



United States Department of the Interior



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In Reply Refer To:
02ETCC00-2012-F-0186-R001
2023-008741

November 14, 2023

Ms. Stacy Zee
Office of Commercial Space Transportation
Federal Aviation Administration
800 Independence Ave, SW
Washington, DC 20591

Dear Ms. Zee:

This transmits the U.S. Fish and Wildlife Service's (Service) **Final Biological and Conference Opinion (BCO) Addendum**. The Federal Aviation Administration requested reinitiation of Endangered Species Act section 7 consultation on September 1, 2023. The 2023 BCO Addendum evaluates the effects of operating a deluge and detonation suppression system at the SpaceX Vertical Launch Area. The BCO Addendum also addresses an updated environmental baseline within the action area and the launch and subsequent mishap of the Starship Super Heavy launch vehicle on April 20, 2023.

We appreciate your consideration for threatened and endangered species. Please refer to the consultation numbers 02ETCC00-2012-F-0186-R001 and 2023-008741 in future correspondence concerning this project. If you have questions regarding this final BCO Addendum to the 2022 BCO, please contact Mary Orms at mary_orms@fws.gov or 281-271-2162.

Sincerely,

Charles Ardizzone
Field Supervisor



United States Department of the Interior



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Office of Commercial Space Transportation
Federal Aviation Administration
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Dear Ms. Zee:

The U.S. Fish and Wildlife Service (Service) received the Federal Aviation Administration's (FAA) request to reinstate formal section 7 consultation and conference for consultation number 02ETCC00-2012-F-0186-R001. The Service received FAA's request on October 5, 2023, with an Addendum to the October 2021 Biological Assessment (BA Addendum #1; dated October 2023). The Service acknowledged the request to reinstate by letter on October 19, 2023, and revised October 30, 2023. The 2023 BA Addendum #1 evaluates the effects of operating a deluge and detonation suppression system at the SpaceX Vertical Launch Area (VLA). The Addendum also provides updated information about the environmental baseline within the action area after a launch and subsequent mishap of the Starship/Super Heavy launch vehicle on April 20, 2023. Additionally, SpaceX has agreed to implement additional conservation measures in connection with its launch program at Boca Chica.

Reinitiation of consultation is in accordance with 50 CFR 402.16(a), since 1) the new activities of deploying a deluge and detonation suppression system to a reinforced launch pad to avoid future damage to the launch pad and resulting debris scatter similar to the April 2023 launch will result in effects not previously considered in the Service's May 2022 Biological and Conference Opinion (BCO), and 2) the listing of a new species, the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) as threatened and the proposed as endangered tricolored bat (*Perimyotis subflavus*).

We note that all conservation measures, Reasonable and Prudent measures from the 2022 BCO and its Incidental Take Statements remain valid and applicable to all proposed changes and considerations of new information discussed herein. For purposes of this reinitiation, we reference our 2022 BCO and the 2023 BA Addendum #1 as appropriate. We revisit the Effects

of the Action in the contexts of the changes proposed in the 2023 BA addendum #1 and any newly considered information. The Action Area defined in the 2022 BCO approximates the extent of the sonic boom impacts, extends approximately 14 miles around the VLA, and remains applicable to this Addendum.

For this reinitiation, the Service provided FAA an official species list for consideration as an automated letter generated on October 2, 2023, by our Information Planning and Consultation (IPaC) database. The Service supplemented the IPaC letter via personal communications with the FAA and SpaceX. In total, the Service recommended review of 15 listed species, 2 proposed or candidate species, 1 designated critical habitat area, and 3 proposed critical habitat areas. The Service, FAA, and SpaceX discussed the content of draft and final versions of 2023 BA Addendum #1 on September 8, September 22, September 29, October 5, October 18, and October 25, 2023.

The FAA declined to consider the monarch butterfly (*Danaus plexippus*), the candidate species under consideration for future listing; candidate species are not subject to section 7. However, it is addressed in the May 22, 2022, BCO under Conservation Recommendations. The FAA determined in the 2023 BA Addendum #1 that operation of the deluge and detonation suppression system would have no effect on the following listed and proposed to be listed species and/or critical habitat: eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*), West Indian manatee (*Trichechus manatus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Mexican fawnsfoot (*Truncilla cognata*) and proposed critical habitat, salina mucket (*Potamilus metnecktayi*) and proposed critical habitat, South Texas ambrosia (*Ambrosia cheiranthifolia*), Texas ayenia (*Ayenia limitaris*), star cactus (*Astrophytum asterias*), and Walker's manioc (*Manihot walkerae*). Determinations were based on lack of habitat or presence in the immediate area of the deluge and detonation suppression system when in operation. The Service does not provide concurrence for agency determinations of no effect.

In the 2021 BA the FAA determined the project impacts may affect the northern aplomado falcon (*Falco femoralis septentrionalis*) and those effects were analyzed by the Service and incidental take coverage was issued. In the 2023 BA addendum #1 FAA analyzed the addition of the deluge and detonation suppression system and determined the project may affect but is not likely to adversely affect the northern aplomado falcon. Although habitat does exist in the surrounding area and the falcon may occasionally pass through seeking prey, it is unlikely that it would be in the vicinity of the deluge system because of the existing construction and noise from the system operation. Therefore, the Service concurs with FAA's determination of may affect but is not likely to adversely affect.

In addition, the FAA's 2023 BA Addendum #1 considered whether the activities addressed by the 2021 BA, 2022 BCO and the addition of the deluge and detonation suppression system may affect the proposed endangered tricolored bat and the threatened cactus ferruginous pygmy-owl. Neither of these species were previously addressed by the 2022 BCO. The FAA and the Service

have considered the tricolored bat through a voluntary conference process. The closest documented sighting of the owl is on Laguna Atascosa National Wildlife Refuge, approximately 20 miles northwest of the VLA, and there is no habitat for either species in the vicinity of the VLA where the deluge system will be operated. Due to lack of habitat for, absence, or rare occurrence of these two species in the immediate vicinity of the deluge and detonation suppression system, the Service considers the effects to be insignificant and discountable and does not anticipate detectable impacts. Reinitiation of consultation or conference on these two species is concluded informally with this written concurrence that the project may affect but is not likely to adversely affect the cactus ferruginous pygmy-owl and tricolored bat.

Therefore, this reinitiation analyzes only the species and critical habitats that are likely to be adversely affected by the operation of the deluge and detonation suppression system. The analysis herein considers whether these additional adverse effects are likely to jeopardize the continued existence of the following species or result in the destruction or adverse modification of the following critical habitat areas: piping plover (*Charadrius melodus*) and designated critical habitat, red knot (*Calidris canutus rufa*) and revised proposed critical habitat, Gulf Coast jaguarundi (*Puma yagouaroundi cacomitli*), and ocelot (*Leopardus* (= *Felis*) *pardalis*). The evaluation of proposed red knot critical habitat is through a formal, but voluntary, conference process.

The Service evaluated the revised proposed boundary of red knot critical habitat in the 2022 BCO, even though the 2022 BCO was issued prior to the April 13, 2023 (88 Fed. Reg. 22530), publication of the proposed revision. Therefore, this reinitiation does not consider the effects of the launch program on the already-evaluated proposed revised critical habitat boundary.

Original effects determinations for the launch program and effects determinations for operation of the new deluge and detonation suppression system are outlined in Table 3 in the Conclusion section of the 2023 BA Addendum #1. All other species' determinations and concurrences are found in Appendix A of the May 12, 2022, BCO and remain valid.

In summary, this addendum to the 2022 BCO (Reinitiation #1) analyzes:

- Whether the operation of the deluge and detonation suppression system is likely to jeopardize the continued existence of the piping plover, red knot, Gulf Coast jaguarundi, and ocelot; and, if not, whether additional incidental take is reasonably certain to occur; and
- Whether the operation of the deluge and detonation suppression system would likely result in the destruction or adverse modification of designated critical habitat for the piping plover or revised proposed critical habitat for the red knot.

ADDENDUM TO THE BIOLOGICAL AND CONFERENCE OPINION

Background

On April 20, 2023, SpaceX launched Starship Orbital Test Flight 1 under FAA's Vehicle Operator License VOL 23-129 from the Boca Chica VLA. The launch caused the pad deck under the launch mount to be damaged. The blast ejected concrete, dust, and fondag (refractory concrete used for thermal protection) debris into the air, and the debris landed in an approximately 1,000-acre area around the launch pad. A small quantity of debris (approximately 4 percent) fell outside of the area previously analyzed in the 2022 Programmatic Environmental Assessment (PEA) in an area of approximately 20 acres (Figure 3 of the 2023 BA Addendum #1) but within the 0.6-mile debris and heat field miles (Figure 2. 2023 BA Addendum #1) analyzed and in the 2022 BCO. The incident and resulting impacts are described further in the updated Environmental Baseline. As a corrective action, SpaceX redesigned the pad deck infrastructure, constructed a deluge and detonation suppression system, and reinforced the launch pad with a steel plate to prevent a similar mishap from reoccurring.

