APPENDIX A
United States Fish and Wildlife Service Consultation

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Ecological Services
Ventura Fish and Wildlife Office
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IN REPLY REFER TO:
2022-0013990-S7-001

March 21, 2023

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Subject: Reinitiation of the Biological Opinion on the Launch, Boost-Back, and Landing of the Falcon 9 First Stage at Space Launch Complex 4 (SLC-4) at Vandenberg Space Force Base, Santa Barbara County, California (2017-F-0480)

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the U.S. Space Force's (Space Force) proposed authorization of the Space Exploration Technologies Corporation (SpaceX) to increase cadence of launches of the Falcon 9 first stage at Space Launch Complex 4 (SLC-4) on Vandenberg Space Force Base (VSFB), and its effects on the federally endangered California least tern (*Sterna antillarum browni*), and the federally threatened California red-legged frog (*Rana draytonii*) and western snowy plover (*Charadrius nivosus nivosus*), in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 et seq.). We received your November 29, 2022, request to reinitiate formal consultation on November 29, 2022.

We have based this biological opinion on information that followed your original November 29, 2022 request for consultation (B. Kephart, in litt., 2022a), including the biological assessment (MSRS 2022a), and further coordination between Space Force and Service staff. These documents, and others relating to the consultation, are located at the Ventura Fish and Wildlife Office.

Definitions Related to Launch Noise and Overpressure Disturbance

Launch and Static Test Fire Noise

The highest sound pressure level measure during a single event is the SPL_{max}. Although it provides some measure of the event, SPL_{max} does not fully describe the noise disturbance because it does not account for how long the sound occurs. Sound exposure level (SEL) takes into account the length of time a noise occurs and provides a measure of the net impact of the entire acoustic event.

Each proposed launch event would generate noise disturbance from the ignition of the rocket fuel with a maximum sound level of 150 decibels (dB) SPL_{max} on SLC-4 during both launch and terrestrial landing events. Noise level would attenuate outward in all directions reaching 100 dB approximately 14.5 miles away (MSRS 2022a, pp. 29, 53; refer to Appendix A, Figure 1a–c

Launch Noise Effect Area). Associated static test fires would also produce noise levels of up to 140 dB SPL_{max} with levels attenuating outward in all directions reaching 100 dB approximately 10.5 miles away (MSRS 2022a, p. 11).

Launch Sonic Boom

Each proposed launch ascent and landing would generate a separate sonic boom. Each sonic boom would produce disturbance in the form of overpressure, which is high energy impulsive sound that would last a fraction of a second (BRRC 2020, p. 32). Overpressure disturbance from launch ascent and landing would impact separate areas (refer to Appendix A, Figure 2a–c, Sonic Boom Effect Area). Static test fires would not create a sonic boom. During ascent and descent, overpressure levels would be up to 8.5 pounds per square foot (psf) (MSRS 2022a, p. 53). Overpressure can be expressed as instantaneous noise disturbance (SPL_{max}) by using a mathematical conversion from psf to decibel levels. The biological assessment did not include conversions of overpressure into instantaneous noise disturbance (SPL_{max}). The Service used past Falcon 9 monitoring reports to reference these conversions for purposes of facilitating comparison (Robinette and Rice 2019, p. 14, 2022, p. 13; MSRS 2022b, p. 4).

Not Likely to Adversely Affect Determination

The Space Force's request for consultation also included the determination that the proposed action may affect but is not likely to adversely affect the federally threatened marbled murrelet (*Brachyramphus marmoratus*) and southern sea otter (*Enhydra lutris nereis*), and the federally endangered California condor (*Gymnogyps californianus*), unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), and tidewater goby (*Eucyclogobius newberryi*).

Marbled Murrelet

There were 23 total observations of marbled murrelets offshore from VSFB between 1995 and 2020 (MSRS 2022a, p. 32; eBird 2022). In 2011, one observation recorded approximately 0.5 mile west of SLC-4 indicated presence of a marbled murrelet at an unreported distance offshore. Two additional 1995 observations (each of one individual) taken from approximately 7.5 miles north of SLC-4 indicated presence offshore from Purisima Point. The remaining observations occurred north of Minuteman Beach. Marbled murrelets do not breed on VSFB due to lack of breeding habitat; project activities would only impact foraging adults which observers document infrequently. Marbled murrelet observations in this area have occurred as close as 984 to 6,561 feet from the shore (Strachan et al. 1995, p. 247).

Sound pressure and overpressure produced by the proposed project activities (launch, landing, and static fire events) have the potential to affect marbled murrelets in the vicinity of SLC-4. Immediately off the coast, maximum anticipated noise levels during proposed activities at SLC-4 would be 130 dB SPL_{max} during Falcon 9 launches, 115 dB SPL_{max} during SLC-4 landings, and 125 dB SPL_{max} during static fire events. This area would also experience sonic booms with overpressure levels up to 4 psf during each vehicle landing at SLC-4 (MSRS 2022a, p. 59). However, marbled murrelets typically inhabit areas further off the coast (984 to 6,561 feet from shore) that experience much lower noise levels. It is unknown how various noise and overpressure levels can affect marbled murrelet hearing capabilities, but we expect any nearby individuals to exhibit a startle response (i.e., dive and resurface) during launch, landing, or static fire events and return to normal behavior post-event (Bellefleur et al. 2009, p. 535). It is unlikely marbled murrelets would be present at the exact moment of a launch, landing, or static fire event because of their transitory nature and scarcity within the project vicinity. Therefore, the probability of noise-related impacts to marbled murrelets from project activities would be extremely low.

After reviewing the information provided, we concur with your determination that the proposed action may affect but is not likely to adversely affect marbled murrelets based on discountable effects. Our concurrence is based on the following:

1. Within the project vicinity, marbled murrelets occur irregularly and only as adults foraging offshore; they do not breed at VSFB.
2. Available monitoring data suggest that maximum noise levels produced from launch operations are unlikely to have a significant effect on marbled murrelets. Effects would likely include only temporary behavioral reactions to noise disturbance.

Southern Sea Otter

Southern sea otters irregularly inhabit (i.e., transit, forage) the coast of VSFB between Purisima Point and Point Arguello. There is a small breeding colony approximately 5.5 miles south of SLC-4 at the boat harbor near Sudden Flats (MSRS 2022a, p. 46). Consequently, noise and overpressure produced from the proposed project's launch operations has the potential to affect southern sea otters in the vicinity of SLC-4.

Sound pressure and overpressure produced by the proposed project activities (i.e., launch, landing, and static fire events) have the potential to affect southern sea otters if present offshore at the time of launch within the vicinity of SLC-4. Immediately off the coast, maximum anticipated noise levels during proposed activities would be 130 dB SPL_{max} during Falcon 9 launches, 110 dB SPL_{max} during boost-back landings at SLC-4, and 125 dB SPL_{max} during static fire events. Potentially occupied southern sea otter areas would also experience sonic booms with overpressure levels up to 5 psf during each boost-back landing at SLC-4 (MSRS 2022a, p. 70). However, the location of the southern sea otter breeding colony south of SLC-4 would experience slightly lower noise levels with maximum anticipated levels of 100 to 110 dB SPL_{max} during launches, 80 dB SPL_{max} during first-stage landings at SLC-4 West (4W), and sonic boom overpressure levels ranging from 1 to 3 psf. Project-related activities would also impact southern sea otters via visual disturbance during launch and landing events.

Monitoring data during space launch activities since 1998 indicate that launch noise and visual disturbances do not substantially affect the number or activities of southern sea otters in the nearshore marine environments of VSFB (Service 2015a, p. 4; MSRS 2022a, p. 71). Southern sea otters adjacent to LF-05 on north base have historically experienced launch noise of 136.6 dB associated with Peacekeeper launches and continue to experience 127.8 dB associated with Minuteman III launches with no observed effects (SRS 1999a as cited in MSRS 2021a, p. 55). Previous monitoring conducted during the SpaceX Sentinel 6A launch mission that contained a boost-back and landing actions with similar noise and overpressure levels on November 21, 2020 documented similar before and after launch counts of southern sea otter (MSRS 2021b, p. 3). Biologists did not detect any discernible impact from the launch activity to southern sea otters.

Additionally, previous research indicates that sea otters may acclimatize to frequent noise disturbance. Davis et al. (1988, pp. 7, 14) conducted a study of northern sea otter's (*Enhydra lutris kenyoni*) response to underwater and in-air noise stimuli utilizing a variety of sounds, including air horns and an underwater acoustic harassment device capable of producing 190 dB for longer period playbacks, pulsing sound every 15 seconds over a maximum of 3 hours. The louder underwater acoustic harassment device did not disturb northern sea otters (Davis et al. 1988, p. 22), but noise exposure to air horn noise resulted in a startle, fleeing response with individuals moving between 300 to 600 feet before resuming normal activity and exhibiting habituation to the variety of noise stimuli over a short amount of time (Davis et al. 1988, pp. 31, 35). Consequently, the Service anticipates any southern sea otters within the project area may exhibit a startle response to initial launch noise disturbance, which may cause them to move a short distance, but individuals would likely resume normal behavior soon after. We also anticipate that southern sea otters located off the coast of VSFB may already exhibit a degree of habituation due to the existing launch environment, and we do not currently expect the proposed project to result in novel effects.

