample Event 4 Static fire central outfall	
Date	8/18/2023	8/6/2023	8/6/2023	8/25/2023	8/25/2023	8/25/2023	Units
Fluoride	ND	1.38	ND	5.3	ND	ND	mg/L
Sulfate	232	337	230	402	232	630	mg/L
Total Dissolved Solids	700	1950	530	2450	660	7880	mg/L
Chemical Oxygen Demand	24.6	ND	ND	21.7	ND	33.2	mg/L
Phosphorus (as P), total	22.5	0.172	0.0694	0.277	0.176	0.0975	mg/L
Fluoride	ND	1.45	ND	ND	ND	ND	mg/L
Nitrate-Nitrite Nitrogen	ND	2.55	0.838	0.912	ND	ND	mg/L
Total Suspended Solids	ND	370	34	34.9	15.5	52.7	mg/L
Total Kjeldahl Nitrogen	1.28	0.959	0.588	1.29	1.3	1.94	mg/L
Biochemical Oxygen Demand	3.13	8.31	4.39	4.85	4.82	7.69	mg/L
Nitrogen, Total	1.28	3.509	1.426	2.202	1.3	1.94	mg/L

Other Pad Water Systems

A detonation suppression system would also be activated during ignition events. The detonation suppression system is independent of the deluge system. The source of the water for the detonation suppression system is stored in a separate tank. It sprays approximately 3,000 gallons of non-contaminated water downward from the nozzles installed on the launch mount ring and is intended to prevent detonations resulting from free methane mixing in air and autoigniting during launch operations. The water would be dispersed in the same ways described above for the deluge water. It is expected that of the approximately 3,000 gallons of water from the detonation suppression system, most (if not all) would be vaporized by the heat of the rocket engines.

In addition, the FireX system[4] would be activated only in the event of a fire on the launch pad. The FireX system is capable of releasing 120,000 gallons of water; however, it is anticipated that approximately 20,000 gallons would be used in the event of a fire on the launchpad. The final volume may vary depending on the fire. Most of the water not vaporized by the fire would be collected in the retention areas on the VLA. This would be an unexpected, off-nominal event and is not considered in the analysis of the BA.

Deluge System Impact Area

This Addendum addresses the effects of deluge system operation and the detonation suppression system. Operation of the deluge system would have physical consequences within an impact area defined by the distance that applied water disperses across the landscape. The maximum expected distance that water would disperse during deluge system operation is 0.6-mile, based on the expected distance of the vapor cloud and subsequent condensation (Figure 2). This is the same distance as the impact area for the heat plume and is contained within the action area defined and evaluated in the October 2021 BA and May 2022 BCO.

[4] The FireX system is a separate system from the detonation suppression system and deluge system and is used in the event of a fire on the launch pad.

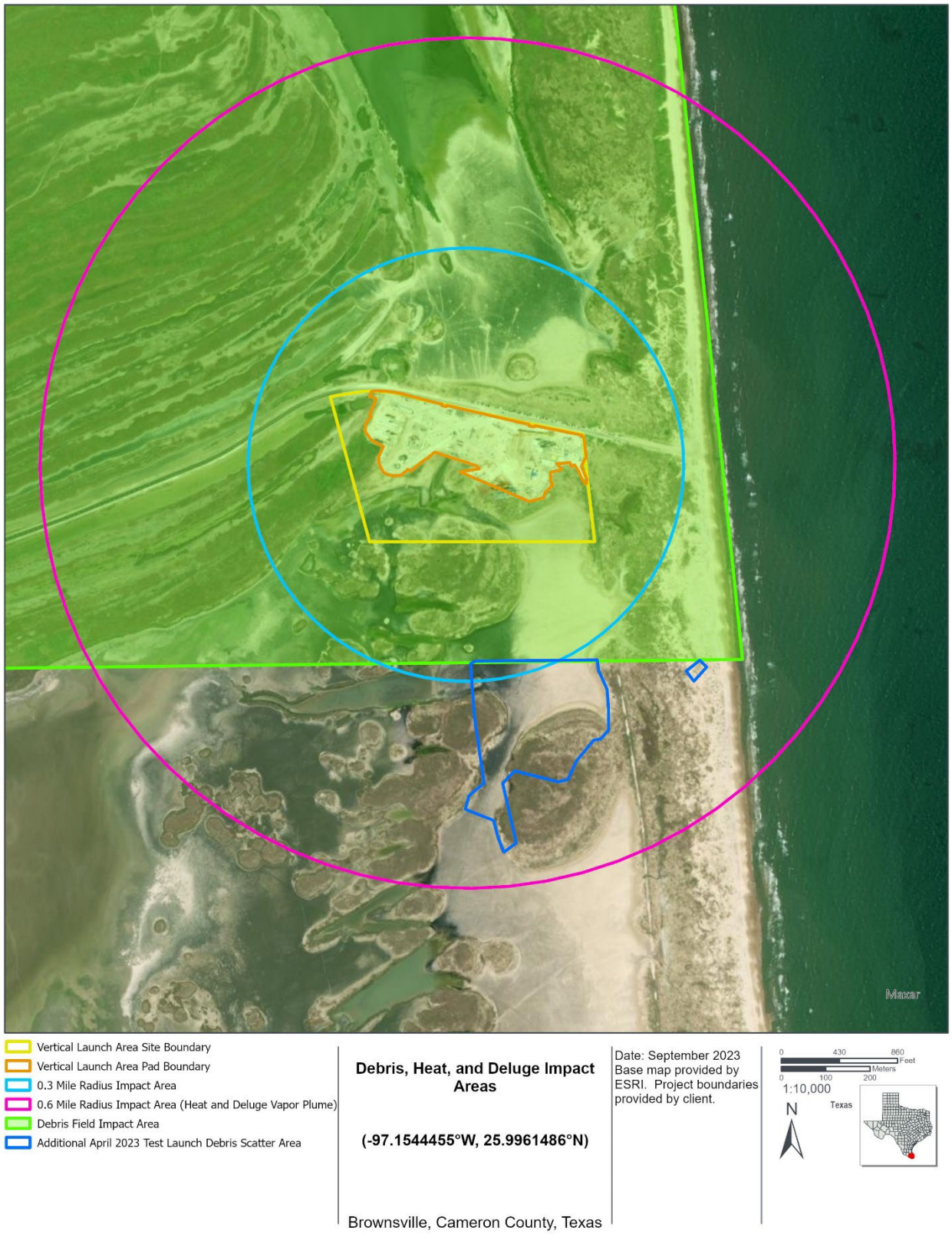


Figure 2. Deluge Impact Area

Updated Environmental Baseline

The USFWS's Information for Planning and Consultation (IPaC) system was queried on October 2, 2023, for an official species list for the action area (Appendix B). The official species list identified 17 ESA-listed endangered, threatened, proposed, or candidate species and designated critical habitat for the piping plover (Table 2; USFWS 2023a). The May 2022 BCO also considers proposed critical habitat for the red knot, which is included on Table 2.

The cactus ferruginous pygmy-owl was not considered in the May 2022 BCO and was not on the October 2, 2023 IPaC list. The pygmy-owl was listed as threatened effective August 21, 2023 (USFWS 2023b). The pygmy-owl has a range that includes Cameron County, Texas (USFWS 2022). Therefore, the pygmy-owl is included in Table 2 and considered in this Addendum.

The tricolored bat was also not considered in the May 2022 BCO and was not on the October 2, 2023 IPaC list. The tricolored bat was proposed for listing on September 14, 2022 (USFWS 2022b). The tricolored bat has a range that includes Cameron County, Texas (USFWS 2021). Therefore, the tricolored bat is included in Table 2 and considered in this Addendum.

The monarch butterfly is a candidate species and under consideration for listing. However, candidate species are not subject to evaluation under ESA Section 7 and, therefore, the monarch is not addressed in this Addendum.

The Mexican fawnsfoot and Salina mucket are proposed endangered and listed on the IPaC report. Both species have proposed critical habitat, but not within Cameron County. The action area does not overlap the current or historic ranges of these two species as reported in the July 2023 Species Status Assessment for these species (USFWS 2023d). Therefore, neither of these species nor their proposed critical habitats are addressed in this Addendum.

USFWS also requested consideration for the star cactus and Walker's manioc, two other endangered plants. However, neither of these plants has a current range that extends into Cameron County or the action area (TPWD 2023a, TPWD 2023b). These two plants are not addressed in this Addendum.

Table 2. Endangered Species Act Listed Species and Designated Critical Habitat in Cameron County, Texas

Mammals	**Status**
Gulf Coast Jaguarundi (*Puma yagouaroundi cacomitli*)	Endangered
Ocelot (*Leopardus (=Felis) pardalis*)	Endangered
West Indian Manatee (*Trichechus manatus*)	Threatened
Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered

Birds	**Status**
Eastern Black Rail (*Laterallus jamaicensis ssp. Jamaicensisi*)	Threatened
Northern Aplomado Falcon (*Falco femoralis septentrionalis*)	Endangered
Piping Plover (*Charadrius melodus*)	Threatened
Red Knot (*Calidris canutus rufa*)	Threatened

Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*)	Threatened

Reptiles	**Status**
Green Sea Turtle (*Chelonia mydasi*)	Threatened
Hawksbill Sea Turtle (*Eretmochelys imbricata*)	Endangered
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	Endangered
Leatherback Sea Turtle (*Dermochelys coriacea*)	Endangered
Loggerhead Sea Turtle (*Caretta caretta*)	Threatened

Flowering Plants	**Status**
South Texas Ambrosia (*Ambrosia cheiranthifolia*)	Endangered
Texas Ayenia (*Ayenia limitaris*)	Endangered

Critical Habitats	**Status**
Piping Plover (*Charadrius melodus*)	Final
Red Knot (*Calidris canutus rufa*)	Proposed

Wildlife

The USFWS published a proposed rule on July 15, 2021, to designate critical habitat unit TX-11 in South Bay and Boca Chica for the red knot. This proposed rule was revised and republished on April 13, 2023 (USFWS 2023c). The revisions included a change to the proposed boundaries of critical habitat unit TX-11. Figure 3 shows the currently proposed boundary of critical habitat unit TX-11. However, the May 2022 BCO already considered the revised boundary in the analysis of effects (see Figure 21 of the BCO).