A separate system, FireX, will be used in the event of a fire on the launch pad. It is anticipated FireX will use approximately 20,000 gallons of water that would be vaporized or collected in the retention areas on the VLA. This would be an extremely unlikely and therefore unexpected event and is not analyzed in the 2023 BA Addendum #1 or in this 2023 Addendum to the 2022 BCO. It has been addressed in an updated Fire Plan. The original plans can be found in Appendix E of the 2022 BCO. All plans in the 2022 BCO are living documents and can be updated or modified consistent with applicable law at any time in coordination with FAA, SpaceX, and the Service.

Proposed Deluge and Detonation Suppression System Components and Operations

The FAA's 2023 BA Addendum #1, Deluge System Components and Operation, incorporated by reference herein consistent with section 7 implementing regulations (50 CFR 402.14(h)(3)(i)), describes the components of the deluge and detonation suppression system. Briefly, these components are:

- A perforated stainless-steel plate installed under the launch tower through which a large volume of water will be released to cool the rocket engine exhaust, absorb sound, and heat energy, and maintain the physical integrity of the launch pad (the deluge system).
- Spray nozzles mounted on the launch mount ring to prevent detonations of free methane mixing in air and autoigniting during launch operations (the detonation suppression system).
- Water storage tanks with a capacity of 358,000 gallons (combined capacity for deluge) and 3,000 gallons (for detonation suppression) to be filled with potable water trucked in from Brownsville, Texas, or from clean water generated as a by-product of industrial processes at other SpaceX facilities or from rainwater collected and filtered at the VLA.

- Press tank pressurized with nitrogen gas at 3,000 pounds per square inch connected to the water storage tanks to expel the water when the deluge system is activated.
- A piping network and pumping system to distribute water under pressure through the deluge system.
- Control system sensors, actuators, valves, and control units to monitor water levels, pressures, and system status and allow operators to activate or deactivate the deluge system and receive alarms or notifications regarding system performance or anomalies.
- Water containment berms and gutters, a retention basin below the launch pad, and surface retention ponds; the total capacity of the water retention structures is presently 276,000 gallons and SpaceX may construct additional ponds to increase that capacity by up to 30,000 gallons; the water retention elements of the deluge system would also be used to collect and manage stormwater within the VLA; water that does not meet Texas Commission on Environmental Quality (TCEQ) standards (Appendix A of 2023 BA Addendum #1) will be removed from the containment structures and hauled to an industrial wastewater treatment facility outside the VLA.

The 2023 BA Addendum #1 describes the deluge and detonation suppression system constructed by SpaceX at Launch Mount A and accounts for SpaceX to construct a similar system at Launch Mount B in the future. The specific configuration of the systems at each launch mount may differ slightly to accommodate site specific conditions but will be functionally equivalent. FAA expects that SpaceX would only operate one system at a time. Construction activities within the VLA are already addressed in the Proposed Action, Construction, Effects of the Action, and various Plans in the 2022 BCO. Therefore, construction of the deluge system components is not addressed in this reinitiation.

As described in 2023 BA Addendum #1, SpaceX would operate the deluge system during static fire engine tests and vehicle launches (engine ignition events). Each launch is associated with an estimated two static fire engine tests. During operation, water begins to spray through the perforations in the steel plate under the launch pad 5 seconds before ignition and continues through the duration of the test or until the launch activity is complete or the volume in the water tanks is fully discharged. Consistent with conservative assumptions made in 2023 BA Addendum #1, it is assumed that up to 358,000 gallons (the maximum volume of the deluge water tanks) would be applied during each ignition event, released at a rate of 100,000 to 260,000 gallons per minute. In addition, the detonation suppression system would discharge another 3,000 gallons of water immediately before engine ignition. The assumed maximum amount of water discharged during each event is 361,000 gallons.

Water discharged through the system would disperse from the launch pad as a combination of overland sheet flow, push out (i.e., pushed through the air by rocket thrust), or vapor (i.e., a cloud of steam or aerosolized mist or fog). The water in the vapor cloud would either condense as rain or dew or remain evaporated and become part of the overall moisture content of the atmosphere. The amount of condensation vs. evaporation would be highly variable with weather conditions. Table 1 summarizes the expected fate of deluge system water.

Table 1. Discharged deluge system water fate

Mode of Discharge	Estimated Maximum Discharge Area	Notes
Overland Sheet Flow	Within 300 feet of the developed edge of the VLA	Most overland sheet flow would be contained within the developed VLA by the water containment structures. Overland sheet flow that evades or overwhelms the containment structures would likely travel no further than approximately 300 feet and remain within the undeveloped part of the VLA site.
Push Out	Within 300 feet of the developed edge of the VLA	The volume of push out water would vary with conditions during each ignition event. But, given the thrust forces involved, the push out distance is expected to be generally within 300 feet of the developed VLA.
Vapor Cloud	0.6-mile radius from VLA (co-incident with the extent of the heat plume)	The vapor cloud would disperse as condensation or evaporation within 5 minutes of the ignition event.

The 2023 BA Addendum #1 estimates approximately 71,000 gallons of water per event (roughly 20 percent) of the total discharge per event) will be dispersed outside of the developed VLA as a combination of overland sheet flow, push out, or condensation from the vapor cloud. The remaining water (approximately 290,000 gallons or roughly 80 percent of the total discharge per event) would either be captured by containment structures on the developed VLA or fully evaporated and dispersed in the air as increased ambient humidity.

Tests of the deluge and detonation suppression system support the impact distances estimated in Table 1. The tests demonstrated that most overland flow or push out water traveled no further than 300 feet of the developed boundary of the VLA. Some overland flow exited the developed VLA via a stormwater drain that directed some water into an adjacent waterbody. SpaceX has subsequently modified this stormwater drain to prevent this type of release. And SpaceX has constructed containment berms at the edge of the developed VLA to minimize overland flow and prevent it from evading or overwhelming the containment structures. Visual monitoring of the vapor cloud created during the tests showed the cloud extended approximately 0.2 mile from the launch pad but could vary based on weather and the volume of water used during a launch.

The stainless-steel components of the launch pad and mount, including the perforated stainless-steel plate of the deluge system, are a combination of approximately 74 percent iron, 18 percent chromium, and 8 percent nickel (FAA 2023). These metals will be mechanically eroded by intense heat and pressure of rocket engines firing; an effect called ablation. SpaceX estimates that each Starship/Super Heavy vehicle launch would ablate (erode) up to 190 pounds of stainless steel from the steel plate and mount, equating to 140.6 pounds of iron, 34.2 pounds of chromium, and 15.2 pounds of nickel. SpaceX expects that most of the ablated metals would be

dispersed no further than the developed VLA (i.e., captured in the overland sheet flow and retained on site). However, some of those metals, including an oxidized form of chromium known as hexavalent chromium, may disperse beyond the developed VLA in the push out water or vapor cloud. Hexavalent chromium is a toxic material regulated by the Environmental Protection Agency with drinking water standards of 100 parts per billion and regulated by the Occupational Safety and Health Administration with an action level of 5.0 micrograms/cubic meter of air (EPA 2023).

The 2022 BCO evaluated the effects of up to 20 static fire engine tests and up to 10 launches per year. Under this scenario, the deluge system may be operated up to 30 times per year. The impact area for the consequences of deluge and detonation suppression system operation is assumed by FAA to be a maximum of 0.6-mile from the VLA. This distance is the furthest extent that the vapor cloud and subsequent condensation have travelled and is the same impact area as the heat plume evaluated in the 2022 BCO.

Proposed Additional Conservation Measures

During informal coordination following FAA's reinitiation request, SpaceX committed to implementing additional conservation measures as part of the Starship/Super Heavy launch program related to operation of the deluge and detonation suppression system. The following minimization and conservation measures will be incorporated in the project to minimize impacts to the ocelot, gulf coast jaguarundi, piping plover, piping plover critical habitat, red knot and proposed red knot critical habitat. These measures were developed with input from Service and FAA and will be terms of the FAA license.