Permanent and temporary threshold shifts in hearing sensitivity have yet to be determined for the southern sea otter. The Service reviewed surrogate thresholds for otariid pinnipeds, closely related marine mammals, developed by the U.S. Navy and the National Marine Fisheries Service (Finneran and Jenkins 2012, pp. 5, 19–21; Navy 2017, p. 164). The lower limit for temporary threshold in-air shifts for otariids is 170 dB, and the lower limit permanent threshold in-air shift is 176 dB (Navy 2017, p. 164). The Service anticipates that these levels are above the predicted exposure level of 110 dB SPL_{max} during the proposed project and that individual noise occurrences will be of short duration (less than one minute). The Service does not anticipate associated temporary or permanent hearing loss for southern sea otters.

In the unlikely event that a launch component or associated debris struck a southern sea otter on the water surface, it could result in disturbance, injury, or death to the individual. The Service assumes there is an extremely low probability of strike potential, as southern sea otters are not known to regularly occur and congregate under the proposed Falcon 9 launch azimuths (MSRS 2022a, pp. 6, 46).

Avoidance and Minimization Measures

1. The Space Force will ensure that a Service Approved Biologist monitors southern sea otters from a monitoring location within occupied habitat on VSFB where landing events at SLC-4W generate boost-back sonic booms of 2 psf or greater (i.e., Sudden Flats). Upon establishment of any new southern sea otter populations within areas of potential impact from project-related activities, the Space Force will consider additional monitoring locations.
    a. The Service Approved Biologist will conduct daily counts of southern sea otters from the monitoring location when otters are most likely rafting (between 9:00AM and 12:00PM) beginning 3 days before and continuing 3 days after boost-back and landing events, noting any mortality, injury, or abnormal behavior. Personnel will use both binoculars (10X) and a high-resolution (50–80X) telescope for monitoring.
2. The Space Force will deploy recording equipment at or near the monitoring location to document and quantify sonic boom levels.

After reviewing the information provided, we concur with your determination that the proposed action may affect but is not likely to adversely affect the southern sea otter on the basis of discountable effects. Our concurrence is based on the following:

1. Monitoring data indicate maximum noise and overpressure levels produced from launch operations are unlikely to have a significant effect on southern sea otters. Effects would likely be temporary behavioral reactions, as southern sea otters have demonstrated acclimatization to routine noise disturbance.
2. The probability of launch debris striking a southern sea otter individual is anticipated to be extremely low.

California Condor

California condors do not occur on VSFB except for one known instance in March 2017 when telemetry data indicated an individual was within VSFB. This California condor (studbook number 760) was an immature, non-reproductive female hatched in captivity on May 22, 2014, and released in the Ventana Wilderness on November 9, 2016. The individual departed the VSFB area on April 12, 2017, and later died on approximately July 19, 2017, in northern San Luis Obispo County. Under launch monitoring requirements, the Space Force maintains routine communication with the Service and the Ventana Wildlife Society to monitor California condor locations during launches. California condors have not been present near VSFB since 2017. However, given the wide-ranging nature of this species, other California condors may occur on VSFB in the future if this species expands into their historical range.

Sound pressure levels produced from the proposed project's test firings and launches have a low potential to affect California condors in the vicinity of SLC-4. As described in the recovery plan for California condors, this species appears less tolerant of human disturbances near nesting sites than at roosting sites, and loud noises may alarm them from distances greater than 1.6 miles (Service 1996, p. 5). In addition, the greater the disturbance in either noise level or frequency, the less likely a California condor would be to nest nearby. The Service typically recommends isolating roost and nest sites from human intrusion if feasible (Service 1996, p. 27). If California condors were present in the project area during the proposed project, they would likely be foraging or roosting, and the combination of noise from launch, landing, or static fire events, sonic booms, and visual disturbances could cause a temporary startle response or other minor and temporary behavioral shifts. However, it is unlikely that California condors would be present during these activities or that they would establish nests on VSFB in the near future.

Avoidance and Minimization Measures

1. Prior to any launch, the Space Force will determine if any California condors are present by coordinating with Service and Ventana Wildlife Society personnel (Note: VSFB computers are unable to review the Service's 'Daily Snapshot – California Condor Population' Google Earth imagery). The Space Force will contact the Service if California condors appear to be near or within the area affected by a launch from SLC-4. In the unlikely event that a California condor is nearby, Qualified Biologists will monitor California condor movements in the vicinity of VSFB and coordinate with the Service to analyze data before, during, and after launch events to determine whether any changes in movement occur.
2. The Space Force will coordinate with current Service personnel, including Arianna Punzalan, Supervisory Wildlife Biologist, USFWS California Condor Recovery Program, at arianna_punzalan@fws.gov or (805) 377-5471; Joseph Brandt, Senior Biologist, USFWS, at joseph_brandt@fws.gov, 805-677-3324, or 805-644-1766 extension 53324; or Steve Kirkland, California Condor Field Coordinator, USFWS California Condor Recovery Program, at steve_kirkland@fws.gov or 805-766-4630. The Space Force will also coordinate with current Ventana Wildlife Society personnel, including Joe Burnett, Senior Wildlife Biologist, at joeburnett@ventanaws.org or 831-800-7424.

After reviewing the information provided, we concur with your determination that the proposed action may affect but is not likely to adversely affect the California condor on the basis of discountable effects. Our concurrence is based on the following:

1. The proposed project is in an area outside the normal range of California condors, and the species is not known to breed or roost within the project area.
2. The probability of a California condor being present during project activities is extremely low.

Unarmored Threespine Stickleback and Tidewater Goby

Unarmored threespine stickleback occupy San Antonio Creek from Barka Slough to the lagoon (Swift 1999, p. 17). Tidewater gobies occur in all major drainages of VSFB up to 7.5 miles upstream from the Pacific Ocean (Swift 1999, p. 34). The project area consists of suitable habitat for both species within Honda Creek, San Antonio Creek, and the Santa Ynez River. Neither species has occurred in Honda Creek since 2008, as the creek is becoming shallower and narrower due to drought, making the potential for presence of either species unlikely. In San Antonio Creek, unarmored threespine stickleback occur mostly in the creek channel, and tidewater gobies primarily inhabit the lagoon. Tidewater gobies occur in the Santa Ynez River from the estuary to the 13th Street bridge and San Antonio Creek.

If unarmored threespine stickleback and tidewater gobies were present in Honda Creek, project-related engine noise and vibrations could cause a temporary disruption to individuals. Within potential habitat for the two species in Honda Creek, maximum anticipated noise levels would be 123 dB SPL_{max} during launches, 100 dB SPL_{max} during landings, and 115 dB SPL_{max} during static fire events. Overpressure modeling anticipates levels to be between 2 to 3 psf during landings. However, using the best available information, the Service anticipates that any perceived disturbance would be temporary and overall unlikely given that neither species occupies the creek, they are unlikely to recolonize in the future, and individuals within San Antonio Creek would be located outside of the noise and overpressure disturbance area.

Water usage for the proposed project would increase extraction from the San Antonio Creek basin. The Space Force would authorize a total of 4.28 million gallons (13.1 acre-feet) per year for flame duct usage and to support general non-launch activities at SLC-4. Increasing water extraction could reduce flow rates, hydration periods, or water levels in San Antonio Creek and negatively impact unarmored threespine sticklebacks and tidewater gobies. However, the Space Force indicates that the proposed project's water usage would be negligible and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek (MSRS 2022a, p. 51). The Service reviewed past hydrological assessments produced for a separate project (USGS 2019a; AECOM 2019a). Using this available information for purposes of comparison, the estimated additional 13.1 acre-feet extraction per year is a negligible amount that would produce minute effects to the two species. This concurrence is based on the current average water usage between 2019 to 2021 of approximately 2,794 acre-feet annually. However, the Service understands that there are additional future launch programs currently permitted but not yet implemented that would also require water extraction from San Antonio Creek. The Space Force did not provide this total permitted extraction amount. Without this information, the Service is unable to make a clear quantifiable reference for how the proposed project would contribute to the permitted baseline of water extraction. The Service understands that there has been a level of habitat change within Barka Slough driven by increasing groundwater withdrawals from the San Antonio Creek groundwater basin for agriculture on and off VSFB. Since the 1980s, withdrawals have exceeded the recharge rate for the basin (Public Works 2020 as referenced in MSRS 2022c, p. 5). Since the 1950's, ground water levels have dropped between 10 to over 30 meters (USGS 2019 as referenced in MSRS 2022c, p. 5). The Space Force indicates that they will continue to monitor water levels and anticipate that the proposed project's water usage, in consideration of additional future water extraction needs, would be negligible and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek. The Service's concurrence is based on this assertion.

After reviewing the information provided, we concur with your determination that the proposed action may affect but is not likely to adversely affect the unarmored threespine stickleback or tidewater goby on the basis of discountable effects. Our concurrence is based on the following:

1. Unarmored threespine stickleback and tidewater goby do not currently occur in Honda Creek, and there is low likelihood for recolonization.
2. Project-related noise and vibration are unlikely to impact occupied unarmored threespine stickleback and tidewater goby individuals or their habitat.
3. Increased water extraction from the San Antonio Creek basin due to proposed project activities would be negligible.

Our concurrence with the determinations that the proposed action is not likely to adversely affect marbled murrelet, southern sea otter, California condor, unarmored threespine stickleback, or tidewater goby is contingent on the project activities as outlined above being implemented by the Space Force. If the Space Force fails to implement the project as proposed, we will consider our concurrence invalid. If the proposed action changes in any manner, if novel effects associated with the proposed project not previously considered within this concurrence occur over time, or if new information reveals the presence of listed species in the project area, you should contact our office immediately and suspend all project activities until you complete appropriate compliance with the Act.

Consultation History

We previously completed three biological opinions (Service 2010, Service 2011a, Service 2014a), two concurrence letters (Service 2014b, Service 2015b), and two electronic mail transmittals (C. Diel, pers. comm., 2022a, Diel, pers. comm., 2022 b) regarding the effects of operations performed to support the Falcon Launch Vehicle program at SLC-4.