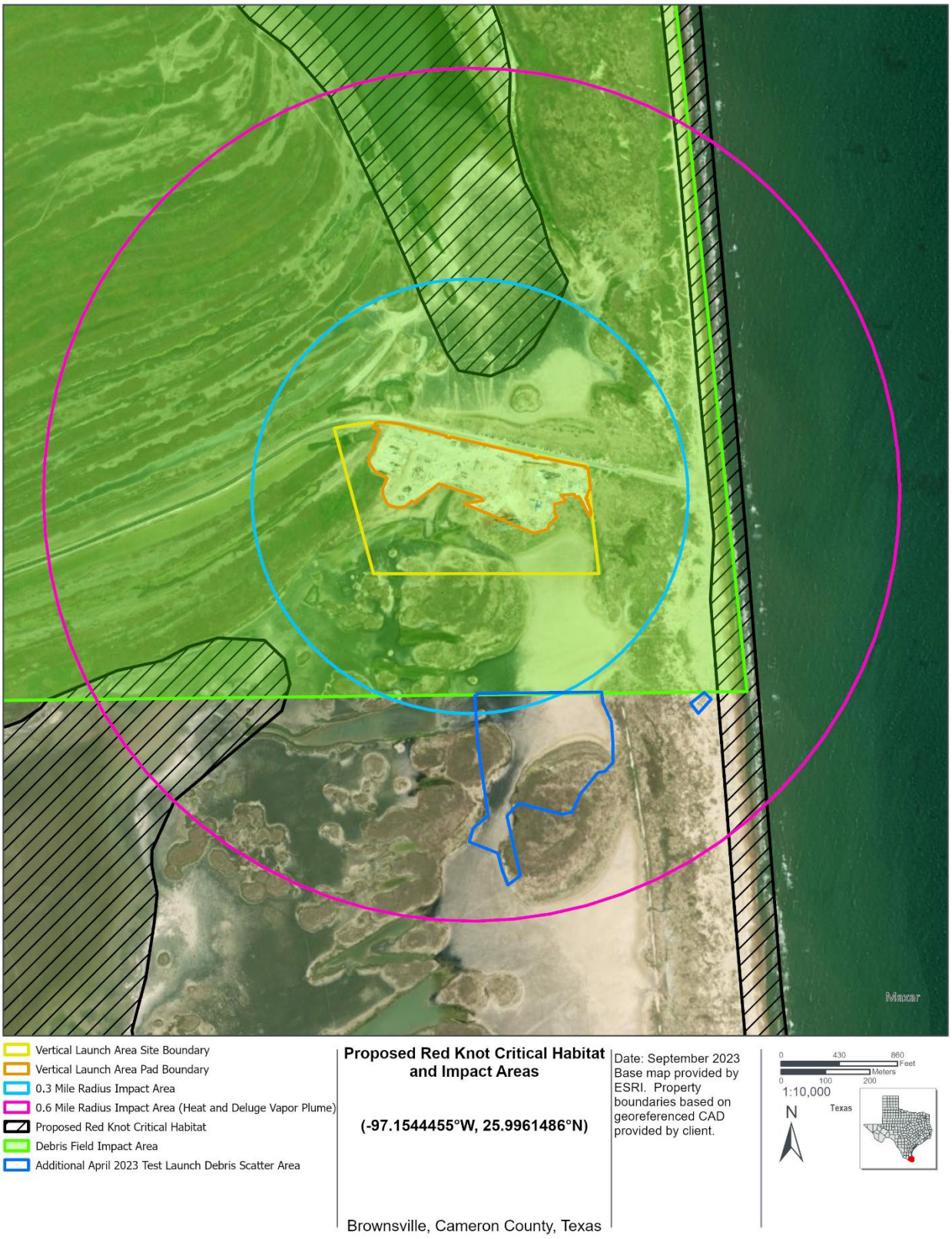


Figure 3. Proposed Red Knot Critical Habitat

SpaceX has been implementing a biological monitoring program in the vicinity of the VLA since 2015 that includes annual avian monitoring and vegetation monitoring (University of Texas 2021). The avian monitoring program includes the piping plover, red knot, and aplomado falcon as target species. The vegetation monitoring targets the area adjacent to the VLA in Boca Chica, Texas. Both types of monitoring occur in the deluge system impact area.

Since the publication of the May 2022 BCO, SpaceX has deployed avian biologists from SWCA Environmental Consultants (SWCA) with experience monitoring for coastal shorebirds to implement monthly surveys (starting in July 2022) as part of the avian monitoring plan. SpaceX deployed biologists from Raba Kistner and SWCA for additional avian monitoring immediately before and after the April 20, 2023 launch. During the pre-launch survey on April 16, 2023, a total of 67 piping plovers, 13 snowy plovers, and 65 Wilson's plovers were observed, no aplomado falcons or red knots were observed. During the post-lunch survey conducted on April 22 and April 23, 2023, 22 Piping Plovers, 15 Snowy Plovers, 11 Wilson's Plovers, and 74 Red Knots, and no aplomado falcons were observed. No deceased species were observed along any of the routes during pre- or post-launch surveys (Raba Kistner 2023a).

Trend analysis of the data collected by University of Texas Rio Grande Valley (UTRGV) from 2015 to 2021 found little to no evidence of meaningful trends, either increasing or decreasing, in the number of birds observed through time. SWCA's survey data from July 2022 to June 2023 (Appendix C) are consistent with the natural, varied cycles of the target species. Additional years of data collection will likely allow for a more definitive conclusion regarding whether potential trends are more likely the result of background variation and sampling issues rather than trends in abundance. Only one aplomado falcon was observed several miles away from the VLA during the 10 months of surveys.

Vegetation

Vegetation monitoring near the VLA has tracked the composition and extent of three different habitat types that are present adjacent to the VLA: low-lying and unvegetated mud flats, a transition zone of halophytic vegetation, and short "hind dunes" (referred to in the monitoring reports as 'Bare', 'Transition', and 'Dune' communities). The monitoring also tracks encroachment ('creep') of vegetation at the transition between the unvegetated mud flats and halophytic salt flats. The vegetation monitoring report published in 2021 by UTRGV was previously evaluated in the May 2022 BCO. Since then, results from the 2022 vegetation monitoring were released and used for the evaluation in this report.

Between 2021 and 2022, total plant cover within different habitat types was highly variable. There was a 57% decrease in total live plant cover in mudflats (from 1.87% to 0.80%) and a 20% decrease in transition plots (from 17.57% to 13.97%); however, live plant cover changed little in dune plots (from 26.2% to 26.4%), and there was a 20% increase in creep plots (from 15.7% to 18.8%). This was the lowest plant cover observed in mudflat and transition plots since 2018, and for transition plots this represents a continuing decline in plant cover. Creep plots also exhibited a gradual increase in plant cover.

UTRGV identified two possible alternative explanations regarding the observed differences between plant communities in the monitoring and take zones: First, it is possible that some of the observed differences be explained by additional factors that have not been quantified or analyzed, such as proximity to the road or differences in elevation. Second, it is possible that proximity to the launch pad is having more and/or stronger effects on plant communities than UTRGV was previously able to detect because the operational distance for this proximity effect is greater than the cutoff between monitoring zone categories. Much of the variation observed over the past 7 years of monitoring has been within the range

of natural variability, but some large changes attributable to land use change at the launch pad have also been observed (Appendix D). Primary constituent elements essential for conservation of piping plovers includes intertidal flats with sand and/or mud flats with no or very sparse emergent vegetation (65 FR 41782). The monitoring to date has not detected increased vegetation in the mudflat monitoring plots.

Reporting from the vegetation monitoring conducted by Raba Kistner within the 0.6-mile radius area surrounding the VLA following the April 20 launch shows minimal damage to vegetation, consisting of sand and debris. Larger vegetation damage patterns were identified approximately 360 feet southwest and southeast of the VLA. Damage to the northern and western portions of the study area consisted of sand deposits and launch pad debris, with no other changes identified. The southeastern portion of the study area contained minor sand deposits and debris, with no loss of vegetation identified. The study areas surrounding the VLA and south of the VLA exhibited the most damage, consisting of heavy sand deposits, debris, and 3.5 acres of fire damage (Raba Kistner 2023b). No discoloration, browning or death of vegetation has been noted as result of the rocket heat plume or from the sand. Evaluation of the fire damaged area shows that the fire resulted in a temporary reduction of upland shrubs, in particular *Sophora tomentosa* (Hicks and Contreras 2022). Based on the vegetation recovery documented to date, habitat function and ecosystem services should return to pre-burn levels within one to two growing seasons (Hicks and Contreras 2022). Long-term impacts from the sand deposited on vegetation is not expected.