1. SpaceX will use drone imagery to monitor the visible extent of water in overland sheet flow discharges and vapor plume from the developed VLA during deluge and detonation suppression system operation. SpaceX will summarize and report findings to FAA and the Service in each post-launch monitoring report and in the annual report.
2. SpaceX will schedule deliveries of water for the deluge and detonation suppression system to the VLA during daytime hours to the maximum extent practicable.
3. SpaceX will test water generated by its production and manufacturing facilities in Boca Chica to assure it is of comparable quality to potable water trucked in from Brownsville before adding it to the water tanks at the VLA. Findings will be reported to FAA and the Service in each post-launch monitoring report and in the annual report.
4. SpaceX will sample the soil, water, and air adjacent to the launch pad for components of stainless steel including but not limited to total chromium, hexavalent chromium, iron, and nickel according to the contaminants plan. Findings will be sent to FAA and the Service in each post-launch monitoring report and in the annual contaminants report.

Updated Environmental Baseline

Conditions in the Action Area

SpaceX implements a biological monitoring plan, as required by the 2022 BCO, for sea turtles, certain avian species, and vegetation conditions near the VLA following protocols reviewed and approved by the Service. Sea turtle monitoring is not addressed in this 2023 Addendum to the 2022 BCO because the operation of the deluge and detonation suppression system is not expected to impact the sea turtles. The avian and vegetation monitoring plans are implemented to monitor and track potential changes in avian behavior and vegetative changes in habitat that may occur due to construction and operation activities at the VLA and under this 2023 Addendum to the 2022 BCO due to the operation of the deluge and detonation suppression system. The avian monitoring and reporting monitors for sensitive shorebird species, including piping plovers and red knots. The avian plan monitors abundance estimates for surveyed species within the study area based on sampled locations to document long-term trends and regional movements. The vegetation plan will ensure that vegetation and any potential project-induced changes are accurately traced and reported. Findings are reported to the Service in the quarterly and annual reports. Depending on the nature of the reported changes under both plans, FAA, and SpaceX coordinate with the Service to implement remediation measures as needed.

The most recent annual avian monitoring report provided to the Service addresses findings from avian monitoring conducted between July 2022 and June 2023. The most recent vegetation monitoring report is dated June 2023 and addresses intensive vegetation monitoring performed in October 2022. The report also addresses the most recent extensive (remote sensing) vegetation monitoring using imagery from March 2022.

The various study areas for the monitoring program overlap partially or fully with the 0.6-mile impact area for the consequences of deluge and detonation suppression system operation. Monthly avian monitoring occurs along 4 established survey routes that sample areas within 3 miles of the VLA. Pre- and post-launch avian monitoring occurs along the portions of these survey routes that occur within 1 mile of the VLA. The intensive vegetation monitoring occurs approximately 0.25 mile from the VLA, and the extensive vegetation monitoring assesses a study area of 3 miles around the VLA.

Monthly avian monitoring between July 2022 and June 2023 detected 1,016 piping plover observations and 273 red knot observations under survey protocols (i.e., excluding incidental observations). Data analysis did not detect significant evidence for trends, increasing or decreasing, in the abundance of piping plovers or red knots. These observations are consistent with prior annual monitoring reports prepared by University of Texas Rio Grande Valley from 2016 through 2021, that did not find evidence of trends in the number of observations of these species over time (SWCA 2023). SpaceX performed the first launch of the Starship/Super Heavy launch vehicle on April 20, 2023. Pre- and post-launch avian monitoring around this event reported 67 pre-launch and 22 post-launch piping plover observations and 0 pre-launch and 74 post-launch red knot observations. Piping plovers are present on wintering grounds July

through May. Red knots are present essentially the same months as piping plovers, but occurrence is variable.

Routine vegetation monitoring reported in the 2022 annual report found that between 2021 and 2022, total vegetation cover within different habitat types was variable. In 2022, vegetation plots were surveyed within the 8.66 acres of piping plover critical habitat that were originally anticipated to be impacted by water vapor ground clouds and an additional 23.51 acres that may be subject to change (Figure 1.1, Gabler and Hicks 2023). Incidental take was issued for the direct loss of 6.18 acres from construction and indirect loss from the conversion of the 8.66 acres of occupied piping plover critical habitat in Critical Habitat Unit TX-1 for a total of 14.84 acres of piping plover critical habitat in the December 18, 2013, BCO. Take was not issued for the additional 23.51 acres that was to be monitored. Sampling areas encompassed low-lying, unvegetated or barren mudflats, a transition zone comprised of halophytic vegetation and short hind dunes, and creep plots. “Creep” plots are placed at the edge of a vegetation zone transition between mudflats and halophytic salt flats to track encroachment or “creep” of plants into mudflats (Figure 1.2, Hicks and Gabler 2023). In 2016 some pin flags were degraded and were not discoverable, so they were replaced with new markers as close as possible to original points. Therefore, comparisons between the 2015 and 2016 surveys of the same plots were limited. Some of the plot markers were lost due to beach cleanup in 2018, some were lost when heavy machinery was used in the area to clean up rocket debris in 2021 after the SN10 prototype exploded. Two of the sampling plots were overtaken by a southward expansion of the launch pad in 2020-2021 and were not re-staked. Missing marker pipes since the start of vegetation monitoring has reduced the surveyor’s ability to use a standard repeated measures approach to make direct plant community comparisons between years, but they were able to make group-scale comparisons (Hicks and Gabler 2023, Appendix D). A total of 121 plots were surveyed in 2022, 41 (33.1 percent) in the take zone, and 80 (66.9 percent) in the monitoring zone. Overall, 58 plots (47.9 percent) were categorized as bare/mudflat, 14 (11.5 percent) as dune, 42 (34.7 percent) as transition, and 7 (5.8 percent) as creep. Vegetation cover decreased in mudflats (57 percent) and transition plots (20 percent), there was little change in dune plots (26.2-26.4 percent), and vegetation cover increased in creep plots (20 percent) (Hicks and Gabler 2023, Appendix D). This represents the lowest plant cover observed in mudflats and transition plots since 2018, but also represents additional evidence of a gradual (with variability) 5-year increase in plant cover in creep plots which could be significant over time. It is a reversal of the temporary decrease seen in 2021 and reinforces a larger multi-year trend towards increasing plant cover at the mudflat margins. The vegetation monitoring plan concluded much of the variation observed over the past 7 years has been within the range of natural variability, but some may be statistically attributable to land use change at the Boca Chica launch pad. This was true for the two most recent sampling periods, where most change in species composition and abundance were relatively small, and some changes reversed changes observed in prior sampling periods (e.g., the increase in plant cover in creep plots in 2022 following a sharp decrease in 2021). Some of the largest changes observed to date have been in the most recent sampling period and during the most active time period to date by far for launch pad construction and operations. Some of the large changes observed were directly attributable to this activity, such

as the over 20-fold increase in cover by vehicle tracks in the survey plots in 2021 compared to prior years. (Hicks and Gabler 2023, Appendix D). The evidence suggests:

1. Proximity to the launch site has influenced total plant cover and overall cover of some dominant plant species, such as *Distichlis spicata* and *Salicornia depressa* as well as the abundance of a larger set of species in certain habitat types, however, investigators could not say with absolute certainty whether these changes were due to SpaceX activities, other drivers, or unquantified variation in environmental conditions.
2. Some changes are clearly the result of increased activity in the area, such as a 20-fold increase in vehicle tracks in 2021 from 0.3 percent to 6.7 percent ground cover, which was three times greater than the cover of the most abundant plant species. Notably, groups other than SpaceX, primarily Border Patrol and the public also use vehicles and ATVs in the area. These changes may be associated with other observed changes in ways that could not be substantiated or tested with the current design, such as whether increased vehicle traffic in 2021 contributed to the reduction total plant cover in creep plots in 2021 and its rebound in 2022.
3. Plant community composition differed significantly between the monitoring and take proximity zones. The effects on the monitoring zone were much more visible in the dune and transition habitats, but it did have a significant overall effect. Dune habitat exhibited significantly greater changes in community composition over time than other habitat types (habitat x year interaction), including that plant communities in the vegetated areas in the vicinity of the launch pad have changed in significant ways since 2016.
4. Further monitoring is merited to identify (a) whether observed impacts are temporary or if recent changes will persist or progress further; and (b) whether these impacts are better explained by natural confounding factors not yet quantified, or if they are genuine impacts of the launch pad construction and/or operation. Such investigations would also provide information critical to the success of potential future mitigation efforts. (Hicks and Gabler 2023, Appendix D)

There has not been an increase in vegetation in the mudflats, but there has been an increase in the creep plots that has to be further monitored to determine whether these changes indicate a decrease in habitat for the piping plovers or red knots. Prescribed vegetation monitoring following the April 20, 2023, launch event, conducted by the consulting firm Raba Kistner within the 0.6-mile radius area surrounding the VLA detected only minimal damage to vegetation attributed to sand and debris deposits. Larger vegetation damage occurred approximately 260 feet southwest and southeast of the VLA. Damage to the northern and western portions 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 (Raba Kistner 2023).