In our biological opinion dated December 10, 2010 (Service 2010), we consulted on the modification and operation of SLC-4 East (4E) for the new Falcon 9 and Falcon 9 Heavy Space Vehicle Program. We concurred that launch noise and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect the California least tern, western snowy plover, or southern sea otter. We authorized incidental take of El Segundo blue butterflies resulting from landscape maintenance actions and launch-related fires.

On May 25, 2011, the U.S. Air Force (Air Force) requested reinitiation of that consultation due to a change in the effects determination for the California red-legged frog from "no effect" to "may affect, not likely to adversely affect." In our biological opinion dated June 24, 2011, we concurred that launch noise and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect the California red-legged frog, the California least tern, western snowy plover, or southern sea otter, and re-authorized incidental take of El Segundo blue butterflies resulting from landscape maintenance actions and launch-related fires (Service 2011a).

On October 10, 2013, the Air Force informed us of potential unauthorized impacts to El Segundo blue butterflies and California red-legged frogs resulting from the discharge of water into Spring Canyon during the launch of a Falcon 9 rocket on September 29, 2013. Personnel placed approximately 125,000 gallons of water in the flame bucket, resulting in approximately 25,000 to 50,000 gallons entering Spring Canyon during the launch. Completed mitigation for the unanticipated impacts consisted of habitat restoration (planting of seacliff buckwheat, treatment of invasive plants) and removal of bullfrogs (*Lithobates catesbelanus*) in San Antonio Creek. The Air Force stated that personnel would conduct all future launches from SLC-4E with a dry flame duct to prevent discharge into Spring Canyon. In a letter dated August 29, 2014, we concurred that launch activities at SLC-4E may affect, but were not likely to adversely affect California red-legged frogs that may occur in suitable habitat in Spring Canyon (Service 2014b).

In our biological opinion dated December 22, 2014 (Service 2014a), we consulted on the proposed in-flight abort test and improvements at SLC-4W which included construction of a 300-foot diameter concrete pad to accommodate future landings of Falcon 9 first stage, two new access roads, and a new "FireX" fire control system. We concurred that the proposed activities may affect, but were not likely to adversely affect the California least tern, western snowy plover, or southern sea otter. We authorized incidental take of El Segundo blue butterflies and California red-legged frogs resulting from site improvements and, for California red-legged frogs, capture and relocation.

On July 2, 2015, we consulted on Falcon 9 boost-back landing operations, which would occur up to 10 times per year at SLC-4W or at sea. The anticipated engine noise at landing would be less than the noise generated during launch, and the anticipated sonic boom overpressure would be up to a maximum of 2.0 psf. We concurred that boost-back landings of the Falcon 9 first stage as described at SLC-4W may affect, but were not likely to adversely affect the California red-legged frog, the California least tern, western snowy plover, or southern sea otter (Service 2015b).

As part of our programmatic biological opinion for routine operations and maintenance activities at VSFB (Service 2011b, Service 2015c), we analyzed the impacts of maintaining the firebreaks surrounding both SLC-4E and SLC-4W.

On June 14, 2017, we received the Air Force's initial request for formal consultation, including a biological assessment, for proposed launch, boost-back, and landing of the Falcon 9 first stage, not including the use of flame duct water during launch. This request included determinations for the species named above except for El Segundo blue butterfly. We requested additional information in a letter to you dated July 14, 2017.

We received a revised biological assessment (MSRS 2017a) on August 14, 2017, with your August 8, 2017, request, which included a new project scope regarding SLC-4E flame duct water and impacts to Spring Canyon. As a result of this change, the Air Force made revised determinations that the proposed project may affect and is likely to adversely affect the El Segundo blue butterfly and the California red-legged frog. The determinations that the proposed project is likely to adversely affect the California least tern and western snowy plover and may affect, but is not likely to adversely affect the California condor, marbled murrelet, and southern sea otter, were not changed. The Air Force provided additional and clarifying information regarding species and habitat occurrence data and impacts to California red-legged frogs and western snowy plovers via electronic mail and access to Air Force geographic information system data.

On November 20, 2017, we received the Air Force's revisions to the project description consisting of the Spring Canyon Riparian Mitigation Plan (mitigation required by the Central Coast Water Control Board; MSRS 2017b) and the project's Monitoring and Minimization Plan (MSRS 2017b) for federally listed species. Where monitoring or minimization measures differ between the biological assessment and the Monitoring and Minimization Plan, the Air Force has confirmed that the latter represents the most up-to-date information and we incorporated into the Description of the Proposed Action. The Air Force provided additional clarifications of monitoring measures on November 28, 2017, at which time the Air Force also removed a minimization measure for California least terns from the project description. We sent the Air Force a final biological opinion for the project on December 12, 2017 (Service 2017; 2017-F-0480). In this biological opinion, the Space Force consulted with the Service on the launch of the Falcon 9 from SLC-4E. This included a first stage boost-back and landing at SLC-4W up to 12 times per year, use of up to 200,000 gallons of water in the flame duct, construction of a civil structure and retention basin to divert and retain a portion of the water expelled from the flame duct, removal of vegetation in Spring Canyon to minimize potential effects to nesting birds, and habitat enhancement within Spring Canyon to mitigate for impacts on riparian vegetation.

The Service sent a letter to the Air Force on March 9, 2020 (Service 2020a, entire; 2020-TA-0285), to address a change in status of the *Euphilotes* butterflies on Vandenberg Air Force Base (VAFB) based on the results of a recent study (Dupuis et al. 2020) that determined that they are not the federally endangered El Segundo blue butterfly (*Euphilotes battoides allyni*). We consequently do not consult on the species during this reinitiation.

On May 14, 2021, VAFB changed its name to Vandenberg Space Force Base (VSFB).

In an electronic mail communication dated February 17, 2022, the Service agreed that the effects from modifying two avoidance and minimization measures (CRLF 1 and 2) would maintain the original intention analyzed in the 2017 biological opinion. This concurrence was based on new information that included no suitable California red-legged frog habitat is present within the effects area of Spring Canyon and that biologists encountered no individual California red-legged frogs following 11 survey efforts, indicating that California red-legged frog most likely only use the feature for transitory habitat (Diel, pers. comm., 2022a).

In an electronic mail communication dated October 13, 2022, the Service agreed that the effects from increasing the number of Falcon 9 launches from 12 to 14 in 2022 was consistent with existing analyses and did not warrant reinitiation (Diel, pers. comm., 2022b).

On November 29, 2022, the Space Force requested expedited reinitiation of the formal consultation (Service 2017; 2017-F-0480) due to a change in the project description to increase launch cadence from 12 to 36 launches annually (Kephart, in litt., 2022a). The Service responded with a request for additional information to clarify the project description in relation to the proposed launch frequency, impacts on the Northern Channel Island, and water extraction details for the proposed project. The Space Force clarified their original request's effects determination and provided supplemental information to the Service on January 17, 2023 (Kaisersatt, pers. comm, 2023a). The Service provided the Space Force a draft biological opinion for review on March 3, 2023. The Space Force revised their requested expedited due date from March 8 to March 22, 2023 (Kaisersatt, pers. comm, 2023b). The Space Force provided comments on March 9, 2023 (Kaisersatt, pers. comm., 2023c). The Service reviewed and incorporated changes to the project description where necessary. Additional discussion to clarify the project description between the agencies occurred on March 14, 2023. The Service signed the reinitiated final biological opinion on March 21, 2023.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Project Overview

This reinitiation will address the change in the proposed action to increase the Falcon 9 annual first stage launch number and recovery cadence that was described in the 2017 consultation (Service 2017; 2017-F-0480). The change from the original project description includes changing launch frequency from one launch a month to up to 3 launch events monthly.

Additionally, overall launch number would increase from 12 to 36 at SLC-4 on VSFB and include additional downrange offshore landing locations in the Pacific Ocean.

Previous components of the project's construction features described in the 2017 consultation remain unchanged and this reinitiation will not discuss these features further.

Launch Operations

SpaceX would launch the Falcon 9 vehicle from SLC-4E up to 36 times per calendar year. A static fire test of engines may precede each launch, totaling a maximum of 36 static fire events per calendar year. Following each launch ascent, SpaceX would perform a boost-back and landing descent of the first stage either downrange on a droneship in the Pacific Ocean or at SLC-4W at VSFB. No more than 12 first stage landings would occur at SLC-4W per year.

In addition to the previously flown missions with launch azimuths between 140 and 210 degrees, the proposed action includes adding a northerly mission profile with a launch azimuth between 305 and 325 degrees.

Launch Schedule

The proposed project would conduct launches approximately 3 times a month with launches separated by 8 to 10 days (Kaisersatt, pers. comm., 2023d). Launch operations would occur day or night and at any time during the year under all but extreme weather conditions (i.e., would not occur during gale force winds, high wind shear, or extreme thunder and lightning conditions). Individual launch take-off noise disturbance would last approximately one minute. Individual launch landing disturbance would last less than 30 seconds. The total time from launch to landing would be approximately 6 to 10 minutes (Kaisersatt, pers. comm., 2023a, p. 8).

The Space Force would also authorize a separate associated static fire test for each launch to provide a thorough test of all systems. Static fire test events would typically occur within 2 days of each individual launch (York, in litt., 2022, p. 3).