Changes to Habitat from Previous Anomalies

Following engine ignition and lift-off of the April 20 test flight, it became clear immediately that the pad deck under the launch mount had sustained unanticipated damage, which directly caused concrete debris and dust to be expelled into the air and deposited in the vicinity of the launchpad in an approximately 1,000-acre area. The majority of the debris was concrete detritus from the damaged VLA. The remaining debris was fondag (refractory concrete used for thermal protection) from the launchpad and debris from the vehicle. A small (approximately 4%) amount of debris was deposited outside of the area previously analyzed in the 2022 PEA in an area of approximately 20 acres (Figure 3). SpaceX has undertaken a comprehensive redesign of the pad deck infrastructure in order to avoid a recurrence of the pad failure from the April 20 test flight.

Critically, SpaceX's revised approach to pad infrastructure is designed to resolve the dust and debris consequences associated with the test flight pad deck anomaly in three critical respects:

1. **Improved Pad Deck Foundation**. The improved depth and robustness of the pad foundation will ensure that the concrete debris and dust seen during the test flight, which was principally sand from underneath the earlier pad foundation that was ejected into the air, does not recur—if the pad deck does not fail, there will not be debris or dust which previously resulted from the failure;
2. **Steel Plating**. The steel plating will prevent fracture of the concrete pad deck foundation and is substantially more survivable than the Fondag (refractory concrete) material used during the test flight. Additionally, steel plating is analytically more predictable with respect to erosion as compared to Fondag, allowing SpaceX to better anchor its models with respect to the pad infrastructure;
3. **Water Cooling**. While the primary mitigation for dust and debris is the steel plates, SpaceX will implement the water cooling system as an additional measure. This system, as implemented in combination with the steel plates and improved foundation, will have a secondary but

important benefit of further mitigating dust and heat while enhancing the reusability of the redesigned pad system.

SpaceX's improvements to the Starship pad systems are derived from lessons learned and data gathered from the first orbital flight of Starship, consistent with continuous development for new launch vehicle systems. In preventing a recurrence of the pad deck failure, SpaceX's redesign also solves for the dust and debris generation that occurred as a consequence of the pad deck failure during the first test flight and is not reasonably foreseeable for future missions.

Following the test flight, SpaceX coordinated with TPWD to retrieve debris; however, TPWD requested the remaining debris be left in place due to the presence of nesting birds in the area. TPWD also requested that remaining debris retrieval take place following the nesting bird season. The debris left in place during bird nesting season is non-hazardous, and does not pose a risk to wildlife. Debris from previous anomalies has been removed in coordination with the land managing agencies, and SpaceX is investigating restoration measures for damaged lands in accordance with the Memorandum of Agreement between SpaceX and TPWD (2022 PEA, Appendix K).

The 3.5-acre fire that resulted from the test flight occurred on upland habitat. An assessment of the fire was conducted 22 days after the fire. Significant regrowth of grasses was observed. A single blue crab exoskeleton was observed in the burn area; however, it is unclear if the fire caused the mortality. No evidence of direct impacts to any federally listed species was found. The surveyors noted that impacts to wildlife appeared similar to those which would occur during a prescribed burn in comparable habitats and that prescribed burns are routinely used to improve habitat. The fire occurred within piping plover critical habitat (Unit TX-1) and near proposed critical wintering habitat for red knot (Unit TX-11). However, upland habitat is not suitable habitat for piping plovers or red knots.

Consequences of Deluge System Operation

Operation of the deluge system will have the following physical consequences that might be relevant to the species and critical habitats considered in this Addendum.

Deluge System and Detonation Suppression System Water

Several spacecraft launch and testing facilities around the world employ deluge systems to improve operational safety, absorb vibrations, and protect the integrity of the launch pad infrastructure. Notable examples include the Kennedy Space Center in Florida, the Vandenberg Space Force Base in California, the Baikonur Cosmodrome in Kazakhastan, and the Satish Dhawan Space Centre in India.

Consistent with these other sites, SpaceX has proposed to use a deluge system to cool the area around the VLA and absorb vibrations to improve safety and protect infrastructure so it can be reused. SpaceX has installed a steel plate below the launch pad after the April 20, 2023 launch. Without the water-cooling element, this steel plate could melt and would need to be replaced after each launch attempt.

The operation of the deluge system would also help mitigate the risk of fires igniting in or spreading through adjacent vegetated areas, either within the unconstructed portion of the VLA or outside of the VLA. Deluge system water may exit the launch pad and the constructed portion of the VLA as overland sheet flow, as push out, or as a vapor cloud. Overland sheet flow and push out water will remain close to

the launch pad (within a few hundred feet), which could at least partially mitigate fire within the unconstructed part of the VLA (where most of the vegetation adjacent to the VLA occurs) by dousing the surrounding area with water (a fire prevention tactic). The vapor cloud and any resulting condensation could help suppress fire beyond the VLA.

Vegetation Changes

An influx of freshwater from deluge system operations could increase the amount of vegetation creep into the bare areas of the mud flats. Due to the extremely saline conditions of the mudflats, it is not anticipated that creep would be from non-native species. The vegetation monitoring has not shown an increase in non-native species in the monitored creep plots (Appendix D). When freshwater is added to vegetated areas, it can promote the growth of existing plants and encourage the expansion of their root systems. As plants grow and spread, they may extend their roots into adjacent areas, including the mud flats. However, some plants may not be adapted to the salinity, sediment composition, and availability of nutrients and struggle to establish in the mud flats. The amount of fresh water likely to leave the constructed part of the VLA by overland sheet flow, push out, or condensation is comparable to slightly increased rainfall runoff, so the potential for significant vegetation changes is low.

The operation of the deluge system would apply a maximum of approximately 361,000 gallons per operation (static fire or launch) in combination with the detonation suppression system. Most of the water would be collected in the containment structures or vaporized, although the specific amount in either volume or relative percentage is unknown and may vary across ignition events. For the purposes of this analysis, SpaceX estimates that 92% of the 358,000 gallons of water is vaporized during engine ignition and approximately 20% of the total water (approximately 71,000 gallons) assumed to be dispersed outside the constructed portion of the VLA as overland sheet flow, push out, or condensation. The 20% of the water that would be dispersed outside the constructed area would mainly be from the water that is released during the first five seconds prior to engine ignition and the water released after engine shutdown or launch. Once the engines ignite, the heat is expected to vaporize any water coming out of the deluge system. Using video from the April test flight, the approximate distance the heat plume advances before stopping is approximately a 0.2-mile radius. With the addition of the steel plate deflector, this radius is expected to be reduced due to the additional mass being added to the system. Additionally, temperature data recorded during the April test flight, when extrapolated, shows a predicted temperature of 80°F at approximately a 0.3-mile radius. Though, the expectation of the range of impacts would be a 0.2-mile radius, weather conditions for future operations may vary from those conditions observed during the April test flight, such as winds, humidity, and temperature, therefore a conservative 0.6-mile radius is used to as the potential distance the plume/vapor cloud could reach. This 0.6-mile radius is equal to about 723 acres. If 71,000 gallons were dispersed evenly across the entire 0.6-mile deluge system impact area, it would equate to 0.003 inches of water over this entire area. For the 0.3-mile radius zone with a 181-acre area, the amount of water dispersed evenly throughout would equate to 0.014 inches of water over this entire area. The estimated 20% of water not captured within a 300-foot zone surrounding the launch pad equates to 0.40 inches of water over the 6.5 acres.

The National Oceanic and Atmospheric Administration (NOAA) provides historical data on rainfall averages for various locations. According to their data, the average yearly precipitation from 2000-2022 in the nearby city of Brownsville, Texas, which is about 20 miles from Boca Chica Beach, is nearly 27 inches per year (US Dept of Commerce / NOAA / National Weather Service 2023).

Monthly Total Precipitation for Brownsville Area, TX (NOAA)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2000	0.85	0.19	2.89	0.39	1.87	0.85	0.28	4.29	0.66	2.71	0.41	1.10	16.49
2001	0.48	1.43	0.36	1.10	0.49	2.21	1.81	1.80	3.25	0.36	2.42	1.02	16.73
2002	0.09	0.98	0.22	0.64	1.96	1.88	0.84	1.87	6.04	8.31	4.22	1.24	28.29
2003	0.69	0.55	0.56	0.41	0.19	3.24	2.58	2.74	15.13	6.90	0.44	0.31	33.74
2004	1.84	0.79	3.63	2.85	5.37	3.19	0.38	2.35	4.05	1.98	1.82	1.46	29.71
2005	0.57	0.78	0.24	0.03	1.17	0.06	3.32	0.77	2.70	1.43	1.84	1.50	14.41
2006	0.68	0.14	0.42	0.05	3.46	0.24	1.90	2.89	3.67	5.02	1.16	2.04	21.67
2007	1.84	0.90	5.50	0.56	1.91	5.23	4.73	3.16	5.32	1.02	0.77	0.11	31.05
2008	1.34	0.04	0.28	3.35	0.61	0.62	13.24	2.61	9.57	3.26	2.98	0.47	38.37
2009	0.11	0.47	0.11	T	4.52	0.49	0.24	0.60	9.43	3.12	1.46	5.64	26.19
2010	0.61	4.08	0.90	1.53	2.99	7.62	5.14	0.92	12.63	0.00	0.13	0.01	36.56
2011	2.42	0.06	0.07	0.00	0.08	8.88	0.71	0.22	2.14	1.25	0.55	1.55	17.93
2012	0.34	4.24	0.51	0.26	1.14	3.85	2.17	3.85	3.76	0.80	0.16	0.32	21.40
2013	1.47	0.01	0.28	3.10	0.74	0.85	2.13	1.47	11.88	1.63	1.93	3.52	29.01
2014	0.68	0.07	1.46	0.28	2.83	0.64	1.64	1.91	10.36	3.82	3.46	1.43	28.58
2015	3.56	0.76	4.74	1.73	9.72	0.76	2.36	3.03	3.84	13.68	2.54	0.16	46.88
2016	1.88	T	2.67	3.26	2.18	2.98	0.18	0.51	1.98	1.08	4.42	1.67	22.81
2017	0.18	1.36	1.84	0.63	1.85	3.49	2.31	1.38	4.64	3.25	0.79	1.15	22.87
2018	0.76	1.47	0.49	1.90	0.68	5.21	0.48	0.48	7.71	1.31	1.90	0.65	23.04
2019	1.60	0.30	2.22	0.41	1.15	4.38	2.56	1.07	4.58	3.38	0.45	0.74	22.84
2020	0.53	0.10	0.07	0.39	2.38	5.66	4.93	0.46	5.96	0.06	0.45	1.34	22.33
2021	0.90	0.61	0.90	1.55	4.96	1.67	9.54	0.50	4.64	9.17	3.84	1.32	39.60
2022	2.54	1.88	0.12	3.03	5.14	0.13	0.25	2.87	4.56	2.30	5.44	0.25	28.51
Mean	1.13	0.92	1.33	1.19	2.50	2.79	2.77	1.82	6.02	3.30	1.89	1.26	26.91
Max	3.56 2015	4.24 2012	5.50 2007	3.35 2008	9.72 2015	8.88 2011	13.24 2008	4.29 2000	15.13 2003	13.68 2015	5.44 2022	5.64 2009	46.88 2015
Min	0.09 2002	T 2016	0.07 2020	0.00 2011	0.08 2011	0.06 2005	0.18 2016	0.22 2011	0.66 2000	0.00 2010	0.13 2010	0.01 2010	14.41 2005