The April 20, 2023, launch distributed debris from damage to the launch pad (mostly composed of concrete and dust) across approximately 1,000 acres. Concrete debris was detected outside of the debris impact area evaluated in the BCO, affecting approximately 20 additional acres. This additional debris impact area was south of the VLA and inside of the 0.6-mile heat plume impact

area. In response, SpaceX modified the launch pad deck infrastructure, including the addition of the deluge system, to avoid recurrence of this unexpected damage. SpaceX began retrieving the concrete debris following the close of the 2023 avian nesting season (February 15 through August 31) on September 1, 2023, and work continues, with clean-up activities contingent on weather and tidal conditions.

The April 20, 2023, launch burned approximately 3.5 acres of upland vegetation (Hicks and Contreras 2022) within piping plover critical habitat and red knot proposed critical habitat. However, upland vegetation is not a key component of habitat for piping plovers or red knots, so any impacts would have been minimal, if any at all. On wintering grounds, these species use areas with no or sparse vegetation.

Analysis of water samples from the two tests of the deluge and detonation suppression system on August 6 and August 25, 2023, (Table 1. attached) detected trace amounts of arsenic, barium, fluoride, and nitrate in amounts comparable to the quantities found in the potable water used to fill the tanks. Elevated amounts of chromium, zinc, aluminum, iron, and total suspended solids were also detected, with levels after the first test much higher than after the second test. The results suggest that the elevated metals and total suspended solids are the result of residual stainless-steel remaining in the deflector after being manufactured or other manufacturing-related debris and/or rust inside tanks and pipes. Levels of chromium, aluminum, iron, zinc, and total suspended solids decreased with the second test showing below the numeric effluent limitations found in TCEQ's Industrial Stormwater multi-sector general permit.

Piping Plover and Designated Critical Habitat

The listing status of the piping plover and the piping plover critical habitat designation remain unchanged from the date of the 2022 BCO. The Service has not performed a new status review (i.e., Species Status Assessment, 5-year Status Review, or updated Recovery Plan) of the piping plover since the date of the 2022 BCO. As described above, avian monitoring conducted by SpaceX following protocols approved by the Service demonstrate that piping plovers continue to use the action area and continue to be detected along all four survey routes, including the portions of these routes nearest to the VLA. Piping plovers were detected during pre- and post-launch monitoring. While the number of piping plover detections post-launch was less than during pre-launch monitoring, the species begins peak spring migration in mid-April and is generally scarce on Texas wintering grounds by mid-May. The avian monitoring data are consistent with this seasonal pattern.

Vegetation monitoring near the VLA has not detected a significant change in vegetation within piping plover habitat that would indicate habitat loss.

Red Knot and Revised Proposed Critical Habitat

The listing status of the red knot remains unchanged from the date of the 2022 BCO. The Service has not performed a new status review of the red knot since the date of the 2022 BCO. While the Service revised its proposed designation of red knot critical habitat in April 2023, the

2022 BCO already evaluated effects to proposed red knot critical habitat using the revised boundary.

Avian monitoring by SpaceX following protocols approved by the Service demonstrate that red knots continue to occasionally use the areas within 3 miles and 1 mile of the VLA. Red knots were detected during post-launch monitoring following the April 20, 2023, launch. Vegetation monitoring near the VLA has not detected a significant change in vegetation within proposed red knot critical habitat that would indicate habitat loss.

Gulf Coast Jaguarundi

The listing status of the Gulf Coast jaguarundi remains unchanged and the Service has not performed a new status review of the subspecies since the date of the 2022 BCO. The Service is unaware of any reports of the Gulf Coast jaguarundi in the action area since the date of the 2022 BCO.

Ocelot

The listing status of the ocelot remains unchanged, and the Service has not performed a new status review of the species since the date of the 2022 BCO. Our 2018 5-year Status Review estimates the current Texas population of ocelots as numbering approximately 80 individuals in two separate populations (Service 2018). One population resides primarily on two ranches, the Yturria Ranch and El Sauz Ranch, in Kenedy, Kleberg, and Willacy counties; the other population primarily resides on the Laguna Atascosa National Wildlife Refuge in Cameron County. The refuge population may occasionally use the northern edge of the action area (Service 2018). A petition was made to list the ocelot as a distinct population of the Texas population of ocelots but found not warranted in February 2022 (87 FR 7082; February 8, 2022). Currently there are ongoing efforts to reintroduce the ocelot into historically documented habitat (delaGarza, Pers. Comm. 2023), however the Service is unaware of any new reports of ocelots in the action area since the date of the 2022 BCO.

Effects of the Action

Physical Consequences of Operating the Deluge and Detonation Suppression System

The 2023 BA Addendum #1 describes the likely physical consequences of operating the deluge and detonation suppression system. These likely physical consequences include:

1. Discharging approximately 71,000 gallons of potable, chlorinated water as a combination of overland sheet flow, push out, and vapor cloud condensation outside of the developed VLA with each engine ignition event;
2. Increasing the duration and magnitude of visual disturbances by spraying a large volume of water from the launch pad up to 5 seconds prior to engine ignition;

3. Discharging up to 190 pounds of metals (chromium, nickel, iron) per launch from steel components of the launch pad infrastructure being mechanically eroded or ablated by rocket engine plumes' heat and the pressure of lift off;
4. Cooling and reducing the extent of the heat plume;
5. Absorbing and reducing the amount and extent of noise and vibrations;
6. Reducing the likelihood of damage to launch pad infrastructure and related debris scatter beyond the VLA;
7. Reducing ignition risk and minimizing the extent of fires in adjacent vegetation; and
8. Increasing truck traffic on State Highway 4 by up to 73 trips per engine ignition event to fill or refill the water tanks.

Pursuant to FAA-licensed activities, SpaceX may operate the deluge and detonation suppression system up to 30 times per year. Therefore, a year's worth of operations may, at most:

- Discharge up to 2,130,000 gallons of fresh, clean water outside the developed VLA to a maximum distance of 0.6-mile;
- Discharge up to 1,900 pounds of metals (190 pounds x 10 launches) from mechanical erosion of the steel components of the launch pad infrastructure to a maximum distance of 0.6-mile; and
- Increase truck traffic on State Highway 4 within the action area by 2,190 trips (an increase of less than 1 percent of the estimated daily traffic load of trucks otherwise supporting the Starship/Super Heavy launch program).

As described in the 2023 BA Addendum #1, each of these estimated quantities and extents are conservative and may overestimate the actual quantity and extent of the impact.

The 2023 BA Addendum #1 also describes possible, but speculative, physical consequences of operation, including:

- Vegetation growth promoted by increased freshwater deposition that increases the density and/or extent of vegetation into the naturally unvegetated or sparsely vegetated mudflats; and
- Metal contamination of soil, air, and/or water that causes long-term negative effects to ecological communities.

Vegetation growth promoted by increased freshwater is unlikely or speculative at this time because the amount of freshwater likely deposited outside the developed VLA is equivalent to a light rain. If 71,000 gallons were to be distributed evenly across the 0.6-mile maximum impact radius, the applied depth would be approximately 0.003 inch of water. If applied evenly across a 0.3-mile impact radius, the depth would be 0.014 inch of water. If applied evenly across a 300-foot impact radius (approximating the undeveloped VLA boundary), the depth would be 0.4 inch of water. The mean monthly rainfall totals for the City of Brownsville between 2000 and 2022, which range from 6.02 inches to 0.92 inches, are at least twice and mostly many times greater

than the amount of water likely to be deposited across the impact areas at any of the contemplated impact distances.