Is Launch Fueling and Combustion

During launch operations, mobile fuel trailers would supply fuel (RP-1 and liquid oxygen (LOX) rocket propellant or Jet-A) to on-site ground support equipment. Black carbon (soot) can be a biproduct of rocket launches and is largely a factor of running a fuel-rich mixture, such as a fuel-rich gas generator rocket engine. The Space Force has included that the proposed project uses oxidizer-rich staged combustion engines from Ursa Major Technologies that produce a diminutive amount of soot. The primary emission products from the Falcon liquid engines are carbon dioxide (CO2), carbon monoxide (CO), water vapor, oxides of nitrogen, and carbon particulates. Although the exhaust is fuel-rich and contains high concentrations of CO, subsequent entrainment of ambient air results in complete conversion of the CO into CO2 and oxidation of the soot from the gas generator exhaust. Referencing previously produced environmental assessments for other Falcon 9 launch operations, the Space Force further specifies that the proposed project's exhaust process results in the complete conversion of produced carbon monoxide into carbon dioxide as well as the oxidation of soot from the gas generation exhaust. The Space Force consequently expects that the produced soot would subsequently burn up in the exhaust plume (Kaisersatt, pers. comm., 2023a, p. 7).

Launch Noise

The Space Force provided modeling of individual launches and associated static test fire events for the purposes of this analysis using the SPL_{max} noise metric. SPL_{max} is the highest sound pressure level measure during a single launch event. Although it provides some measure of the event, SPL_{max} does not fully describe the noise disturbance because it does not account for the duration of the sound. Sound exposure level (SEL) considers the length of time a noise occurs and provides a measure of the net impact of the entire acoustic event. In previous analyses, the Service has considered the SEL metric; however, for the purposes of this analysis, the biological assessment did not include SEL information and consequently the Service will use the SPL_{max} metric.

The Space Force includes that engine noise would reach as high as 150 dB SPL_{max} on SLC-4 during both launch and terrestrial landing events with noise level attenuating outward in all directions reaching 100 dB approximately 14.5 miles away (MSRS 2022a, pp. 29, 53). Noise produced by launch operations to terrestrial areas would last approximately 1 minute (60 seconds) during launches, 30 seconds during terrestrial landings, and approximately 7 seconds during static fire events.

Appendix A, Figure 1a–c depicts the Launch Noise Effect Area, which is the modeled SPL_{max} footprint of the proposed project generated by noise modeling software (RUMBLE 4.1, Rocket Propulsion Noise and Emissions Simulation, developed by Blue Ridge Research and Consulting). Noise modeling conducted for the proposed project did not consider topography and how topographical features may attenuate or enhance actual noise levels. The modeling does not account for the attenuation of sound by the ground surface when estimating the received noise (MSRS 2022a, p. 8). The model assumes a five-foot receiver height and a variable ground impedance to account for grass (soft) or water (hard) ground surfaces.

Launch Sonic Boom (Overpressure Disturbance)

Each proposed launch ascent and landing descent would generate a sonic boom resulting in overpressures of high energy impulsive sound. Sonic booms are low frequency, impulsive noise events with durations lasting a fraction of a second (BRRC 2020, p. 32). Sonic boom impact areas will depend on the launch trajectory. During launch ascent, a sonic boom with overpressure up to 5 psf could impact various linear pathways across the northern Channel Islands (Santa Rosa and Santa Cruz Islands). However, the Space Force estimates that only 8 of the 36 proposed launches annually would impact the Channel Islands and that the majority of these will include overpressure of under 2 psf (Kaisersatt, pers. comm, 2023a, p. 1). During descent, vehicle landings that occur at SLC-4 will create a sonic boom with overpressure between 0.5 to 4 psf that would impact the vast majority of VSFB, extending eastward to Buellton and across the Pacific Ocean. Vehicle landings that occur on a droneship in the Pacific Ocean will produce sonic booms of up to 5 psf across approximately 500 to 1,100 miles of the western coast between Baja California, Mexico and San Francisco, California.

Overpressure can be expressed as instantaneous noise disturbance (SPL_{max}) by using a mathematical conversion from psf to decibel levels. The biological assessment did not include conversions of overpressure into instantaneous noise disturbance (SPL_{max}). The Service used past Falcon 9 monitoring reports to reference these conversions for purposes of facilitating comparison (Robinette and Rice 2019, p. 14, 2022, p. 13; MSRS 2022b, p. 4). Previous monitoring indicates that the sonic boom would produce overpressure comparable to experienced noise levels of up to 138 dB SPL_{max} at south Surf Beach, 136 dB SPL_{max} at Purisima point, and 135 dB SPL_{max} at Honda Creek (Robinette and Rice 2019, p. 14; MSRS 2022b, p. 4).

Appendix A, Figure 2a–b depicts the modeled sonic boom terrestrial footprint, or Overpressure Effect Area, provided in the biological assessment. The Space Force utilized PCBoom 6.7b software to calculate the magnitude, waveform, and location of sonic boom overpressures on the ground from supersonic flight operations. Overpressure modeling conducted for the project did not consider topography and how topographical features may attenuate or enhance actual overpressure levels (MSRS 2021a, p. 51).

Vehicle Landing

Following each launch ascent, SpaceX would perform a boost-back and landing of the first stage either downrange on a droneship in the Pacific Ocean or at SLC-4W at VSFB. No more than 12 first stage landings would occur at SLC-4W per year. Appendix A, Figure 3 depicts the Vehicle Landing Effects Area.

Vehicle Recovery

Following vehicle landings that occur downrange on a droneship in the Pacific Ocean, SpaceX would transport the reclaimed vehicle first to the Port of Long Beach and then back to the VSFB Harbor via a ‘roll-on-roll-off’ barge. A tug would pull the barge from the Port of Long Beach into the VSFB Harbor. SpaceX personnel would then drive the first stage off the barge, transport it from the VSFB Harbor to SLC-4E, and unload the vehicle in the hangar.

Deluge Water System and Water Usage

SpaceX would utilize an existing water-filled flame duct to reduce vibration impacts from noise on payloads. The flame duct would use up to 2.52 million gallons (7.7 acre-feet) of water per year to reduce vibration impacts.

Since the original project's implementation, SpaceX has reduced the amount of water needed in the flame duct per launch from 200,000 gallons to 70,000 gallons. In November 2022, SpaceX also replaced the former deluge water system with a closed loop system for cooling water that eliminates the need to utilize launch pad water for cooling. SpaceX would use an additional 2.1 million gallons (6.4 acre-feet) of water annually to support general non-launch activities at SLC-4 (MSRS 2022a, p. 5).

In total, the Space Force would authorize a maximum of 4.28 million gallons (13.1 acre-feet) of water per year to support the proposed project (MSRS 2022a, p. 51). The current water source for VSFB consists of four water wells located within the San Antonio Creek Basin.

Flame Duct and Vegetation Maintenance

As the 2017 biological opinion described, launches would eject flame duct water. Based on prior Falcon 9 missions, approximately half of the volume of water remains in the flame duct and half is expelled as water and water vapor. Of the expelled water, approximately half is in the form of steam (17,500 gallons) with the remaining half being liquid (17,500 gallons). There is no longer overland flow of water into Spring Canyon as v-ditches divert and collect the water before it leaves the SLC-4 fence line. The v-ditch feature within SLC-4 holds all water for a short duration until it dissipates. The Space Force maintains vegetation within the v-ditch feature on a periodic basis (Kaisersatt, pers. comm. 2023e). A minimal quantity of water reaches Spring Canyon in the form of steam and water droplets and is expected to dissipate quickly.

Water discharged as part of this action would meet the thresholds identified by the Regional Water Quality Control Board in the statewide low threat discharge to surface waters permit. The maximum temperature of the water vapor would be 130 degrees Fahrenheit by the point at which it would reach Spring Canyon.

As discussed in the 2017 biological opinion, SpaceX would continue to maintain all vegetation to just above ground level within a 3.3-acre area of Spring Canyon adjacent to SLC-4 (hereafter referred to as the Vegetation Management Area) that launches impact by the ejection of steam.

AVOIDANCE AND MINIMIZATION MEASURES

All avoidance and minimization measures previously identified in the original consultation (Service 2017; 2017-F-0480) are still applicable for the purposes of this reinitiation. The following is a list of avoidance and minimization measures specifically applicable to this reinitiation. The measures provided below are either new for this reinitiation or sourced from the 2017 consultation and reiterated for clarity.

Biologist Definitions

Avoidance and minimization measures included in this biological opinion require various levels of biological competency from personnel completing specific tasks, as defined below:

- Permitted Biologist: Biologist with a valid and current Section 10(a)(1)(A) Recovery Permit issued by the Service or specifically named as a Service Approved Biologist in a project-specific biological opinion. The Space Force will coordinate with the Service prior to assigning Permitted Biologists to a specific project.
- Service Approved Biologist: Biologist with the expertise to identify listed species and species with similar appearance. The Space Force will review and approve the resumes for each individual, and then submit them to the Service for review and approval no less than 15 days prior to the start of the project. A Service Approved Biologist could train other biologists and personnel during surveys and project work; in some cases, a Service Approved Biologist could also provide on-site supervision of other biologists.
- Qualified Biologist: Biologist trained to accurately identify specific federally listed species and their habitats by either a Permitted or Service Approved Biologist. This person could perform basic project monitoring but would need to have oversight from a Permitted or Service Approved Biologist. Oversight will require a Permitted or Service Approved Biologist to be available for phone/electronic mail consultation during the surveys and to have the ability to visit during monitoring/survey activities if needed.

General Project Avoidance and Minimization Measures

The following protection and monitoring measures would apply to all aspects of the proposed action to protect and minimize effects on biological resources. The Space Force will ensure SpaceX takes all identified applicable actions as listed below.