Source: US Dept of Commerce / NOAA / National Weather Service 2023

An average summertime thunderstorm at Boca Chica would deposit more water over the landscape than any single or all combined activations of the deluge system. Brownsville receives about 27 inches of rain a year on average. The operation of the deluge system and detonation suppression system combined at its maximum discharge amount might add the equivalent of 0.001 inches of rain over the 723-acre deluge impact area approximately two times per month on average. Since the amount of water that is anticipated to reach the mud flats from a maximum of the operation of the deluge system is expected to be less than significant in comparison to an average summer rainfall event, this amount of water would be unlikely to alter the habitat and cause alterations to vegetation growth.

Water Quality

The vapor cloud would form as a result of the rocket engine fire vaporizing water from deluge system operation. The rocket engine fire includes exhaust from the combustion of the propellent fuels. The launch vehicles use only liquid oxygen (LOX) and cryogenic liquid methane (LCH4). The exhaust produced from the combustion of LCH4 and LOX in the rocket engine primarily consists of carbon dioxide (CO_2) and water vapor (H_2O); thus, the exhaust cloud would consist mainly of CO_2 and steam and would contain only trace amounts of other combustion byproducts such as carbon monoxide (CO) and nitrogen oxides (NOx). A more detailed discussion of the combustion products is found in Appendix G: Exhaust Plume Calculations for Space X Raptor Booster Engine, dated May 31, 2022, and is part of the existing FAA file. Due to the trace amounts, none of the combustion byproducts are expected to degrade the quality of water that may leave the VLA.

Truck Traffic

The initial filling of the water storage tanks will require deliveries by tanker trucks from either the nearby town of Brownsville or from Starbase. An average large-capacity tanker truck will hold approximately 5,000 gallons. Filling the water storage tanks to the 361,000-gallon capacity would require 73 truck trips. If the entire capacity of the water storage tanks needs to be refilled after every activation of the deluge system (which is unlikely), then truck traffic would increase by approximately 2,190 trips per year. However, much of the water applied during deluge system operation would be captured by the containment structures and would be reused. It is not expected that the entire 361,000 gallons would need to be trucked in from other locations before each deluge system operation. Additionally, rainwater that falls on the launch pad area will be captured and collected the same way the deluge water is collected and used to further refill the water tanks. Various operations at Starbase produce water, which could also be reused. Only water meeting TCEQ water standards would be used. Water trucked in from Starbase would only need to travel approximately 3 miles to the water storage tanks at the VLA. The BA stated it was anticipated that the combined construction activity and SpaceX staff vehicles would add up to 505 vehicles per day along State Highway 4. Assuming the entire capacity of the water tanks is depleted between each ignition event and needs to be fully refilled, which is unlikely, the maximum additional traffic from water truck deliveries would add less than 1% to this estimated daily traffic load of trucks supporting the Proposed Action.

Effects to Listed and Proposed Species and Critical Habitats

In comparison to the effects already evaluated in the October 2021 BA and May 2022 BCO, deluge system operation would have presumed beneficial direct effects to listed species that occupy the deluge system impact area. The activation of the deluge system in advance of ignition would provide an additional advanced warning to nearby animals and cause them to flush from the immediate vicinity of the VLA. These animals would have an opportunity to move to a safer distance from the launch pad before the heat plume begins to radiate outward. The deluge system may help dampen the vibrations and attenuate the sound waves generated by a rocket launch near the launch mount and is a common method in the rocket industry for vibration and noise suppression. By reducing the intensity of vibrations and noise during the early phases of launch, animals in the vicinity may experience lower levels of stress and disruption.

Deluge system operation may alter the distribution, cover, and species composition of vegetation in the deluge system impact area, with vegetation closer to the VLA most likely to experience the greatest amount of potential change. However, since the amount of water that is anticipated to reach the mud flats from a maximum operation of the deluge system is expected to be insignificant, resulting in less water over the area than an average summer rainfall event, it would not likely be enough to alter the habitat and cause vegetation growth. Further, water deposited from deluge system operation is not expected to include pollutants. Therefore, habitat used by listed species in the deluge system impact area is not expected to be lost or significantly modified. Similarly, deluge system operation is not expected to degrade any of the factors contributing to the designation of critical habitat.

Effects analyses for each of the listed species and designated or proposed critical habitats that occur within the deluge system impact area are provided below.

Eastern Black Rail

Eastern black rail habitat (i.e., marsh with dense herbaceous vegetation) does not occur within the deluge system impact area (FAA 2021). Therefore, the eastern black rail would not be affected by the operation of the deluge system.

Northern Aplomado Falcon

Northern aplomado falcons have not been reported from the deluge system impact area. The closest recent observations of a foraging falcon occurred approximately 2.5 miles north-northeast of the VLA in April 2023 (*personal communication*, Michael Heimbuch 2023). No aplomado falcons were observed in the UTRGV bird surveys from 2015 - 2020 (UTRGV 2021). Aside from the one observation in April 2023, there have not been any other falcon sightings in the past 8 years within the Boca Chica survey areas. There are no falcon nests or nest platforms within the deluge system impact area, the closest nests are located approximately 4.7 miles to the southwest and 4.5 miles to the northwest of the VLA (USFWS 2012b).

The October 2021 BA and May 2022 BCO determined the species was likely to be adversely affected due to the construction of the new infrastructure that could attract falcons to the launch site for nesting and perching. Perching and potential foraging habitat exist within the deluge impact area. The activation of the deluge system may act as an advanced warning system by flushing perched falcons, if present, prior to ignition. Additionally, the concurrent operation of the deluge system during ignition events would likely mitigate the sound and heat generated by the engines and reduce the risk of fire outside of the VLA. The aplomado falcons may be affected, but are not likely to be adversely affected by the operation of the deluge system.

Piping Plover and Critical Habitat

The launch site is within the piping plover critical habitat unit TX-1. The TX-1 unit includes mud flats, intertidal flats, and salt flats and does not include densely vegetated habitat within those boundaries. Piping plovers prefer open mud flats for their habitat due to several factors that meet their specific ecological needs. The mud flats provide a rich source of food for the plovers as they contain many invertebrates and other small organisms dwelling in shallow water or sediment (USFWS 2009).

The VLA is located next to an unvegetated flat that provides foraging and roosting habitat for the plover. Some water applied by deluge system operation may reach this unvegetated area via uncaptured overland sheet flow, push out from the engine thrust, water vapor, or condensation.

The operational impacts of the construction within the VLA were previously evaluated in the May 2022 BCO. It was noted that an increase in discharges to adjacent wetlands could cause vegetation to grow within the mud flats or reduce available piping plover food and roosting habitat in piping plover Critical Habitat Unit TX-1. The operation of the deluge is likely to have similar impacts on piping plover habitat as the previous stormwater discharge from construction and would mostly affect the same vegetation (i.e., that which is closest to the VLA). Therefore, changes to habitat due to freshwater inflows have already been considered. Beyond the immediate area of the VLA (e.g., approximately 300 feet), the amount of additional freshwater that may occur from deluge system operation via the vapor cloud and subsequent condensation would be a small percentage of the amount of rainfall in these areas, with each use of the system resulting in less water in this area than an average summer rainfall event. The likelihood of detectable vegetation change beyond the immediate vicinity of the VLA is low.

The activation of the deluge system may act as an advanced warning system by flushing the plovers prior to the ignition of the engine. Additionally, the concurrent operation of the deluge system during engine ignition events would likely mitigate the sound and heat generated by the engines and heat plume, reducing the impact on plovers that may be present beyond the heat plume impact area.

The piping plover and critical habitat are likely to be adversely affected by the operation of the deluge system. But since the deluge system impact area is within the heat plume impact area, for which adverse effects and incidental take have been accounted for, these new activities are not likely to cause additional incidental take.

Red Knot and Proposed Critical Habitat

The species is occasionally detected within the deluge system impact area using habitat similar to that described for the piping plover. Proposed critical habitat for the red knot occurs within the deluge system impact area. Deluge system operation would have effects similar to those described for the piping plover and its critical habitat.

The red knot is likely to be adversely affected by the operation of the deluge system. But since the deluge system is within the heat plume impact area, for which adverse effects and incidental take have been accounted for, these new activities are not likely to cause additional incidental take.