Metal contamination distributed outside the VLA from the ablation of steel via heat from rocket engine plumes and pressure from lift off is poorly studied and the best available comparable information suggests negative effects on ecological communities near the VLA are unlikely (FAA 2023). Deposition of metals from the plumes of solid rocket boosters (SRBs) used on the Space Shuttle has been analyzed by the National Aeronautics and Space Administration (NASA) and can be used to compare the significance of minimal steel ablation. SRBs are made of a solid propellant mixture consisting of ammonium perchlorate, aluminum, and iron oxide and react to produce hot gases at high-speed creating thrust that would deposit metals from the plume of the vehicle. The raptor engines of the Starship-Super Heavy use liquid oxygen and liquid methane as propellants, not SRBs and no metals would be produced from the combustion of these propellants, but only from the ablation from the steel plating instead. The ablation is from the plume contacting the stainless-steel plate comprised of chromium, nickel, and iron, not a chemical reaction from the vehicle (FAA 2023). Therefore, the number of metals likely to be eroded from the launch pad infrastructure is small compared to the number of metals released and dispersed by the exhaust from NASA's Space Shuttle vehicle (FAA 2023). The Starship/Super Heavy program would erode approximately 190 pounds of metals per launch, while the Space Shuttle exhaust plume generates and distributes approximately 61,835 pounds of aluminum-based metals (FAA 2023). Although the metals are different, Space Shuttle program monitoring has detected no adverse ecological changes in nearby or far-afield areas from its metals (FAA 2023).

Piping Plovers and Red Knots

The increased duration and magnitude of visual disturbances associated with spraying water from the launch pad for several seconds prior to engine ignition is likely to cause piping plovers and red knots in the immediate vicinity to flush and move away from the VLA. This flushing response is likely to adversely affect the behavior of individual birds as they are startled and compelled to cease their prior activity (foraging, resting, grooming, evading potential predators) and move away from the disturbance.

Ultimately, however, this flushing response may benefit these individuals if they move further away from the most intense parts of the heat plume and vapor cloud, which could cause death or physical injury. The applied water is also likely to reduce the intensity and extent of the heat plume and associated noise and vibrations from the engine ignition. To date, data from the avian monitoring program performed by SpaceX, with methods approved by the Service, has not detected any significant changes in how either species uses habitat in the vicinity of the VLA .

The addition of the deluge and detonation suppression system to the suite of launch-related activities is not expected to modify piping plover or red knot habitat beyond the levels previously evaluated in the 2022 BCO. The amount of freshwater dispersed outside of the VLA is small compared to the amount of natural rainfall in the area and is unlikely to cause a significant

increase in vegetation that would encroach into (and cause a loss of) the mudflat or beach habitat used by these species.

The dispersal or accumulation of metals eroded from steel components of the launch pad infrastructure are presently speculative. There is no evidence at present that metals are being deposited outside of the developed VLA. SpaceX has agreed to monitor the presence of metals in air, water, and soil within the 0.6-mile vapor plume and overland overflow water impact areas and will report the findings to the Service. If findings result in elevated levels of contaminants, FAA, SpaceX the Service, and other appropriate agencies will coordinate and implement measures identified in the contaminants plan described further in the Terms and Conditions of this document.

Piping Plover and Red Knot Designated or Proposed Critical Habitats

Water leaving the developed VLA during operation of the deluge and detonation suppression system may cause a change in vegetation by promoting the growth of plants that would otherwise be inhibited by the saline conditions of the tidal, wind, sand, and mudflats that comprise piping plover and red knot habitat at Boca Chica. Vegetation growth could invade these flats and alter important habitat types that are otherwise devoid of vegetation. This could cause a potentially adverse effect to designated or proposed critical habitats for these species. However, evidence of increased vegetation cover in the unvegetated flats has not been detected by vegetation monitoring. This monitoring is ongoing, and findings will continue to be reported to the Service by SpaceX. Further, the spatial extent of vegetation changes, if any, would most likely be limited to the area closest to the developed VLA (i.e., generally within 300 feet). Much of this area is within the part of the VLA identified for future expansion and has already been evaluated as eventual habitat loss.

The mechanical erosion of steel during engine ignition events and subsequent opportunity for metals to disperse with the water applied during operation of the deluge and detonation suppression system could also adversely affect designated and proposed critical habitats for the piping plover and red knot. Chromium, nickel, and iron could accumulate over time because they do not really degrade after each launch and metal concentrations in the deposition area could increase over time due to repeated launches. This could cause disruptions to the food chain that supports migrating and wintering piping plovers and red knots. The likelihood and extent to which eroded metals escape the developed VLA, accumulate in critical habitat areas, and alter food chains are presently unknown. However, if these metals are primarily carried by water, then most effects would likely occur nearest to the VLA (i.e., generally within 300 feet) and within an area already evaluated as habitat loss. SpaceX has agreed to monitor the presence of metals in air, water, and soil within the 0.6-mile vapor plume impact area and will report the findings to the Service. If metals are detected, benthic organism testing will begin. The contaminants plan, noted in the amended incidental take statement below, will be updated to include this type of testing.

Gulf Coast Jaguarundis and Ocelots

Gulf Coast jaguarundis and ocelots are not expected to occur within the 0.6-mile vapor plume impact area due to a lack of suitable habitat. However, suitable habitat with a moderate probability of use by ocelots occurs towards the western edge of the action area between the Rio Grande and State Highway (SH) 4. Increased truck traffic on SH 4 could increase the risk of vehicle strikes with these cats and the activity could functionally increase this existing barrier to dispersal. While these adverse effects are to some extent likely, the lack of recent detections of either species within the action area, particularly along SH 4, limiting truck deliveries to daylight hours to the maximum extent possible, and implementation of an employee transportation shuttle would reduce the potential that additional vehicle mortality or habitat avoidance is reasonably certain to occur.

Opinion Regarding Jeopardy or Destruction or Adverse Modification of Critical Habitat

Operating the deluge and detonation suppression system is likely to have some adverse effects on:

- piping plovers and red knots by creating new visual disturbances that will likely flush individual birds that may be nearest to the VLA immediately prior to an engine ignition event; and
- Gulf Coast jaguarundis and ocelots by creating additional truck traffic along State Highway 4 that may increase the risk of vehicle mortality and inhibit use of potentially suitable habitat along the highway.

However, the expected adverse behavioral responses (i.e., flushing and avoidance) are also likely to have other beneficial effects that, overall, would not create an appreciable reduction of the likelihood of survival and recovery in wild for any of these species. No individuals of these species have been detected dead or injured because of SpaceX's Starship/Super Heavy launch program. The addition of the deluge and detonation suppression system is likely to further reduce the risk for wintering piping plover or red knot death, physical injury, or impacts to use of habitat for feeding or sheltering as it will not directly destroy or degrade habitat. Neither species breeds along the Texas coast. The additional water truck traffic is minor compared to existing traffic loads and does not create a new or substantially greater barrier to movement, such that neither the Gulf Coast jaguarundi nor ocelot is likely to face an appreciably reduced likelihood for survival and recovery in the wild.

Piping Plover Critical Habitat

Although piping plover critical habitat Unit TX-1 (7,217 acres) is one designated unit out of 141 total units totaling 165,211 acres, the Service must base its analysis on the value of critical habitat as a whole for the conservation of the listed species.

Our determination of no adverse modification is based on the fact that metal deposition is unknown until after launch, and, as described in the 2022 BCO, impact of 903.65 acres which

includes the loss of 444.27 acres within the total acreage (construction and/or operational) to piping plover critical habitat Unit TX-1 represents only .5 percent of all designated wintering critical habitat in the United States.

Red Knot Proposed Critical Habitat

Although red knot proposed critical habitat Unit TX-11 is one designated unit out of 127 total units totaling 165,211 acres, the Service must base its analysis on the value of critical habitat as a whole for the conservation of the listed species.

Our determination of no adverse modification is based on the fact that metal deposition is unknown until after launch and as described in the 2022 BCO, impact of 444.27 acres within that total acreage (construction and/or operational) to red knot proposed critical habitat Unit TX-11 represents only 0.65 percent of all designated and proposed wintering critical habitat in the United States.

For the above reasons, the Service does not expect that the proposed action will reduce the overall reproduction, numbers, or distribution of the piping plover or the red knot so that the likelihood of survival and recovery in the wild of any of these species is appreciably reduced.