In relation to water release, SpaceX will continue to implement measures described in the 2017 biological assessment (MSRS 2017a) which include: (1) SpaceX will follow the site-specific Stormwater Pollution Prevention Plan already implemented for SLC-4; (2) SpaceX will implement the Best Management Practices within the latest California Stormwater Quality Association's Stormwater Best Management Practices Handbook; (3) SpaceX will collect any rocket propellant seen floating in the retention basin using absorbent pads prior to discharge to the spray field; and (4) SpaceX will fully implement the procedures in VSFB's Hazardous Materials Emergency Response Plan in the event of a hazardous materials spill.

Species-specific Avoidance and Minimization Measures

California Red-Legged Frog

AM-1. One day prior to vegetation removal from Spring Canyon, the Space Force will require a Qualified Biologist to conduct surveys for California red-legged frog within the area personnel will mow. The Space Force will require a Service Approved or Permitted Biologist to capture any California red-legged frog present, if possible, and release at the nearest suitable habitat within Spring Canyon but outside of the Vegetation Management Area, as determined by the biologist. The Space Force will also require that all biologists follow the Declining Amphibian Populations Task Force fieldwork code of practice (DATF 2019) to avoid conveying diseases between work sites and will clean all equipment between use following protocols that are also suitable for aquatic reptiles. The Service Approved or Permitted Biologist will also be present during vegetation removal to capture and relocate California red-legged frog to the extent that safety precautions allow. This Service Approved or Permitted Biologist will also search for injured or dead California red-legged frogs after vegetation removal to document take.

AM-2. The Space Force will require a Qualified Biologist to perform one California red-legged frog survey annually during peak breeding season (typically November through April, depending on rainfall) in Spring Canyon when individuals are most likely to be present and detectable. If the Qualified Biologist does not encounter California red-legged frog at the time of this survey, the Space Force will not require any other subsequent pre-/post-launch surveys. If California red-legged frogs are present during the annual survey, the Space Force will require pre- and post-launch surveys and relocation of any California red-legged frogs encountered for each subsequent launch event.

AM-3. The Space Force will conduct quarterly night surveys for California red-legged frog and spring tadpole surveys of lower Honda Creek to compare baseline California red-legged frog occupancy data collected over the past 10 years and assess if there are any changes in California red-legged frog habitat occupancy, breeding behavior (calling), and breeding success (egg mass and tadpole densities). The Space Force will record and measure the following during the surveys:

a. California red-legged frog detection density (number of individuals per survey hour) following the same survey methods conducted previously at these sites and throughout VSFB;

b. California red-legged frog locations and breeding evidence (e.g., calling, egg masses);

c. environmental data during surveys (temperature, wind speed, humidity, and dewpoint) to determine if environmental factors are affecting California red-legged frog detection or calling rates;

d. annual habitat assessments to measure flow rates, stream morphology, depths, and sediment to determine if any changes in California red-legged frog metrics are associated with other environmental factors, such as drought;

e. and, locations and densities of co-occurring anurans, including bullfrogs (*Lithobates catesbeianus*) and Baja California tree frogs (*Pseudacris hypochondriaca*).

AM-4. The Space Force will conduct bioacoustic monitoring annually during California red-legged frog breeding season (typically November through April, depending on rainfall) to characterize the noise environment and determine if there are changes in calling behaviors as the proposed project commences. The Space Force will place passive noise recorders and environmental data loggers (temperature, relative humidity, dew point) at two suitable breeding locations in lower Honda Creek. Passive bioacoustic recording would occur throughout the entirety of the breeding season using the Wildlife Acoustics Song-Meter 4 (or similar technology) with software that enables autodetection of California red-legged frog calling. The Space Force will use bioacoustic monitoring to characterize and analyze impacts of launch, static fire, and SLC-4W landing events on calling behavior during the breeding season to assess whether Falcon 9 noise events affect California red-legged frog calling frequency.

AM-5. To address potential declining trends that may be a result of the proposed project, the specified threshold criteria is described below.

a. California red-legged frog occupancy, calling rate, or tadpole densities decline from baseline by 15 percent or more and,

b. the 15 percent decline from baseline maintains for two consecutive years.

If any of these threshold criteria are met and cannot confidently be attributed to other natural- or human-caused catastrophic factors, not related to the proposed action, that may eliminate or significantly degrade suitable habitat (see potential scenarios described below), the Space Force will mitigate for these impacts as discussed under the *Habitat Mitigation and Monitoring Plan* section below. Examples of potential catastrophic scenarios include the following:

c. Fire, unrelated to project activities or launch operations, that directly impacts Honda Canyon and is demonstrated to degrade or eliminate breeding habitat.

d. Landslides or significant erosion events, unrelated to project activities or launch operations, in Honda Canyon that result in the elimination or degradation of California red-legged frog breeding habitat.

e. Drought or climate impacts that quantifiably reduces available aquatic habitat further than what was available during existing baseline.

f. Flash flood events during the breeding season that are more significant than what was experienced during the existing baseline.

The Space Force will review the supported cause of decline with the Service and reach agreement. If cause of declines is determined to be inconclusive, the Project Proponent will implement proposed mitigation.

Western Snowy Plover

AM-6. The Space Force will deploy motion triggered video cameras during the breeding season (March 1 through September 30) to determine western snowy plover nest fates and potential impacts to nests due to launches and landings to reduce disturbance associated with human activity within breeding habitat.

a. The Space Force will monitor at least 10 percent of active western snowy plover nests at South Surf Beach with motion triggered video cameras during the breeding season (March 1 through September 30).

b. The Space Force will place cameras in a manner to minimize disturbance to nesting western snowy plovers. This will be determined in the field based on the best judgement of a Permitted Biologist.

AM-7. The Space Force will conduct acoustic monitoring throughout the western snowy plover breeding season (March 1 through September 30) by placing sound level meters immediately inland of South Surf Beach to characterize the noise environment and any related launch and landing associated disturbance.

AM-8. The Space Force will augment the current western snowy plover monitoring program on VSFB by performing geospatial analysis of nesting activity on South Surf Beach to assess potential adverse effects from Falcon 9 noise events.

a. The current basewide western snowy plover monitoring program estimates breeding effort, nest fates, and fledging success while recording patterns of habitat use throughout the season. The Space Force will perform geospatial analysis annually to identify declines in the western snowy plover population, nesting activity, and reproductive success that may result from cumulative effects of multiple launches and landings from SLC-4.

To address potential declining trends that may be a result of the proposed project, the specified threshold criteria is described below.

b. Geospatial analysis shows a statistically significant decline (defined as a decline greater than the baseline annual variation in these variables over the past 10 years at South Surf Beach) in population or reproductive success, and

c. the decline from baseline maintains over two consecutive years within the areas impacted by noise from the Falcon 9.

If any of these threshold criteria are met and cannot confidently be attributed to other natural- or human-caused catastrophic factors, not related to the proposed action, that may eliminate or significantly degrade suitable habitat (see potential scenarios described below), the Space Force will mitigate for these impacts as discussed under the *Habitat Mitigation and Monitoring Plan* section below. Examples of potential catastrophic scenarios include the following:

d. Significantly higher levels of tidal activity, predation, etc. as compared with the existing baseline and demonstrable across remainder of base population.

e. Significant avian disease demonstrable across the recovery unit.

f. Separate work activities (i.e., restoration efforts) not related to project.

The Space Force will review the supported cause of decline with the Service and reach agreement. If cause of declines is determined to be inconclusive, the Project Proponent will implement proposed mitigation.

<u>California Least Tern</u>

AM-9. The Space Force will deploy motion triggered video cameras during the breeding season (typically April 15 to August 15) to determine California least tern nest fates and potential impacts to nests due to launches and landings to reduce disturbance associated with human activity within breeding habitat.

a. The Space Force will monitor at least 10 percent of active California least tern nests at Purisima Point with motion triggered video cameras during the breeding season (typically April 15 to August 15).

b. The Space Force will place cameras in a manner to minimize disturbance to nesting California least tern. This will be determined in the field based on the best judgement of a Permitted Biologist.

AM-10. The Space Force will conduct acoustic monitoring throughout the California least tern breeding season (typically April 15 to August 15) by placing sound level meters immediately inland of the California least tern colony at Purisima Point to characterize the noise environment and any related launch and landing associated disturbance.

AM-11. The Space Force will augment the current California least tern monitoring program on VSFB by performing geospatial analysis of nesting activity at Purisima Point to assess potential adverse effects from Falcon 9 noise events.

a. The current basewide California least tern monitoring program estimates breeding effort, nest fates, and fledging success while recording patterns of habitat use throughout the season. The Space Force will perform geospatial analysis annually to identify declines in the California least tern population, nesting activity, and reproductive success that may result from cumulative effects of multiple launches and landings from SLC-4.

To address potential declining trends that may be a result of the proposed project, the specified threshold criteria is described below.

g. Geospatial analysis shows a statistically significant decline (defined as a decline greater than the baseline annual variation in these variables over the past 10 years at Purisima Point) in population or reproductive success, and

h. the decline from baseline maintains over two consecutive years within the areas impacted by noise from the Falcon 9.

If any of these threshold criteria are met and cannot confidently be attributed to other natural- or human-caused catastrophic factors, not related to the proposed action, that may eliminate or significantly degrade suitable habitat (see potential scenarios described below), the Space Force will mitigate for these impacts as discussed under the *Habitat Mitigation and Monitoring Plan* section below. Examples of potential catastrophic scenarios include the following:

i. Significantly higher levels of predation, lower prey availability, etc. as compared with the existing baseline and demonstrable across remainder of base population.

j. Significant avian disease demonstrable across the recovery unit.

k. Separate work activities (i.e., restoration efforts) not related to project.