Cactus Ferruginous Pygmy-owl

The Species Status Assessment (SSA) reports the current known distribution of the pygmy-owl as "Almost extirpated along Rio Grande, but more common now in areas of Kenedy and Brooks counties" (USFWS 2022a Table 4.2). Kenedy and Brooks Counties are approximately 42 miles from the action area. Preferred habitat for the pygmy-owl in Texas is associated with Southern Texas Plains ecoregions, which do not occur in the action area that is located in the Western Gulf Coastal Plains (Griffith et al., 2007).

Cavity trees in thorny scrub and woodlands of live oak forests as well as large, columnar cacti are essential components of pygmy-owl habitat (USFWS 2022a), which are lacking in the action area. The action area ecoregion consists of vegetated flats of grass-stabilized dunes, wide tidal mud flats, vast seagrass meadows, and a hypersaline lagoon system (USFWS 2022). Other birds that create cavities that may be used by pygmy-owls include woodpeckers and flickers. (USFWS 2022a). Daytime avian monitoring within 3 miles of the VLA has not documented pygmy-owls and has documented only a few auditory observations of the golden-fronted woodpecker in an area with yucca and mesquite 2.5 miles southwest of the action area (*personal communication*, Michael Heimbuch August 2023). Due to general lack of suitable habitat within the action area, the likely near extirpation of the species from areas along the Rio Grande, and the large distance to the nearest likely extant population in Kenedy and Brooks Counties, the FAA-licensed SpaceX Starship-Super Heavy Launch Vehicle Program may affect, but is not likely to adversely affect, the pygmy-owl.

Gulf Coast Jaguarundi and Ocelot

The tidal flats and lomas in the immediate vicinity of the VLA are not known to be used regularly or predictably by ocelots or jaguarundis, but could be occasionally used by these species as travel corridors. Neither species has been documented occurring within the 0.6-mile deluge system impact area. Since individuals of these species are not expected to be present, the activities and consequences that occur within the deluge system impact area would not affect these species.

Vehicle traffic from water transport trucks traveling from either the town of Brownsville or Starbase would increase the potential for vehicle collisions on Boca Chica Boulevard/State Highway 4. Most of the traffic from water trucks and operations would occur during daylight hours. Peak ocelot activity occurs at sunset and sunrise, with activity continuing during the night; however, jaguarundis are known to be primarily diurnal. Neither species has been observed in the area in decades and neither are believed to occupy this area. The traffic is expected to increase when filling the tanks; however, a large amount of the water from the operations of the deluge system is expected to be recaptured and cycled back into the water storage tanks for reuse. Increased traffic on State Highway 4 from SpaceX operations has not resulted in any reported road mortality of either species.

The Gulf Coast jaguarundi and ocelot may be affected but are not likely to be adversely affected by the operation of the deluge system.

West Indian Manatee

The deluge system impact area extends over a small nearshore portion of the Gulf of Mexico and into potential manatee habitat (Figure 2). However, the deluge system operation would only cause condensation of water into this area. This condensation may affect, not likely to adversely affect the manatee.

Tricolored Bat

The known distribution of the tricolored bat (TCB) includes Cameron County, Texas (Schmidly and Bradley 2016). According to the 2021 SSA for the TCB, the species roosts in woodland habitats with live or recently dead hardwoods, pines, and cedars during the spring, summer, and fall months (USFWS 2021). During the winter, TCB hibernate in caves and mines, however in the South where caves are less common, they may also overwinter in culverts, tree cavities, and other abandoned artificial structures (USFWS 2021).

The action area encompasses a 0.6-mile radius zone surrounding the Vertical Launch Area in which the extent of impacts from the rocket heat plume and operation of the deluge system are estimated to reach. Within this radius, there is an absence of wooded habitat and a lack of structures, such as large culverts, that would provide optimal roosting or hibernation habitat. TCB may be present within this area while migrating from winter hibernacula to summer roosting habitat, however, it is unlikely that the species would utilize launch facility structures for roosting and hibernating as they prefer landscapes with tree corridors and largely forested areas and are less abundant among urban development (USFWS 2021) The area outside the 0.6-mile radius, but within the action area is also prominently devoid of preferred habitat. Due to general lack of suitable habitat within the action area, the FAA-licensed SpaceX Starship-Super Heavy Launch Vehicle Program may affect, but is not likely to adversely affect, the tricolored bat.

Sea Turtles

The green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*) have all been recorded nesting along the beaches within the action area, with Kemp's ridley the only species nesting on Boca Chica Beach with regularity (Sea Turtle Inc. 2020). The deluge system impact area includes a portion of Boca Chica Beach.

Deluge system operation would only cause condensation of water onto this area. This condensation would not affect sea turtles. While this Addendum to the BA evaluates deluge system operation and determined the condensation would not affect sea turtles, the Service found in the May 2022 BCO that the Proposed Action was likely to adversely affect each of the five species of sea turtles considered in the BCO. This determination was made in consideration of the mitigation measures detailed in the BCO. Therefore, the Updated Overall Effect Determination is Adversely Effect.

South Texas Ambrosia and Texas Ayenia

The South Texas ambrosia and Texas ayenia have not been found to occur within the action area. Suitable habitat for either species does not occur within the deluge system impact area, and the operation of the deluge system would have no effect to the ambrosia or ayenia. Therefore, neither of these plants would be affected by the operation of the deluge system.

Measures to Minimize Adverse Effects

Water Recapture and Treatment

The launch pad is engineered to recapture as much water as possible. This includes rainwater and water discharged from the deluge system or other fire suppression systems. Any water falling to the launch pad is directed to the periphery gutter system and then to containment structures. SpaceX would develop appropriate sampling protocols and water quality criteria in coordination with TCEQ to confirm the water does not exceed the water quality criteria. SpaceX would pump water back to the water storage tanks at the VLA.

Vegetation Monitoring

Vegetation monitoring is implemented by qualified biologists as described in the Biological Monitoring Plan and reported annually. The findings of the most recent monitoring report are reported above (see the "Vegetation" discussion in the Updated Environmental Baseline).

New Foundation

The launch of the Starship-Super Heavy launch vehicle on April 20, 2023, caused damage to the launch pad, launch mount, and equipment within the VLA. The reconstructed launch pad includes more piles and a thicker concrete mat designed to strengthen the foundation. Steel plates were installed on top of the new foundation underneath the launch mount to prevent launch pad debris scatter and the potential for a large dust cloud. This steel plate will protect the launch pad from excessive damage. There is also a stainless-steel apron and specialized concrete with high-strength and heat-resistant properties (i.e., fondag) installed at the launch mount area.

Vehicle Collisions

SpaceX continues to follow the terms and conditions of the incidental take statement included with the May 2022 BCO. This includes educating its personnel on the potential for vehicle collisions with ocelots and jaguarundis and encouraging personnel to reduce speeds along State Highway 4. Vehicles would be restricted to existing paved and unpaved roads, parking areas, and authorized construction sites.

Timing of Debris Removal

In the event that an anomaly occurs during avian nesting season (February 15 through August 31), SpaceX would coordinate with TPWD and USFWS to determine whether debris should be left in place until after nesting season. SpaceX would coordinate with TPWD and USFWS to determine whether the debris poses an immediate hazard to the ecosystem and to evaluate the likelihood that debris retrieval activities may further disturb the habitat or birds. If the agencies recommend that debris remain in place to minimize impacts to birds and their nests, SpaceX would delay debris retrieval activities until after avian nesting season.

Conclusion

Deluge systems are widely used and have proven effective at other rocket launch pads around the world. The operation of the deluge system at the SpaceX Boca Chica Launch Site would help mitigate the impacts of Starship-Super Heavy operations by reducing sound waves and vibrations, assist in cooling and fire suppression, and provide protection to the launch pad and other equipment. A new foundation and a steel plate were installed underneath the launch mount to reduce debris scatter and the potential for a large dust cloud. Some water applied during the operation of the deluge system could reach the surrounding landscape and may cause vegetation changes. However, the amount of water that is expected to escape the VLA is likely to be less than the amount of water released on this area from an average rainfall event; therefore, it is not expected to change the salinity of the existing mud flats or significantly reduce or modify piping plover or red knot habitat.

The effect determinations for the ESA-listed species evaluated in the October 2021 BA are summarized in Table 3 and compared to the effect determinations for the new activities addressed in this Addendum.

Table 3. Effect Determinations for ESA-listed and Proposed Species

ESA Listed Species	Original Effects Determination in BA	Effect Determination for Operation of Deluge System	Updated Overall Effect Determination
Eastern black rail	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
Northern aplomado falcon	May affect, likely to adversely affect	May affect, not likely to adversely affect	May affect, likely to adversely affect
Piping plover	May affect, likely to adversely affect	May affect, likely to adversely affect; No additional incidental take	May affect, likely to adversely affect
Piping plover Critical Habitat TX-01	May affect, likely to adversely affect	May affect, likely to adversely affect	May affect, likely to adversely affect

ESA Listed Species	Original Effects Determination in BA	Effect Determination for Operation of Deluge System	Updated Overall Effect Determination
Red knot	May affect, likely to adversely affect	May affect, likely to adversely affect; No additional incidental take	May affect, likely to adversely affect
Proposed red knot critical habitat TX-11	May affect, likely to adversely affect	May affect, likely to adversely affect	May affect, likely to adversely affect
Cactus Ferruginous Pygmy-owl	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Gulf Coast jaguarundi	May affect, likely to adversely affect	May affect, likely to adversely affect	May affect, likely to adversely affect
Ocelot	May affect, likely to adversely affect	May affect, likely to adversely affect; No additional incidental take	May affect, likely to adversely affect
West Indian manatee	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
Green sea turtle	Adversely Affect	No effect	Adversely Affect
Hawksbill sea turtle	Adversely Affect	No effect	Adversely Affect
Kemp's ridley sea turtle	Adversely Affect	No effect	Adversely Affect
Leatherback sea turtle	Adversely Affect	No effect	Adversely Affect
Loggerhead sea turtle	Adversely Affect	No effect	Adversely Affect
South Texas ambrosia	No effect	No effect	No effect
Texas ayenia	No effect	No effect	No effect
Tricolored Bat	None	May affect, not likely to adversely affect	May affect, not likely to adversely affect

The May 2022 BCO outlines the amount or extent of incidental take that is expected because of the proposed construction and operations of the SpaceX Boca Chica Launch Site. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Impacts caused by vegetation change that may affect the listed species from the operations of the deluge system would not likely result in direct mortality. The minor increase in vehicle traffic due to water truck deliveries has been previously evaluated with the traffic increases due to construction activities. The amount and extent of take previously considered will not be increased by the operation of the deluge system. No additional incidental take needs to be considered at this time.