AMENDED INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 100 listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. “Incidental take” is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be undertaken by the FAA and/or SpaceX as appropriate, for the exemption in section 7(o)(2) to apply. The FAA has a continuing duty to regulate the activity covered by this incidental take statement. If the FAA (1) fails to assume and implement the terms and conditions or (2) fails to require SpaceX to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or license the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FAA and/or SpaceX must report the progress of the action and its impact on the species as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

Amount or Extent of Take

The likely adverse effects of operating the deluge and detonation suppression system are not expected, with reasonably certainty, to cause additional incidental take of the piping plovers and red knots and their habitat that may occur within the 0.6-mile rocket heat plume radius and the potential anomaly debris field area shown in Figure 2 of the 2023 BA Addendum #1, and fully described in the 2022 BCO. Also, adverse effects of operating the deluge and detonation suppression system are not expected, with reasonable certainty, to cause additional incidental take of Gulf Coast jaguarundi and ocelot. Although water delivery truck traffic will increase along SH 4, limiting delivery to daylight hours and implementation of a shuttle system to transport employees will reduce potential overall effects. Therefore, no additional incidental take is authorized with this reinitiation, and the take limits previously established in the 2022 BCO and associated Incidental Take Statement remain applicable to the proposed set of expanded activities, operation of a deluge and detonation suppression system, at the Vertical Launch Area. We also concluded the operation of the deluge and detonation suppression system will not result in jeopardy to the ocelot, Gulf coast jaguarundi, piping plover and red knot as determined in the 2022 BCO and there will be no adverse modification of piping plover critical habitat and proposed red knot critical habitat. Although we have determined that this reinitiation is unlikely to result in additional incidental take, we will be reviewing contaminant monitoring reports to corroborate or refute this initial finding. Should monitoring indicate incidental take or adverse modification of critical habitat is occurring beyond what is described in the 2022 BCO, the FAA will need to reinitiate consultation.

Reasonable and Prudent Measures

1. The Service believes the following reasonable and prudent measures are necessary and appropriate to avoid or minimize adverse effects and will not result in additional incidental take of the piping plover, red knot, Gulf Coast jaguarundi, and ocelot previously authorized in the 2022 BCO. These reasonable and prudent measures apply only to those activities discussed within this 2023 Addendum to the 2022 BCO. All reasonable and prudent measures associated with the May 12, 2022, BCO, and the respective Incidental Take Statement remain valid. In addition: FAA and SpaceX will design and implement a Contaminant Monitoring Plan to ensure that any launch-related accumulation of potential contaminants of concern will be detected, and if necessary, corrective actions taken to protect listed and proposed species. Monitoring will include any chemicals or compounds associated with launch activities that will be introduced to the surrounding environment and may pose a risk to listed and proposed species that utilize the area. Substances that are persistent and can bioaccumulate in the environment, and that are potentially toxic to wildlife are the highest priority, including constituents in steel (e.g., total chromium, hexavalent chromium, nickel, and iron) used in launch pad infrastructure, but also pollutants that may not be persistent but can nevertheless result in short-term adverse impacts (e.g., trace constituents of potable water applied, such as (chlorine/chloride). The monitoring plan will be coordinated with and approved by the Service. Findings, including analysis of the data, comparison with baseline data, and

recommendations for corrective actions (if any) will be reported to the Service, as outlined in the monitoring plan once it is developed.

2. FAA and SpaceX will coordinate with the Service to review and update all plans, in particular the Biological Monitoring Plan outlined in the May 12, 2022, BCO as needed. Reviews will focus on needed updates of survey methods, their effectiveness in tracking take issued in the 2022 BCO, and potential remediation solutions if needed.
3. FAA will make implementation of the voluntary conservation measures listed on page 7 as well as reasonable and prudent measures listed above and, in the Terms and Conditions section of this document, a condition of its launch license, such that SpaceX is required to implement all the Terms and Conditions of the 2022 BCO and this 2023 Addendum #1.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the FAA and SpaceX must comply with the following terms and conditions that implement the reasonable and prudent measures described above and outlined in reporting/monitoring requirements. These terms and conditions are non-discretionary. The following terms and conditions implement reasonable and prudent measure 1:

1. FAA and SpaceX will coordinate with the Service in the design of a Contaminants Monitoring Plan, testing protocols and adaptive management strategies based on findings.
2. FAA will ensure that SpaceX will coordinate with the Service in the development, review, and concurrence of the final Contaminants Monitoring Plan to be completed within 3 months of the date of this letter.
3. FAA will ensure that SpaceX will include control sites to establish baseline conditions, with sampling collected prior to the next launch. Baseline data will be compared to future monitoring data to determine whether deposition and/or accumulation of potential contaminants is occurring. Sampling can occur in a phased approach, with more intensive sampling initially to ensure changes to the environment are captured, then potentially tapering off if contaminant levels remain low or otherwise do not indicate harmful impacts might occur. Sampling will occur after every launch beginning in 2023, twice a year after a launch in 2024, and potentially quarterly the following 3 years depending on the initial findings of the monitoring and whether contaminant accumulation is occurring.
4. FAA will ensure that SpaceX will test for changes in air, soil, water, and the benthic environment within the 0.6-mile water overland sheet flow and vapor plume impact areas. Sampling methods of air, water and benthic environment will be identified during the development of the monitoring plan. The following Terms and Conditions are soil specific but could also be expanded to include other sample media during the development of the plan.
5. FAA will ensure that SpaceX must also collect soil samples outside the 0.6-mile water overland sheet flow and vapor plume impact areas for preliminary baseline monitoring (i.e., to establish background concentrations for comparison) prior to the next launch.

Collecting soil samples from outside the 0.6-mile area will be more representative of natural conditions not impacted by past and ongoing launch activities.

6. FAA will ensure that SpaceX will, at a minimum, identify 3 representative transects extending radially from the VLA to 0.6-mile and collect 5 soil samples, equally spaced, from each of the transects. Depending on findings, the number of transects and number of samples may increase. Samples will be collected and stored in a manner appropriate for analysis.
7. FAA will ensure that SpaceX analyzes soil samples in a timely manner (i.e., not stored beyond what is necessary to transport to the lab), however, interpretation of the data may be deferred until the Contaminants Monitoring Plan is finalized. If monitoring indicates levels of contaminants are increasing, FAA will ensure that SpaceX will expand monitoring to include biological sampling sufficient to determine if levels are accumulating in wildlife. If contaminant levels are increasing in biota, FAA will ensure that SpaceX will conduct an Ecological Risk Assessment to determine if levels are approaching toxicity thresholds or are otherwise harmful to target species. If the Ecological Risk Assessment shows a contaminant risk to target species, the FAA will ensure that SpaceX will coordinate with the Service and other appropriate agencies to remove, reduce, and remediate contaminant levels in order to minimize or eliminate potential injury to listed species.

The following terms and conditions implement reasonable and prudent measure 2.

1. FAA and SpaceX will coordinate with the Service to update the 2022 BCO plans as necessary and review effectiveness of each plan as needed or at least annually.
2. FAA and SpaceX will coordinate with the Service to update the Biological Monitoring Plan to improve the quality of data being collected to track potential incidental take.

The following terms and conditions implement reasonable and prudent measure 3:

1. FAA and SpaceX shall comply with the reasonable and prudent measures described above and the required reporting and monitoring requirements below to ensure the amount of authorized incidental take is not exceeded and to further minimize the take.
2. Any failure by FAA and SpaceX to comply with these Terms and Conditions stated herein may result in loss of Section 9 take coverage. If noncompliance is expected, the Service is to be notified within 48 hours as to which term and condition cannot be implemented, including the reason for noncompliance, and FAA and SpaceX will begin coordination with the Service to identify potential remediation efforts.

Monitoring and Reporting Requirements

Upon locating a dead, injured, or sick listed species on refuge lands SpaceX will contact Refuge Law Enforcement, Iriz Elizondo-Navarro at 956-784-7520 located at 3325 Green Jay Road Alamo, Texas 78516. If the species is found off refuge, contact Special Agent Alejandro Rodriguez at 956-686-8591, 4500 N. 10th Street #400, McAllen, TX 78504, within three working days of its finding. Written notification must be made within five calendar days and

include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy sent to U.S. Fish and Wildlife Service, Texas Coastal Ecological Services Field Office, ATTN: Assistant Field Supervisor, 4444 Corona Drive, Suite 215, Corpus Christi, Texas 78411. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered specimens or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed. FAA and SpaceX shall inform the Service immediately if any of the conservation measures, reasonable and prudent measures and terms and conditions within this 2023 Addendum, and the May 12, 2022, BCO are not implemented to the fullest extent at any time during project implementation. Additionally, FAA and SpaceX will implement actions to remedy any failure to fully implement all conservation measures and Reasonable and Prudent Measures associated with this consultation.

Conservation Recommendations

The Service recommends the following additional discretionary conservation recommendations in connection with the SpaceX/Super Heavy launch program:

1. SpaceX should coordinate with the Service to help identify and implement opportunities to conserve loma habitat on and off the project site and preserve trees along the Rio Grande corridor.
2. SpaceX should partner with the Service on the implementation of camera monitoring to detect ocelot and their movements in the action area.
3. SpaceX should partner with the Service to conserve important habitats for the listed species adversely affected by the SpaceX/Super Heavy launch program.