The Space Force will review the supported cause of decline with the Service and reach agreement. If cause of declines is determined to be inconclusive, the Project Proponent will implement proposed mitigation.

Habitat Mitigation and Monitoring Plan

The Space Force proposes a mitigation and monitoring plan in the event the proposed project's monitoring detects a change in the baseline of species populations (AM-5, 8, 11). In the event the Space Force detects declines and declines meet threshold trigger criteria, the Space Force will implement mitigation activities as detailed below.

The potential mitigation actions for California red-legged frog include the creation of new breeding habitat at a 2:1 ratio (habitat enhanced: habitat affected) within the San Antonio Creek Oxbow Restoration "expansion area" (Appendix A, Figure 4a). The Oxbow Restoration site is an abandoned tract of agricultural land that riparian vegetation historically occupied. The Space Force initiated compensatory mitigation restoration work at this site associated with a separate previous project (San Antonio West Bridge; 2016-F-0103; Service 2018) in the fall of 2019 to improve California red-legged frog habitat within San Antonio Creek (MSRS 2020, p. 2). Specifically, potential mitigation actions associated with the proposed project within the Oxbow Restoration include site preparation via herbicide application, plowing, container plant installation, seeding, willow pole planting, and watering via water truck. The existing biological opinion (2016-F-0103; Service 2018) includes potential mitigation actions for California red-legged frog and the Space Force will implement all required avoidance, minimization, and monitoring measures. The Space Force will track and report on restoration efforts and success within an annual report. Restoration activities will align with the objectives of the California red-legged frog Conservation Strategy (Service, *in prep*) with the goal of achieving no net loss to the species (2022a, p. 59).

The potential mitigation actions for western snowy plover and California least tern include increasing predator control in the non-breeding season, including trapping, shooting, and tracking known predators of western snowy plover and California least tern with particular focus on raven removal at and adjacent to VSFB beaches. We refer to areas targeted for predator control as the Predator Management Area which includes the majority of VSFB (Appendix A, Figure 4b). An existing biological opinion (8-8-12-F-11R; Service 2015a) permits these actions, and the Space Force will implement all required avoidance, minimization, and monitoring measures. The Space Force also maintains a depredation permit issued by the Service. The Space Force will report on predator removal efforts and success within an annual report. Additionally, the Space Force will continue pursuing other beneficial actions including recovery opportunities outlined in the western snowy plover and California least tern recovery plans (Service 1970a, Service 2007) and 5-year reviews (Service 2006a, 2019a, 2020b) following mutual agreement by the Service and the Space Force annually, supporting the Space Force's goals to ensure no net loss (MSRS 2022a, pp. 67, 69).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the current rangewide condition of the California red-legged frog, western snowy plover, and California least tern, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the California red-legged frog, western snowy plover, and California least tern in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the California red-legged frog, western snowy plover, and California least tern; (3) the Effects of the Action, which determines all consequences to the California red-legged frog, western snowy plover, and California least tern caused by the proposed action that are reasonably certain to occur in the action area; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities, that are reasonably certain to occur in the action area, on the California red-legged frog, western snowy plover, and California least tern.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the California red-legged frog, western snowy plover, and California least tern, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of the California red-legged frog, western snowy plover, and California least tern in the wild by reducing the reproduction, numbers, and distribution of that species.

STATUS OF THE SPECIES AND ITS CRITICAL HABITAT

California Red-Legged Frog

Legal Status

The California red-legged frog was federally listed as threatened on May 23, 1996 (61 Federal Register (FR) 25813). Revised critical habitat for the California red-legged frog was designated on March 17, 2010 (75 FR 12816, Service 2010). The Service issued a recovery plan for the species on May 28, 2002 (Service 2002, entire).

Natural History

The California red-legged frog uses a variety of habitat types, including various aquatic systems, riparian, and upland habitats. They have been found at elevations ranging from sea level to approximately 5,000 feet. California red-legged frogs use the environment in a variety of ways, and in many cases, they may complete their entire life cycle in a particular area without using other components (i.e., a pond is suitable for each life stage and use of upland habitat or a riparian corridor is not necessary). Populations appear to persist where a mosaic of habitat elements exists, embedded within a matrix of dispersal habitat. Adults are often associated with dense, shrubby riparian or emergent vegetation and areas with deep (greater than 1.6 feet) still or slow-moving water; the largest summer densities of California red-legged frogs are associated with deep-water pools with dense stands of overhanging willows (*Salix* spp.) and an intermixed fringe of cattails (*Typha latifolia*) (Hayes and Jennings 1988, p. 147). Hayes and Tennant found juveniles to seek prey diurnally and nocturnally, whereas adults were largely nocturnal (Hayes and Tennant 1985, p. 604).

California red-legged frogs breed in aquatic habitats; larvae, juveniles, and adult frogs have been collected from streams, creeks, ponds, marshes, deep pools and backwaters within streams and creeks, dune ponds, lagoons, and estuaries. They frequently breed in artificial impoundments such as stock ponds, given the proper management of hydro-period, pond structure, vegetative cover, and control of exotic predators. While frogs successfully breed in streams and riparian systems, high spring flows and cold temperatures in streams often make these sites risky egg and tadpole environments. An important factor influencing the suitability of aquatic breeding sites is the general lack of introduced aquatic predators. Accessibility to sheltering habitat is essential for the survival of California red-legged frogs within a watershed and can be a factor limiting population numbers and distribution.

California red-legged frogs are "irruptive" breeders where their breeding capacity is highly dependent on local environmental conditions, specifically the availability of cool water for egg deposition and larval maturation (Jennings and Hayes 1994, p. 62). California red-legged frogs breed from November to May and breeding activity typically begins earlier at southern coastal than northern coastal localities (Storer 1925, p. 2; Alvarez et al. 2013, pp. 547-548). Breeding may start as late as March or April in Sierra Nevada localities, due to low temperatures at these sites in January and February (Tatarian 2008, p. 16). Breeding in southern California localities may start as late as April, as exemplified in Matilija Canyon following the 2017 Thomas Fire (P. Lieske, pers. comm., 2021). High water flows in the winter and spring also can delay breeding in streams and rivers (Fellers et al. 2001, p. 157). Female California red-legged frogs lay only one egg mass in a breeding year and each egg mass contains between 300 to 4,000 eggs (Storer 1925, p. 240). Frogs typically deposit egg masses in relatively shallow water (approximately 1.6 to 2 feet deep) on emergent vegetation within 4 feet of shore (Storer 1925, p. 239; Jennings and Hayes 1994, p. 64). However, the species can deposit eggs on a wide variety of substrates including boulders and cobbled substrate and submerged tips of overhanging branches, and egg masses have been documented 39 feet from shore and in water up to 10.5 feet deep (Alvarez et al. 2013, pp. 544-545; Wilcox et al. 2017, p. 68). California red-legged frog tadpoles hatch from egg masses after 6 to14 (Storer 1925, p. 241). Tadpole development and growth rates are variable and likely temperature dependent (Fellers 2005, pp. 552-554). Occasionally, tadpoles may overwinter and then metamorphose the following spring, a phenomenon so far observed in Santa Clara, Marin, Contra Costa, and San Luis Obispo Counties (Fellers et al. 2001, entire).

The juvenile California red-legged frog life stage is defined as the time after an individual undergoes metamorphosis (when they lose their tails and become small froglets) which typically occurs four to five months after hatching and it spans to when an individual is able to breed (Storer 1925, p. 241; Wright and Wright 1949, p. 422). On average, the juvenile life stage is from about five months of age to three years in California red-legged frogs. Immediately after metamorphosis, juveniles shelter near their natal pond. However, some juveniles may disperse in the fall to nearby moist uplands or different aquatic habitat to avoid predation by larger, older frogs. Hayes and Tennant (1985, p. 604) found juveniles to seek prey diurnally and nocturnally, whereas adults were largely nocturnal. During periods of wet weather, starting with the first rains of fall, some individual California red-legged frogs may make long-distance overland excursions through upland habitats to reach breeding sites. In Santa Cruz County, Bulger et al. (2003, p. 90) found marked California red-legged frogs moving up to 1.74 miles through upland habitats, via point-to-point, straight-line migrations without regard to topography, rather than following riparian corridors. Most of these overland movements occurred at night and took up to 2 months. Similarly, in San Luis Obispo County, Rathbun and Schneider (2001, p. 1302) documented the movement of a male California red-legged frog between two ponds that were 1.78 miles apart in less than 32 days; however, most California red-legged frogs in the Bulger et al. (2003, p. 93) study were non-migrating frogs and always remained within 426 feet of their aquatic site of residence (half of the frogs always stayed within 82 feet of water). Rathbun et al. (1993, p. 15) radio-tracked three California red-legged frogs near the coast in San Luis Obispo County at various times between July and January; these frogs also stayed close to water and never strayed more than 85 feet into upland vegetation. Scott (2002, p. 2) radio-tracked nine California red-legged frogs in East Las Virgenes Creek in Ventura County from January to June 2001, which remained relatively sedentary as well; the longest within-channel movement was 280 feet and the farthest movement away from the stream was 30 feet.

After breeding, California red-legged frogs often disperse from their breeding habitat to forage and seek suitable dry-season habitat. Cover within dry-season aquatic habitat could include boulders, downed trees, and logs; agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hayricks, and industrial debris. California red-legged frogs use small mammal burrows and moist leaf litter (Jennings and Hayes 1994, p. 64; Rathbun and Schneider 2001, p. 15); incised stream channels with portions narrower and deeper than 18 inches may also provide habitat (Service 2002, p. 14). This type of dispersal and habitat use, however, is not observed in all California red-legged frogs and is most likely dependent on the year-to-year variations in climate and habitat suitability and varying requisites per life stage.