Literature Cited

Federal Aviation Administration (FAA). 2021. Biological Assessment. Space X Starship/Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site. Cameron County, Texas. FAA Office of Commercial Space Transportation. Available at: https://www.faa.gov/sites/faa.gov/files/2022-06/AppendixD_EndangeredSpeciesActSection7Consultation.pdf. Accessed June 2023.

Griffith, Bryce, Omernik, Rogers. 2007. Ecoregions of Texas. U.S. Environmental Protection Agency. Texas Commission on Environmental Quality. Austin, Texas. Available at: TXeco_Jan08_v8_Cmprsd.pdf (epa.gov)

Heimbuch, M. 2023. Project Biologist, SWCA Environmental Consultants, Austin, Texas. Personal Communication, Teams Chat to Jennifer Brinkworth, SWCA, dated August 10, 2023.

Heimbuch, M. 2023. Project Biologist, SWCA Environmental Consultants, Austin, Texas. Personal Communication, Email to Stephanie Bilodeau and Chris Perez, FWS, dated May 2, 2023.

Hicks and Contreras. 2022. Biological Assessment Starship Super Heavy Orbital Launch Wildfire. May 26, 2023.

Raba Kistner. 2023a. SpaceX Boca Chica Launch Site - Pre & Post Launch Avian Monitoring Boca Chica, Cameron County, Texas. May 5, 2023.

Raba Kistner. 2023b. SpaceX Boca Chica Launch Site - Pre & Post Launch Vegetation Monitoring Boca Chica, Cameron County, Texas. May 5, 2023.

Sea Turtle, Inc. 2012. Sea turtle nesting on Boca Chica Beach, Texas. Personal communication from J. George, Executive Director, South Padre Island, TX via email to A. Stevens, Wildlife Biologist, Cardno TEC, Inc., Albuquerque, NM. July 10, 2012.

Sea Turtle, Inc. 2020. Sea turtle nesting on Boca Chica Beach, Texas. Personal communication from M. Devlin, Conservation/Internship Coordinator, South Padre Island, TX via email to K. Condell, SpaceX, Cape Canaveral, FL. April 15, 2020.

Schmidly, David J., and Bradley, Robert D. 2016. The Mammals of Texas, Seventh Edition, University of Texas Press. https://www.depts.ttu.edu/nsrl/mammals-of-texas-online-edition/Accounts_Chiroptera/Perimyotis_subflavus.php. Accessed October 2, 2023.

Texas Parks and Wildlife Department (TPWD) 2023a. star cactus: Federal & State Listed Plants of Texas.

Texas Parks and Wildlife Department (TPWD) 2023b. Walker's manioc: Federal & State Listed Plants of Texas

U.S. Fish and Wildlife Service (USFWS). 2001. Endangered and Threatened Wildlife and Plants; Final Determinations of Critical Habitat for Wintering Piping Plovers; Final Rule. Federal Register 66:36038-36132.

U.S. Fish and Wildlife Service (USFWS). 2009. 5-Year Review Summary and Evaluation of the Piping Plover (*Charadrius melodus*). U.S. Fish and Wildlife Service, Hadley, Massachusetts.

U.S. Fish and Wildlife Service (USFWS). 2012a. Final Biological and Conference Opinion (BCO). SpaceX Starship/Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site, Cameron County, Texas. Available at: https://www.fws.gov/sites/default/files/documents/5-12-2022%20SpaceX%20Final%20BCO_signed%20with%20appendix%20A-D.pdf. Accessed June 2023.

U.S. Fish and Wildlife Service (USFWS). 2012b. Aplomado Falcon Nest Structure Locations, 2010. Personal communication via mail from E. Reyes, Lower Rio Grande Valley NWR, Alamo, TX to R. Spaulding, Sr. Wildlife Biologist, Cardno TEC, Bainbridge Island, TX. October 22.

U.S. Fish and Wildlife Service. 2021. Species Status Assessment Report for the Tricolored Bat (Perimyotis subflavus), Version 1.1. December 2021. Hadley, MA.

U.S. Fish and Wildlife Service (USFWS). 2022a. Species status assessment report for *Glaucidium brasilianum cactorum* (cactus ferruginous pygmy-owl), Version 1.2. USFWS, Tucson, Arizona.

U.S. Fish and Wildlife Service (USFWS). 2022b. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Tricolored Bat. 87 Fed. Reg. 56,381 (October 2, 2023).

U.S. Fish and Wildlife Service (USFWS). 2023a. Information for Planning and Consultation (IPaC). Available at: http://ecos.fws.gov/ipac/. Accessed October 2023.

U.S. Fish and Wildlife Service (USFWS). 2023b. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Cactus Ferruginous Pygmy-Owl. 88 Fed. Reg. 46,910 (July 20, 2023).

U.S. Fish and Wildlife Service (USFWS). 2023c. Proposed Rule: Designation of Critical Habitat for Rufa Red Knot. 88 Fed. Reg. 22530 (April 12, 2023).

U.S. Fish and Wildlife Service. 2023d. Species Status Assessment Report for two Rio Grande Mussels, Version 1.2. February 2023. Albuquerque, NM

University of Texas Rio Grande Valley (UTRGV). 2021. Commercial Launch Site Construction-Phase Species Monitoring Survey. University of Texas Rio Grande Valley, Brownsville, Texas.

US Department of Commerce / NOAA / National Weather Service. 2023. Brownsville/Rio Grande Valley, TX. Climate (weather.gov) Accessed June 1, 2023.

Attachments

Appendix A – Texas Council on Environmental Quality General Permits to Discharge Under the Texas Pollutant Discharge Elimination System

Appendix B – USFWS Species List – Texas Coastal Ecological Services Field Office, May 30, 2023

Appendix C – Final Biological Monitoring Annual Report for the SpaceX Boca Chica Launch Site Construction and Seasonal Avian Monitoring report –July 2022 through June 2023.

Appendix D – Commercial Launch Site Construction-Phase Vegetation Monitoring Survey. 2021 to 2022 reporting cycle.

APPENDIX A
TEXAS COMMISION ON ENVIRONMENTAL QUALITY GENERAL PERMITS TO DISCHARGE UNDER THE TEXAS POLLUNTANT DISCHARGE ELIMINATION SYSTEM

APPENDIX B

U.S. Fish and Wildlife Service Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Texas Coastal Ecological Services Field Office
17629 El Camino Real, Suite 211
Houston, TX 77058-3051
Phone: (281) 286-8282 Fax: (281) 488-5882

In Reply Refer To:
Project Code: 2024-0000441
Project Name: Space X Boca Chica Launch Facility (Oct. 2023 Update)

October 02, 2023

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The U.S. Fish and Wildlife Service (Service) field offices in Clear Lake, Corpus Christi, and Alamo, Texas, have combined administratively to form the Texas Coastal Ecological Services Field Office. All project related correspondence should be sent to the field office address listed below responsible for the county in which your project occurs:

Project Leader; U.S. Fish and Wildlife Service; 17629 El Camino Real Ste. 211; Houston, Texas 77058
Angelina, Austin, Brazoria, Brazos, Chambers, Colorado, Fayette, Fort Bend, Freestone, Galveston, Grimes, Hardin, Harris, Houston, Jasper, Jefferson, Leon, Liberty, Limestone, Madison, Matagorda, Montgomery, Newton, Orange, Polk, Robertson, Sabine, San Augustine, San Jacinto, Trinity, Tyler, Walker, Waller, and Wharton.

Assistant Field Supervisor, U.S. Fish and Wildlife Service; 4444 Corona Drive, Ste 215; Corpus Christi, Texas 78411
Aransas, Atascosa, Bee, Brooks, Calhoun, De Witt, Dimmit, Duval, Frio, Goliad, Gonzales, Hidalgo, Jackson, Jim Hogg, Jim Wells, Karnes, Kenedy, Kleberg, La Salle, Lavaca, Live Oak, Maverick, McMullen, Nueces, Refugio, San Patricio, Victoria, and Wilson.

U.S. Fish and Wildlife Service; Santa Ana National Wildlife Refuge; Attn: Texas Ecological Services Sub-Office; 3325 Green Jay Road, Alamo, Texas 78516
Cameron, Hidalgo, Starr, Webb, Willacy, and Zapata.

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as

amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/media/endangered-species-consultation-handbook.

Non-Federal entities may consult under Sections 9 and 10 of the Act. Section 9 and Federal regulations prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR § 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR § 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Should the proposed project

have the potential to take listed species, the Service recommends that the applicant develop a Habitat Conservation Plan and obtain a section 10(a)(1)(B) permit. The Habitat Conservation Planning Handbook is available at: https://www.fws.gov/library/collections/habitat-conservation-planning-handbook.