Conservation recommendations are advisory and are not intended to carry any binding legal force.

REINITIATION NOTICE

This concludes the reinitiation of formal consultation and conference for the FAA-licensed SpaceX Starship/Super Heavy launch program in Boca Chica, Cameron County, Texas (consultation number 02ETCC00-2012-F-0186-R00) addressing the operation of a deluge and detonation suppression system during engine ignition events. As provided in 50 CFR 402.16, reinitiation of consultation is required and shall be requested by the federal action agency where discretionary federal involvement or control over the action is retained or is authorized by law and: (1) if the amount or extent of incidental taking specified in the incidental take statement is exceeded; (2) if new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or an extent not previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or designated critical habitat not considered in the biological opinion or written concurrence; or (4)

if a new species is listed or designated critical habitat that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. The May 12, 2022, BCO is currently effective. This addendum to the May 12, 2022, BCO becomes effective on issuance of FAA license and pursuant to any necessary TCEQ or U.S. Army Corps of Engineers permit being issued.

The Service appreciates your consideration of threatened and endangered species and South Texas's wildlife resources. If you have any questions regarding this addendum to the 2022 BCO, please contact Mary Orms of my staff at 281-271-2162 or by electronic mail at mary_orms@fws.gov.

Sincerely,

Charles Ardizzone
Field Supervisor

Literature Cited

- DelaGarza, L. Personal Communication, Service Ocelot Coordinator, October 20, 2023.
- Environmental Protection Agency (EPA). 2023. Chromium in Drinking Water. <https://www.epa.gov/sdwa/chromium-drinking-water>. Accessed 1 November 2023.
- Federal Aviation Administration (FAA). 2023. 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 the Deluge.
- Hicks, D.W. and L.M. Contreras. 2022. Biological Assessment Starship Super Heavy Orbital Launch Wildfire. May 26, 2023.
- Hicks, D.W. and C.A. Gabler. 2023. Commercial launch site construction-phase vegetation monitoring survey prepared for Space Exploration Technologies (SpaceX). June 2023.
- Raba Kistner. 2023. SpaceX Boca Chica Launch Site-Pre and Post Launch Vegetation Monitoring Boca Chica, Cameron County, Texas. May 5, 2023.
- SWCA. 2023. *Final: biological monitoring annual report for the SpaceX Boca Chica launch site construction and seasonal avian monitoring-July 2022 to June 2023*. (SWCA Project No. 73821). SWCA Environmental Consultants. Austin, TX.
- U.S. Fish and Wildlife Service (Service). 2018. 5-Year Review: Summary and Evaluation. Ocelot. U.S. Fish and Wildlife Service, Hilary Swarts, Laguna Atascosa National Wildlife Refuge, Los Fresnos, TX.

TABLES

Table 2. Analytical results from Water Deluge Sampling

Parameter	Potable Source Water	Sample Event 2 Static fire	Sample Event 2 Static fire	Sample Event 4 Static fire	Sample Event 4 Static fire	Sample Event 4 Static fire	
		(off pad)	(retention pond)	(off pad)	(retention pond)	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	Sample Event 2 Static fire	Sample Event 4 Static fire	Sample Event 4 Static fire	Sample Event 4 Static fire	
		(off pad)	(retention pond)	(off pad)	(retention pond)	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

FIGURES

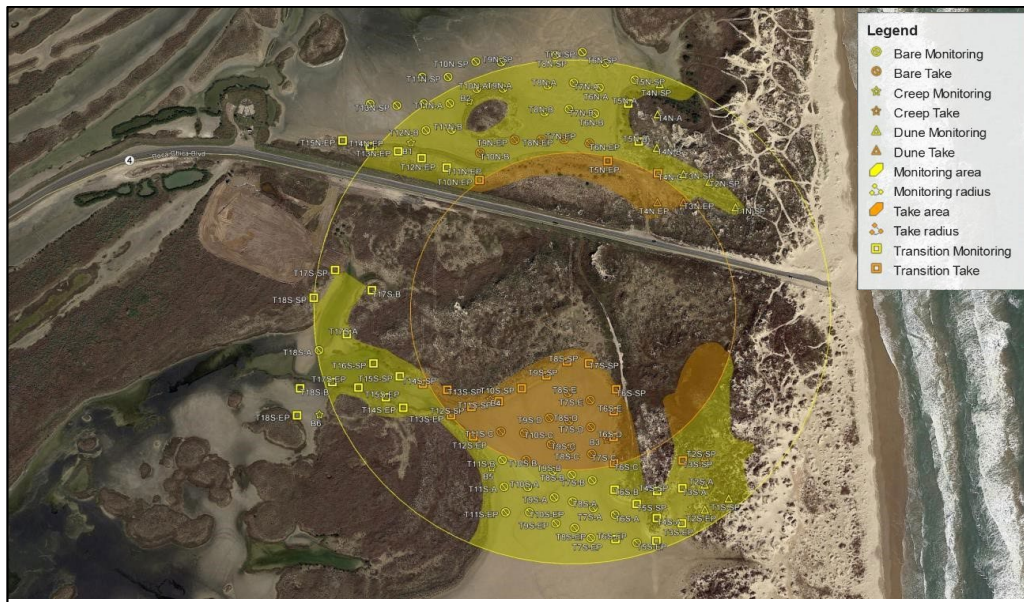


Figure 1.1. Vegetation sampling points near the launch pad site at Boca Chica Beach in South Texas. ‘Take’ denotes the 8.66-acre area for which the Service has issued take, and those sampling plots considered to be in that zone. In some areas (e.g., the NNW region), we consider the sampling plots nearest the take zone to be within the zone for the sake of comparative analyses. ‘Monitoring’ denotes the additional 23.51-acres are designated for supplementary monitoring. Note that the precise locations for the Monitoring and Take zones are approximate, and this map should be used for visualization purposes only. ‘Bare’, ‘Transition’, and ‘Dune’ refer to the three main types of habitats surveyed, which are described above and illustrated in Figure 1.2. ‘Creep’ refers to plots placed at the edge of a vegetation zone transition between mudflats and halophytic salt flats for the sake of tracking encroachment or “creep” of plants into mudflats (Hicks and Gabler 2023).

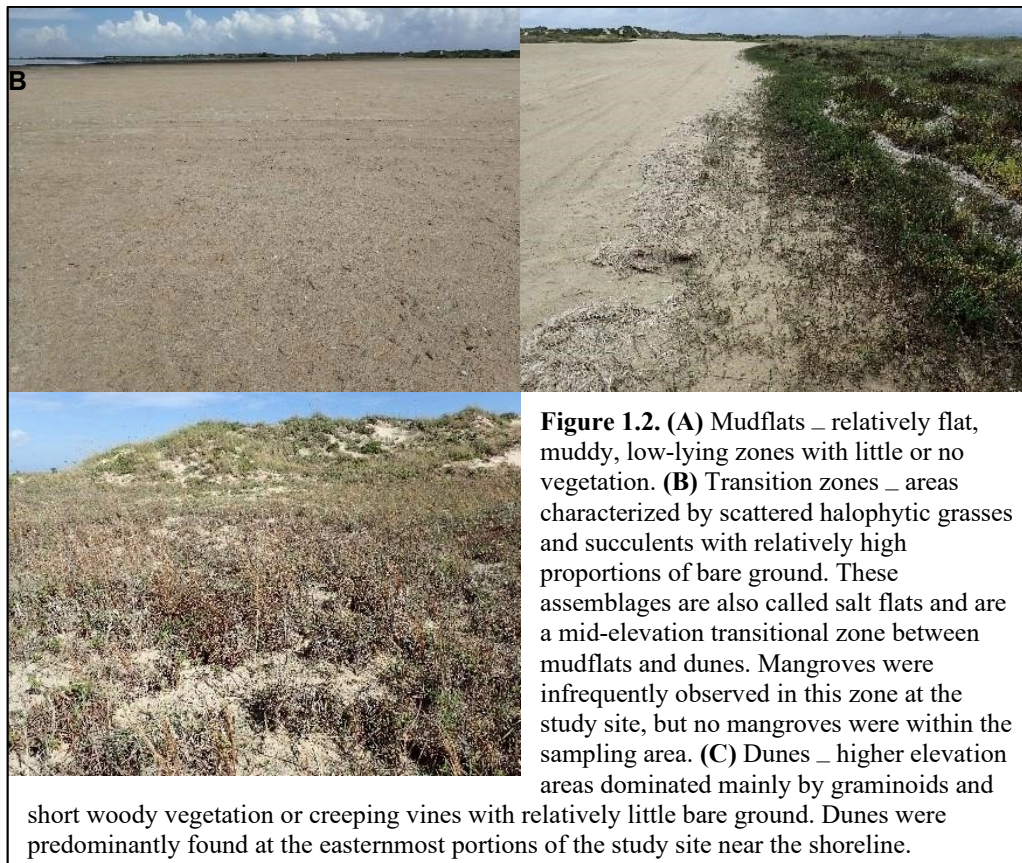


Figure 1.2 Three main habitats surveyed (Hicks and Gabler 2023)