Although the presence of California red-legged frogs is correlated with still water deeper than approximately 1.6 feet, riparian shrubbery, and emergent vegetation (Jennings and Hayes 1994, p. 64), California red-legged frogs appear to be absent from numerous locations in its historical range where these elements are well represented. The cause of local extirpations does not appear to be restricted solely to loss of aquatic habitat. The most likely causes of local extirpation are thought to be changes in faunal composition of aquatic ecosystems (i.e., the introduction of invasive predators and competitors) and landscape-scale disturbances that disrupt California red-legged frog population processes, such as dispersal and colonization. The introduction of contaminants or changes in water temperature may also play a role in local extirpations. These changes may also promote the spread of predators, competitors, invasive plants, parasites, and diseases.

Rangewide Status

The historical range of the California red-legged frog extended coastally from southern Mendocino County and inland from the vicinity of Redding, California, southward to northwestern Baja California, Mexico (Storer 1925, p. 235; Jennings and Hayes 1985, p. 95; Shaffer et al. 2004, p. 2673). The California red-legged frog has sustained a 70 percent reduction in its geographic range because of several factors acting singly or in combination (Davidson et al. 2001, p. 465).

Over-harvesting, habitat loss, non-native species introduction, and urban encroachment are the primary factors that have negatively affected the California red-legged frog throughout its range (Jennings and Hayes 1985, pp. 99-100; Hayes and Jennings 1988, p. 152). Habitat loss and degradation, combined with over-exploitation and introduction of exotic predators, were important factors in the decline of the California red-legged frog in the early to mid-1900s. Continuing threats to the California red-legged frog include direct habitat loss due to stream alteration and loss of aquatic habitat, indirect effects of expanding urbanization, competition or predation from non-native species including the bullfrog, catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquito fish (*Gambusia affinis*), red swamp crayfish (*Procambarus clarkii*), and signal crayfish (*Pacifastacus leniusculus*). Chytrid fungus (*Batrachochytrium dendrobatidis*) is a waterborne fungus that can decimate amphibian populations and is considered a threat to California red-legged frog populations.

A 5-year review of the status of the California red-legged frog was initiated in May 2011, but has not yet been completed.

Recovery

The 2002 final recovery plan for the California red-legged frog (Service 2002, entire) states that the goal of recovery efforts is to reduce threats and improve the population status of the California red-legged frog sufficiently to warrant delisting. The recovery plan describes a strategy for delisting, which includes: (1) protecting known populations and reestablishing historical populations; (2) protecting suitable habitat, corridors, and core areas; (3) developing and implementing management plans for preserved habitat, occupied watersheds, and core areas; (4) developing land use guidelines; (5) gathering biological and ecological data necessary for conservation of the species; (6) monitoring existing populations and conducting surveys for new populations; and (7) establishing an outreach program. The California red-legged frog will be considered for delisting when:

1. Suitable habitats within all core areas are protected and/or managed for California red-legged frogs in perpetuity, and the ecological integrity of these areas is not threatened by adverse anthropogenic habitat modification (including indirect effects of upstream/downstream land uses).

2. Existing populations throughout the range are stable (i.e., reproductive rates allow for long-term viability without human intervention). Population status will be documented through establishment and implementation of a scientifically acceptable population monitoring program for at least a 15-year period, which is approximately 4 to 5 generations of the

California red-legged frog. This 15-year period should coincide with an average precipitation cycle.

3. Populations are geographically distributed in a manner that allows for the continued existence of viable metapopulations despite fluctuations in the status of individual populations (i.e., when populations are stable or increasing at each core area).

4. The species is successfully reestablished in portions of its historical range such that at least one reestablished population is stable/increasing at each core area where California red-legged frog are currently absent.

5. The amount of additional habitat needed for population connectivity, recolonization, and dispersal has been determined, protected, and managed for California red-legged frogs.

The recovery plan identifies eight recovery units based on the assumption that various regional areas of the species' range are essential to its survival and recovery. The recovery status of the California red-legged frog is considered within the smaller scale of recovery units as opposed to the overall range. These recovery units correspond to major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the California red-legged frog. The goal of the recovery plan is to protect the long-term viability of all extant populations within each recovery unit.

Within each recovery unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that combined with suitable dispersal habitat, will support long-term viability within existing populations. This management strategy allows for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of the California red-legged frog.

Western Snowy Plover

Legal Status

The Service listed the Pacific Coast population of the western snowy plover as threatened on March 5, 1993 (Service 1993). We designated critical habitat in 1999 (Service 1999) and redesignated it in 2005 (Service 2005). In 2012, we issued a revised critical habitat designation which included a change in taxonomic nomenclature (Service 2012). We issued a recovery plan in August 2007 (Service 2007) and completed 5-year status reviews in 2006 and 2019 (Service 2006b, 2019a).

Natural History

The western snowy plover is a small shorebird in the family Charadriidae, a subspecies of the snowy plover (*Charadrius nivosus*). It is pale gray/brown above and white below, with a white collar on the hind neck and dark patches on the lateral breast, forehead, and behind the eyes. The bill and legs are black.

Foraging Behavior

Western snowy plovers are primarily visual foragers, using the run-stop-peck method of feeding typical of most plover species. They forage on invertebrates in the wet sand and amongst surf-cast kelp within the intertidal zone, in dry sand areas above the high tide, on saltpans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons. They sometimes probe for prey in the sand and pick insects from low-growing plants (Service 2007, pp. 17–18).

Breeding

The Pacific Coast population of the western snowy plover breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico. The main coastal habitats for nesting include sand spits, dune-backed beaches, beaches at creek and river mouths, and saltpans at lagoons and estuaries (Wilson 1980, p. 23; Page and Stenzel 1981, p. 12). Western snowy plovers nest less commonly on bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and gravel river bars (Wilson 1980, p. 9; Page and Stenzel 1981, pp. 12, 26; Tuttle et al. 1997, pp. 1–3; Powell et al. 2002, pp. 156, 158, 164).

Their nests consist of a shallow scrape or depression, sometimes lined with beach debris (e.g., small pebbles, shell fragments, plant debris, and mud chips). As incubation progresses, western snowy plovers may add to and increase the nest lining. Driftwood, kelp, and dune plants provide cover for chicks that crouch near objects to hide from predators. Because invertebrates often occur near debris, driftwood and kelp are also important for harboring western snowy plover food sources (REPEATPage et al. 2009, Breeding).

Along the west coast of the United States, the nesting season of the western snowy plover extends from early March through late September. Generally, the breeding season may be 2 to 4 weeks earlier in southern California than in Oregon and Washington. Fledging (reaching flying age) of late-season broods may extend into the third week of September throughout the breeding range (Service 2007, p. 11).

The approximate periods required for western snowy plover nesting events are: 3 days to more than a month for scrape construction (in conjunction with courtship and mating), usually 4 to 5 days for egg laying, and incubation averaging 28.4 days in the early season (before May 8) to 26.9 days in the late season (Warriner et al. 1986, pp. 23–24). The usual clutch size is three eggs with a range from two to six (REPEATPage et al. 2009, Breeding). Both sexes incubate the eggs with the female tending to incubate during the day and the male at night (Warriner et al. 1986, pp. 24–25). Adult western snowy plovers frequently will attempt to lure people and predators from hatching eggs and chicks with alarm calls and distraction displays.

Western snowy plover chicks are precocial, leaving the nest with their parents within hours after hatching (Service 2007, p. 14). They are not able to fly for approximately 1 month after hatching; fledging requires 29 to 33 days (Warriner et al. 1986, p. 26). Broods rarely remain in the nesting area until fledging (Warriner et al. 1986, p. 28; Lauten et al. 2010, p. 10). Casler et al. (1993, pp. 6, 11–12) reported broods would generally remain within a 1-mile radius of their nesting area; however, in some cases would travel as far as 4 miles.

Wintering

In winter, western snowy plovers use many of the beaches used for nesting, as well as beaches where they do not nest. They also occur in man-made salt ponds and on estuarine sand and mud flats. In California, most wintering western snowy plovers concentrate on sand spits and dune-backed beaches. Some also occur on urban and bluff-backed beaches, which they rarely use for nesting (Page and Stenzel 1981, p. 12; Page et al. 1986, p. 148). South of San Mateo County, California, wintering western snowy plovers also use pocket beaches at the mouths of creeks and rivers on otherwise rocky points (Page et al. 1986, p. 148). Western snowy plovers forage in loose flocks. Roosting western snowy plovers will sit in depressions in the sand made by footprints and vehicle tracks, or in the lee of kelp, driftwood, or low dunes in wide areas of beaches (Page et al. 2009, Behavior). Sitting behind debris or in depressions provides some shelter from the wind and may reduce their detectability by predators.

Rangewide Status

Historical records indicate that nesting western snowy plovers were once more widely distributed and abundant in coastal Washington, Oregon, and California (Service 2007, p. 21). In Washington, western snowy plovers formerly nested at five coastal locations (WDFW 1995, p. 14) and at over 20 sites on the coast of Oregon (Service 2007, p. 24). In California, by the late 1970s, nesting western snowy plovers were absent from 33 of 53 locations with breeding records prior to 1970 (Page and Stenzel 1981, p. 27).

The first quantitative data on the abundance of western snowy plovers along the California coast came from window surveys conducted during the 1977 to 1980 breeding seasons by Point Reyes Bird Observatory (Page and Stenzel 1981, p. 1). Observers recorded an estimated 1,593 adult western snowy plovers during these pioneering surveys. The results of the surveys suggested that the western snowy plover had disappeared from significant parts of its coastal California breeding range by 1980 (Service 2007, p. 27).