Migratory Birds:
In addition to responsibilities to protect threatened and endangered species under the Act, there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts visit: https://www.fws.gov/program/migratory-birds.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable National Environmental Policy Act (NEPA) documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- Bald & Golden Eagles
- Migratory Birds
- Marine Mammals
- Coastal Barriers
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Texas Coastal Ecological Services Field Office
17629 El Camino Real, Suite 211
Houston, TX 77058-3051
(281) 286-8282

PROJECT SUMMARY

Project Code: 2024-0000441
Project Name: Space X Boca Chica Launch Facility (Oct. 2023 Update)
Project Type: Airport - Maintenance/Modification
Project Description: The area defined is the Action Area for the 2022 BCO as the 13-mile radius surrounding the Vertical Launch Area at the Space X Launch Complex in Boca Chica, Texas. The scope of the proposed project is the operation of a deluge system at the orbital launch pad.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@25.98788905,-97.15918020000001,14z

Counties: Cameron County, Texas

ENDANGERED SPECIES ACT SPECIES

There is a total of 17 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Gulf Coast Jaguarundi *Puma yagouaroundi cacomitli* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3945	Endangered
Ocelot *Leopardus (=Felis) pardalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4474	Endangered
West Indian Manatee *Trichechus manatus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. ***This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.*** Species profile: https://ecos.fws.gov/ecp/species/4469	Threatened

BIRDS

NAME	STATUS
Eastern Black Rail *Laterallus jamaicensis ssp. jamaicensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10477	Threatened
Northern Aplomado Falcon *Falco femoralis septentrionalis* Population: Wherever found, except where listed as an experimental population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1923	Endangered
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

REPTILES

NAME	STATUS
Green Sea Turtle *Chelonia mydas* Population: North Atlantic DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Hawksbill Sea Turtle *Eretmochelys imbricata* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3656	Endangered
Kemp's Ridley Sea Turtle *Lepidochelys kempii* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/5523	Endangered
Leatherback Sea Turtle *Dermochelys coriacea* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1493	Endangered
Loggerhead Sea Turtle *Caretta caretta* Population: Northwest Atlantic Ocean DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1110	Threatened

CLAMS

NAME	STATUS
Mexican Fawnsfoot *Truncilla cognata* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/7870	Proposed Endangered
Salina Mucket *Potamilus metnecktayi* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/8753	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

FLOWERING PLANTS

NAME	STATUS
South Texas Ambrosia *Ambrosia cheiranthifolia* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3331	Endangered
Texas Ayenia *Ayenia limitaris* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4942	Endangered

CRITICAL HABITATS

There is 1 critical habitat wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Piping Plover *Charadrius melodus* https://ecos.fws.gov/ecp/species/6039#crithab	Final

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.

3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

THERE ARE NO BALD AND GOLDEN EAGLES WITHIN THE VICINITY OF YOUR PROJECT AREA.

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Golden-plover *Pluvialis dominica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
American Oystercatcher *Haematopus palliatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8935	Breeds Apr 15 to Aug 31
Audubon's Shearwater *Puffinus lherminieri* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 1 to Aug 5
Black Scoter *Melanitta nigra* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Black Skimmer *Rynchops niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15

NAME	BREEDING SEASON
Black-legged Kittiwake *Rissa tridactyla* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Brown Pelican *Pelecanus occidentalis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Jan 15 to Sep 30
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 25
Common Loon *gavia immer* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/4464	Breeds Apr 15 to Oct 31
Cory's Shearwater *Calonectris diomedea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Dickcissel *Spiza americana* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds May 5 to Aug 31
Gull-billed Tern *Gelochelidon nilotica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9501	Breeds May 1 to Jul 31
Hudsonian Godwit *Limosa haemastica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
King Rail *Rallus elegans* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8936	Breeds May 1 to Sep 5
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Long-billed Curlew *Numenius americanus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/5511	Breeds elsewhere

NAME	BREEDING SEASON
Long-tailed Duck *Clangula hyemalis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/7238	Breeds elsewhere
Magnificent Frigatebird *Fregata magnificens* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Painted Bunting *Passerina ciris* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Apr 25 to Aug 15
Pomarine Jaeger *Stercorarius pomarinus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Prothonotary Warbler *Protonotaria citrea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 1 to Jul 31
Red-breasted Merganser *Mergus serrator* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Red-necked Phalarope *Phalaropus lobatus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Reddish Egret *Egretta rufescens* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/7617	Breeds Mar 1 to Sep 15
Ring-billed Gull *Larus delawarensis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere

NAME	BREEDING SEASON
Royal Tern *Thalasseus maximus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Apr 15 to Aug 31
Ruddy Turnstone *Arenaria interpres morinella* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Sandwich Tern *Thalasseus sandvicensis* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Apr 25 to Aug 31
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Sooty Tern *Onychoprion fuscatus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Mar 10 to Jul 31
Sprague's Pipit *Anthus spragueii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8964	Breeds elsewhere
Surf Scoter *Melanitta perspicillata* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Swallow-tailed Kite *Elanoides forficatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8938	Breeds Mar 10 to Jun 30
White-winged Scoter *Melanitta fusca* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 20 to Aug 5
Wilson's Plover *Charadrius wilsonia* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 1 to Aug 20

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read the supplemental information and specifically the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

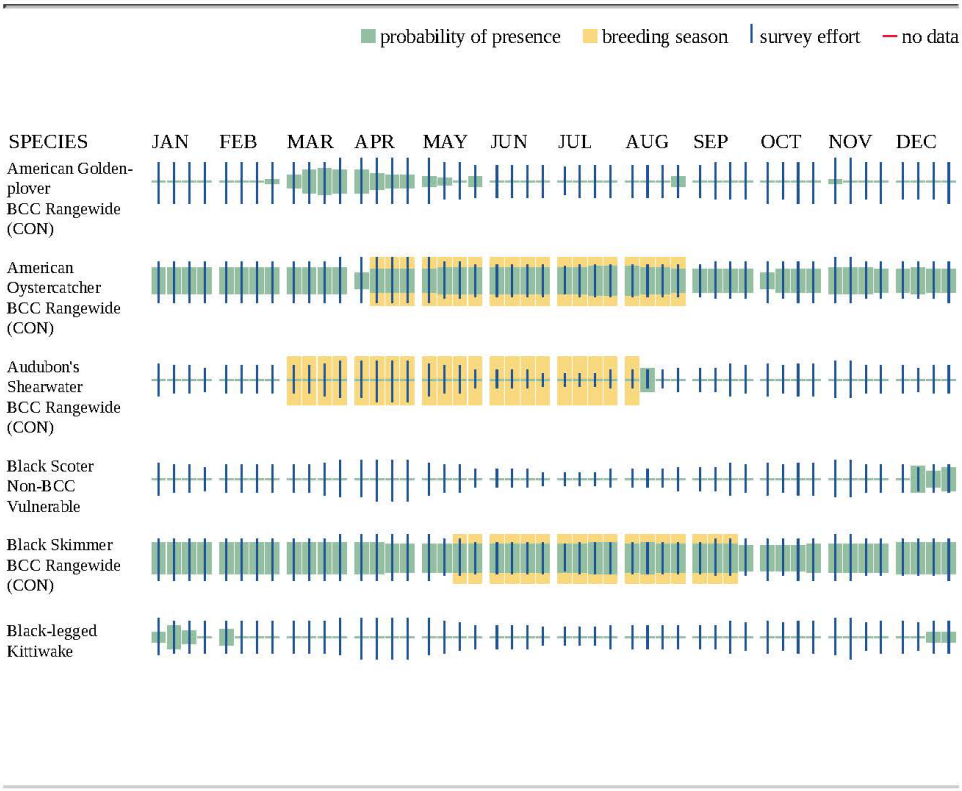
Probability of Presence (▪)