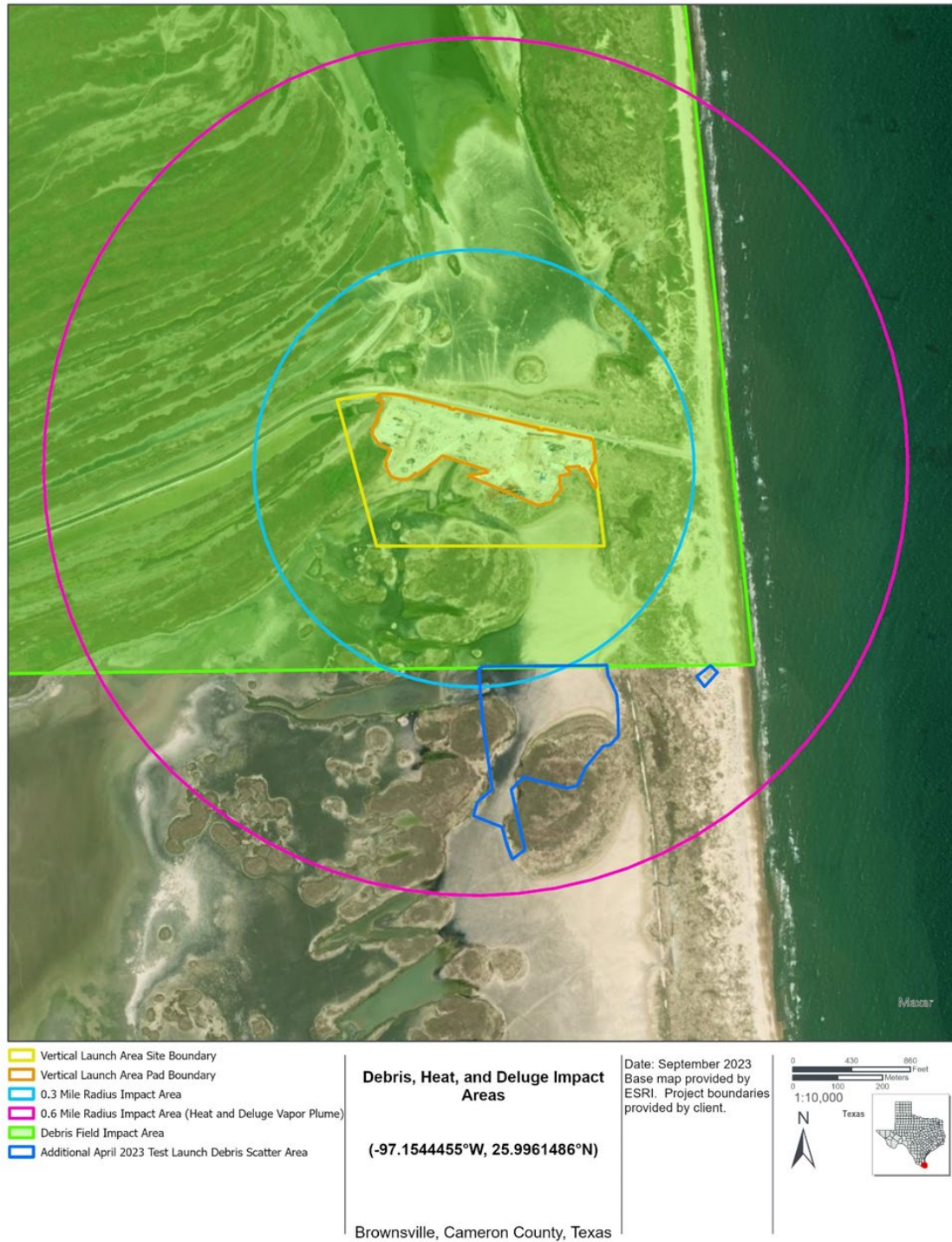


Figure 2 of 2023 BA Addendum #1. Deluge Impact Area

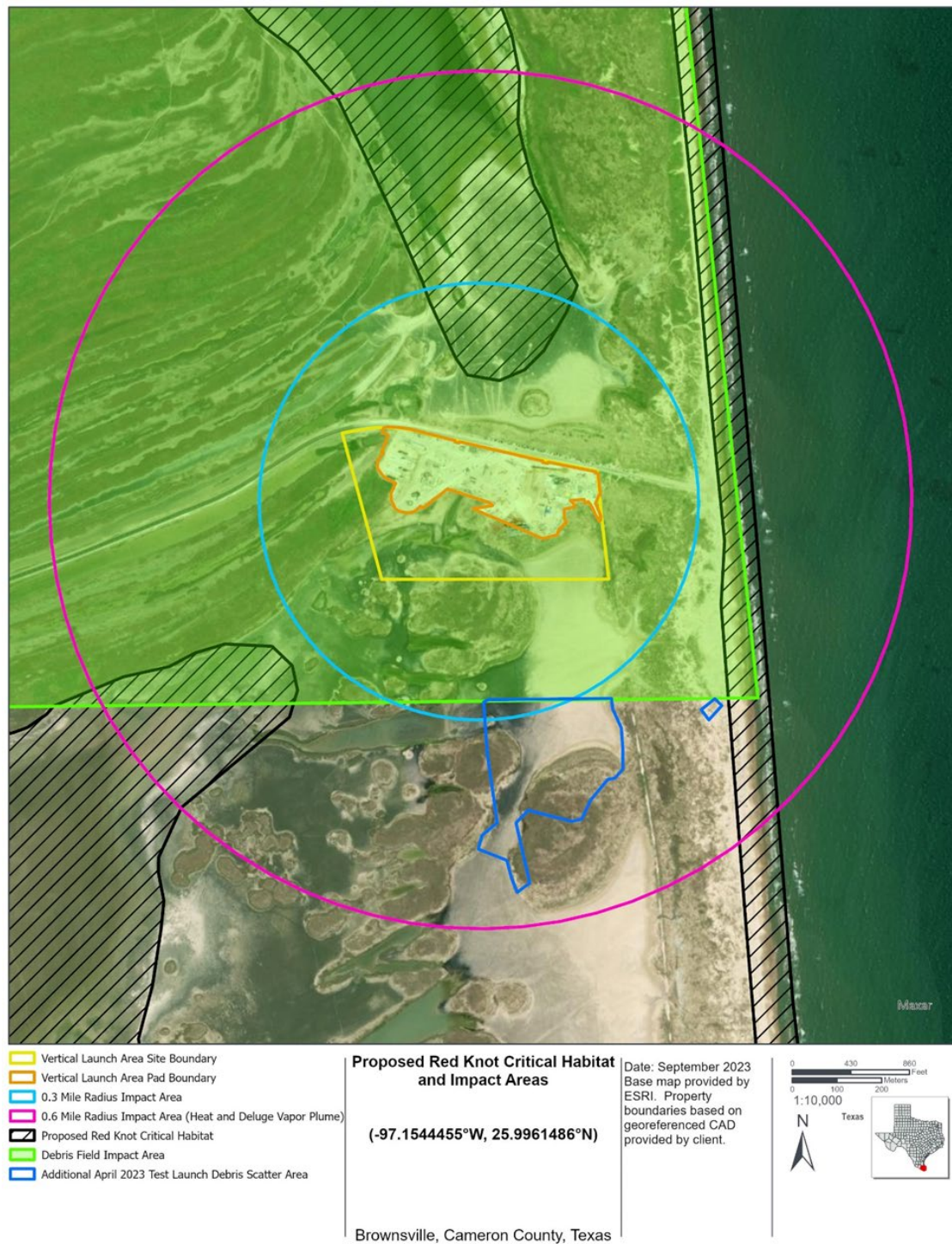


Figure 3 of 2023 BA Addendum #1. Proposed Red Knot Critical Habitat