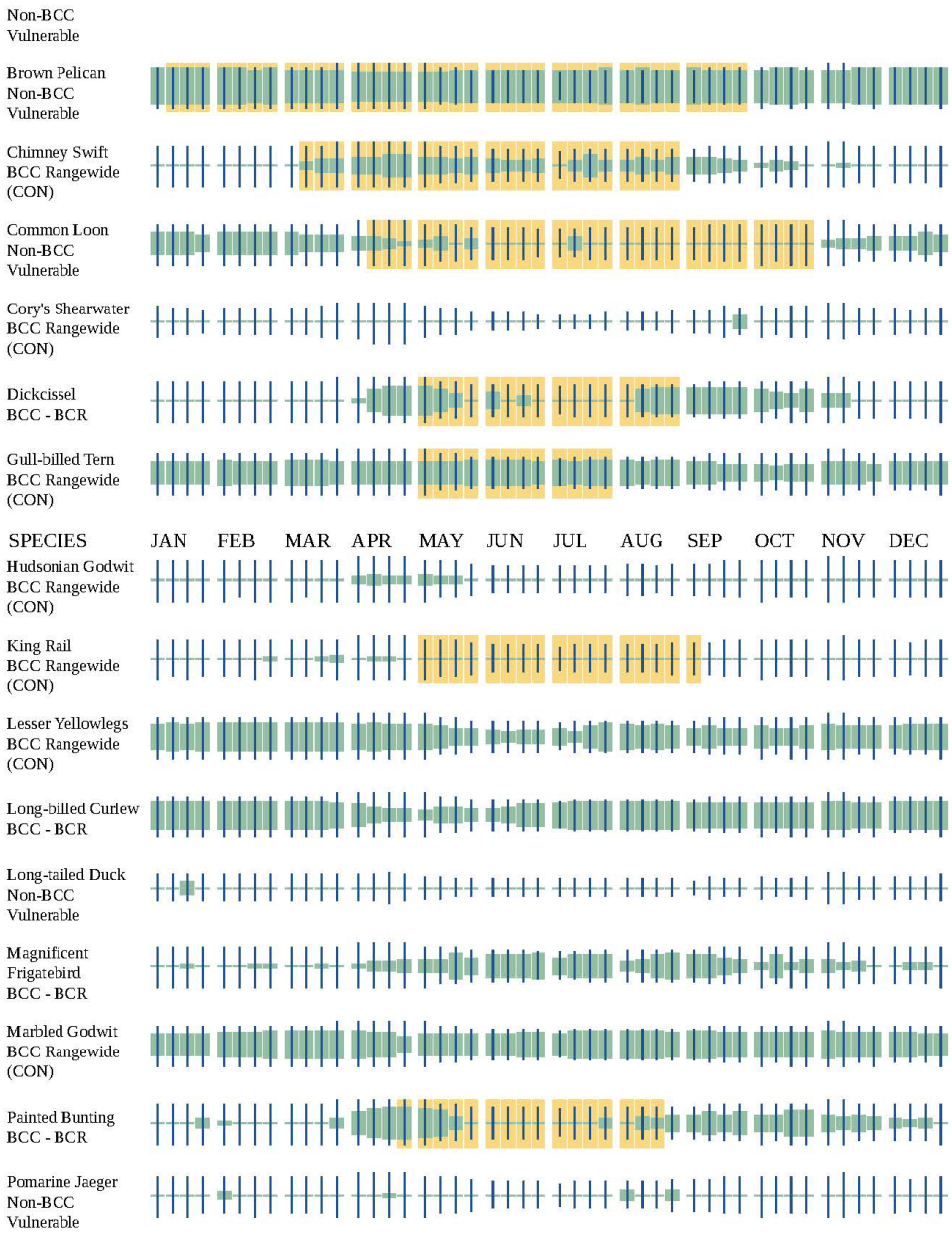
Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

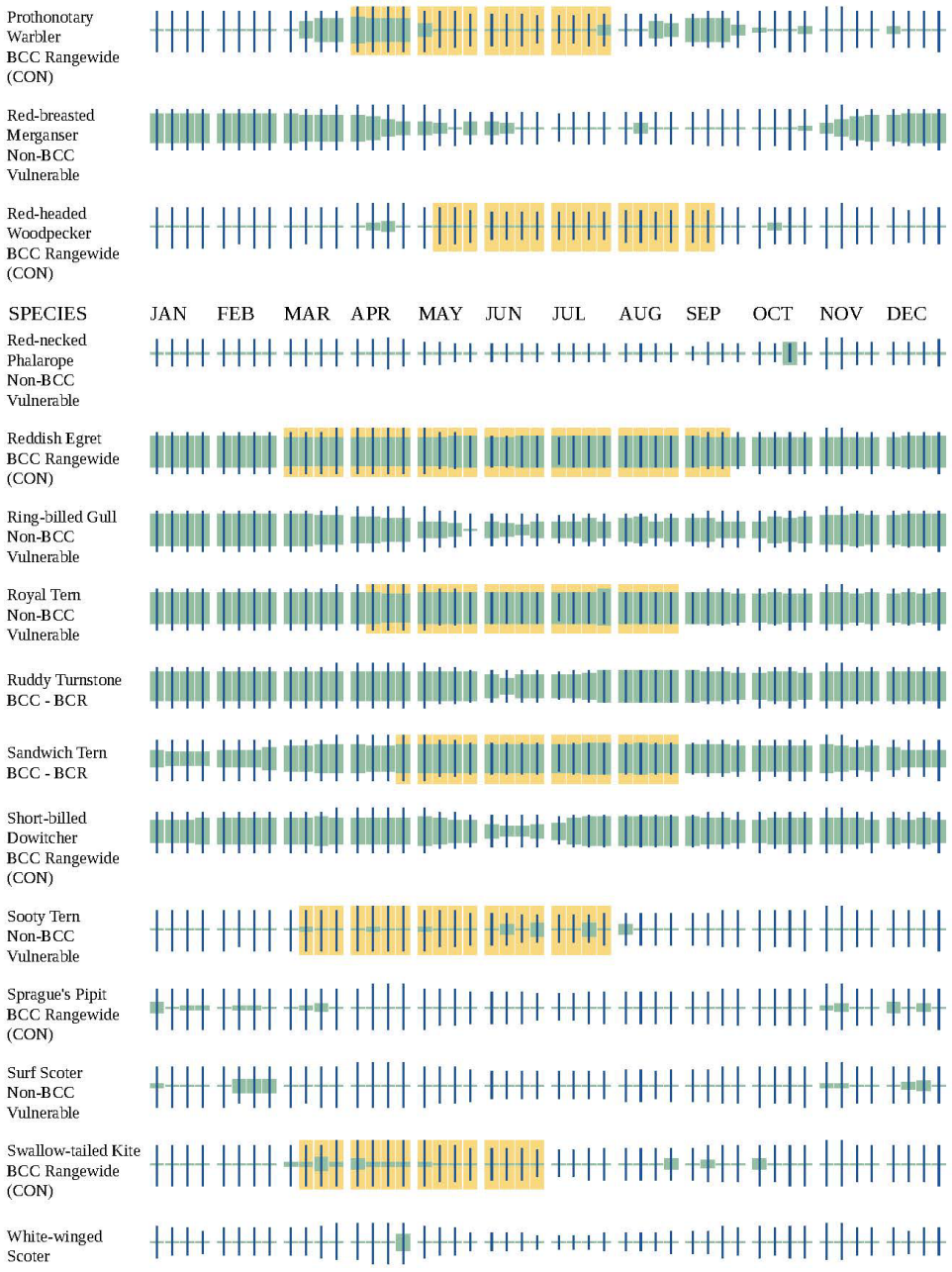
Breeding Season (▪)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

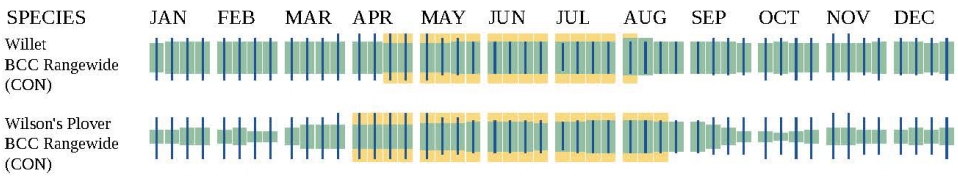
No Data (–)
A week is marked as having no data if there were no survey events for that week.







Non-BCC
Vulnerable



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

COASTAL BARRIERS

Projects within the John H. Chafee Coastal Barrier Resources System (CBRS) may be subject to the restrictions on Federal expenditures and financial assistance and the consultation requirements of the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.). For more information, please contact the local Ecological Services Field Office or visit the CBRA Consultations website. The CBRA website provides tools such as a flow chart to help determine whether consultation is required and a template to facilitate the consultation process.

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/15/1993	11/16/1991
T12	Boca Chica	UNKNOWN	10/18/1982	10/1/1983
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	10/18/1982	10/1/1983
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	10/18/1982	10/1/1983
T12P	Boca Chica	UNKNOWN	N/A	11/16/1991
T12P	Boca Chica	UNKNOWN	N/A	11/16/1991
T12P	Boca Chica	UNKNOWN	N/A	11/16/1991
TX-22P	Andy Bowie	UNKNOWN	N/A	11/16/1991

MARINE MAMMALS

Marine mammals are protected under the Marine Mammal Protection Act. Some are also protected under the Endangered Species Act[1] and the Convention on International Trade in Endangered Species of Wild Fauna and Flora[2].

The responsibilities for the protection, conservation, and management of marine mammals are shared by the U.S. Fish and Wildlife Service [responsible for otters, walruses, polar bears, manatees, and dugongs] and NOAA Fisheries[3] [responsible for seals, sea lions, whales, dolphins, and porpoises]. Marine mammals under the responsibility of NOAA Fisheries are **not** shown on this list; for additional information on those species please visit the Marine Mammals page of the NOAA Fisheries website.

The Marine Mammal Protection Act prohibits the take of marine mammals and further coordination may be necessary for project evaluation. Please contact the U.S. Fish and Wildlife Service Field Office shown.

1. The Endangered Species Act (ESA) of 1973.
2. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a treaty to ensure that international trade in plants and animals does not threaten their survival in the wild.
3. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

NAME

West Indian Manatee *Trichechus manatus*
Species profile: https://ecos.fws.gov/ecp/species/4469

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

Due to your project's size, the list below may be incomplete, or the acreages reported may be inaccurate. For a full list, please contact the local U.S. Fish and Wildlife office or visit https://www.fws.gov/wetlands/data/mapper.HTML

ESTUARINE AND MARINE WETLAND

- E2EM1P
- E2AB1N
- E2SS1P
- E2USMs
- E2USM
- E2SS3P
- E2USMx
- E2SS3Ns
- E2EM1Ps
- E2USN
- E2AB1M
- E2USP
- E2SS3N
- E2EM1Px
- E2EM1N
- E2USNs
- E2AB3Ms
- E2SS3Ps
- E2AB3M
- E2AB1Ns

ESTUARINE AND MARINE DEEPWATER

- E1UBLx
- E1AB3L
- E1UBL

IPAC USER CONTACT INFORMATION

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APPENDIX C

Final Biological Monitoring Annual Report

APPENDIX D

Construction-Phase Vegetation Monitoring Survey