Breeding and winter window survey data from 2005 to 2022 includes approximately 250 sites in Washington, Oregon, and California, with most sites located in California (Table 1). In

California, biological monitors counted 1,830 western snowy plovers during the 2022 breeding window survey, and 4,196[1] western snowy plovers during the 2021 to 2022 winter window survey (Service 2022a, entire). Across the Pacific Coast range, the 2022 breeding window survey estimated 2,371 western snowy plovers, and the 2021 to 2022 winter window survey estimated 4,803 western snowy plovers in Washington, Oregon, and California (Service 2022a, entire). These numbers demonstrate that monitors counted a large percentage of all western snowy plovers in the Pacific Coast range in California during both winter and breeding window surveys.

Table 1. Pacific Coast western snowy plover breeding window survey results, in descending order from 2022 to 2005, for each recovery unit (RUl through RU6) and the U.S. Pacific Coast (excludes the Baja California peninsula). All counts are breeding age adults and are uncorrected (raw). Recovery Units are RU1: Washington and Oregon; RU2: Northern California (Del Norte to Mendocino Counties); RU3: San Francisco Bay; RU4: Monterey Bay area (Sonoma to Monterey Counties); RU5: San Luis Obispo area (San Luis Obispo to Ventura Counties); RU6: San Diego area (Los Angeles to San Diego Counties) (Service 2019a, p. 3).

Year	***RU1***	***RU2***	***RU3***	***RU4***	***RU5***	***RU6***	***TOTAL (U.S. Pacific Coast)***
2022	541	71	281	281	804	393	2,371
2021	624	84	263	292	737	358	2,358
2020	469	46	147	308	855	484	2,309
2019	479	41	190	303	807	397	2,217
2018	402	52	235	361	874	451	2,375
2017	342	56	246	369	856	464	2,333
2016	477	46	202	366	820	373	2,284
2015	340	38	195	348	963	376	2,260
2014	269	27	178	374	822	346	2,016
2013	260	23	202	261	754	326	1,826
2012	234	21	147	324	771	358	1,855
2011	202	28	249	311	796	331	1,917
2010	196	19	275	298	686	311	1,785
2009	182	15	147	279	707	257	1,587
2008	147	18	133	257	717	269	1,541

1 This number likely includes wintering inland birds that are not part of the listed Pacific Coast population.

2007	175	26	207	270	676	183	1,537
2006	158	45	102	357	917	298	1,877
2005	137	41	124	337	969	209	1,817

Recovery and Threats

The primary objective of the recovery plan (Service 2007, p. vi) is to remove the Pacific Coast population of the western snowy plover from the list of endangered and threatened wildlife and plants by:

1. Increasing population numbers distributed across the range of the Pacific Coast population of the western snowy plover;
2. Conducting intensive ongoing management for the species and its habitat and developing mechanisms to ensure management in perpetuity; and
3. Monitoring western snowy plover populations and threats to determine success of recovery actions and refine management actions.

Outlined below are the delisting criteria for the Pacific Coast population of the western snowy plover (Service 2007, p. vii):

1. An average of 3,000 breeding adults has been maintained for 10 years, distributed among 6 recovery units as follows: Washington and Oregon, 250 breeding adults; Del Norte to Mendocino Counties, California, 150 breeding adults; San Francisco Bay, California, 500 breeding adults; Sonoma to Monterey Counties, California, 400 breeding adults; San Luis Obispo to Ventura Counties, California, 1,200 breeding adults; and Los Angeles to San Diego Counties, California, 500 breeding adults. This criterion also includes implementing monitoring of site-specific threats, incorporation of management activities into management plans to ameliorate or eliminate those threats, completion of research necessary to modify management and monitoring actions, and development of a post-delisting monitoring plan.
2. A yearly average productivity of at least one (1.0) fledged chick per male has been maintained in each recovery unit in the last 5 years prior to delisting.
3. Mechanisms have been developed and implemented to assure long-term protection and management of breeding, wintering, and migration areas to maintain the subpopulation sizes and average productivity specified in Criteria 1 and 2. These mechanisms include establishment of recovery unit working groups, development and implementation of participation plans, development and implementation of management plans for Federal and State lands, protection and management of private lands, and public outreach and education.

Our current estimate (2,371 breeding adults) remains below the population size of 3,000 birds listed as a recovery objective in the recovery plan (Service 2007), although some local population sizes have surpassed recovery objectives for some areas (e.g., Monterey Bay, Oregon, Washington). Yearly average productivity (Criterion 2; number of fledglings per male) are not compiled annually for the entire U.S. Pacific Coast; however, the best available information indicates that the yearly average productivity has not been met (Service 2019a, p. 6).

Threats have not changed significantly since the 2006 5-year review. Evidence of habitat loss and degradation remains widespread; while the degree of this threat varies by geographic location, habitat loss and degradation attributed to human disturbance, urban development, introduced beachgrass, and expanding predator populations remain the management focus in all six recovery units. Efforts to improve habitat at current and historic breeding beaches, and efforts to reduce the impacts of human recreation and predation on nesting plovers, have improved western snowy plover numbers. Active vegetation and predator management and habitat restoration should be continued. Because of active management efforts, including increased monitoring, use of predator exclosures at some sites, predator management, and expanded beach closures, western snowy plover population numbers have increased at some locations. However, despite active vegetation and predator management, we expect ongoing and projected changes in sea level and climate to affect coastal habitat suitability, nest survival, overwinter survivorship, and quality of nesting and roosting habitats (Service 2019a, p. 7).

California Least Tern

Legal Status

The Service listed the California least tern as endangered on June 2, 1970 (Service 1970b). We issued a revised recovery plan for the species in 1985 (Service 1985) and 5-year status reviews in 2006 and 2020 (Service 2006a, 2020b). The Service has not designated critical habitat for the species.

Natural History

<u>Foraging Behavior</u>

California least terns forage in nearshore oceans, harbors, marina channels, tidal estuarine channels, and sheltered shallow bays (Atwood and Kelly 1984, pp. 35–36). Adults forage mostly within 2 miles of breeding colonies, and at many sites foraging is primarily in nearshore ocean waters less than 60 feet deep (Service 1985, p. 18). They feed on small fish that they catch by plunging into the water from flight. In a study of fish dropped by California least tern at 10 nesting areas, researchers found 49 species of fish, all individuals less than 1 year old. Northern anchovy (*Engraulis mordax*) and silverside species (Atherinidae) represented 67 percent of the total sample (Atwood and Kelly 1984, p. 38).

Breeding

California least terns are migratory colonial nesters, usually arriving in breeding areas by late April and departing in August (Massey 1974, pp. 6, 43). They exhibit a high degree of nest site fidelity from year to year; individuals often return to breed where they previously bred successfully or to their natal sites (i.e., where they hatched) significantly more than one would predict if birds nested randomly (Atwood and Massey 1988, pp. 391–393). After the initial nesting period that begins on their arrival in April, a second wave of nesting may occur from mid-June to early August. These are mainly re-nests after initial failures and second-year birds nesting for the first time (Massey and Atwood 1981, p. 596).

Nesting California least terns usually occupy a sand-shell beach relatively free of plant growth (Massey 1974, p.5). The nest is typically a shallow, round depression, constructed by a bird sitting and kicking its feet backwards while rotating its body. This may occur several times before the bird lays an egg (Massey 1974, pp.10–11; Wolk 1974, p. 52). California least terns may use "sideways building" after scrape construction, which consists of the sitting bird reaching out with its bill to pick up additional nest material, such as small shells and shell fragments, and depositing them into the nest (Wolk 1974, p. 53).

Early in the breeding season, California least terns display night roosting behavior. Prior to incubation, they will sleep at night at varying distances from the nesting sites. Once incubation begins, birds roost at night on the nest. California least terns use roosting sites away from breeding colonies prior to egg laying, apparently for predator avoidance. By not sleeping within the colony until they lay eggs, they may delay nocturnal predators discovering the colony by 2 to 3 weeks (Service 1985, p. 7).

California least terns begin incubation after laying the first egg. Both parents participate in incubation, which lasts 20 to 25 days (Massey 1974, pp. 15–16). Clutch size ranges from one to three eggs, with two eggs being most common (Massey 1974, p. 13; Ehrlich et al. 1988, p. 186).

California least tern chicks are semi-precocial (capable of a high degree of independent activity from birth) and parents can feed small fish to chicks within hours of hatching (Massey 1974, p. 17; Ehrlich et al. 1988, p. 18). Chicks will begin leaving the nest in one to two days (Massey 1974, p. 17) and fledge at approximately 20 days. Juveniles and adults will fish, loaf, preen, and roost together for several weeks after fledging; adults will continue to feed juveniles during this period (Massey 1974, p. 20).

Wintering

California least terns leave nesting areas by August to spend winter months along the west coast of Baja California, the west coast of Mexico, and further south, possibly from the Gulf of California to Guatemala (AOU 1957, p. 239; Service 1985, p. 17; Thompson et al. 1997, Distribution, Migration, and Habitat).

Rangewide Status

The historical breeding range of the California least tern extends along the Pacific coast from central California (Moss Landing) to southern Baja California (San Jose del Cabo). Observers documented potentially vagrant birds farther north in Alameda County, California (Grinnell and Miller 1944, p. 175; AOU 1957, p. 239). Since 1970, records of nesting sites extend from San Francisco Bay to Bahia de San Quintin, Baja California. The nesting range in California has been discontinuous, with most birds nesting in southern California from Santa Barbara County south through San Diego County (Service 1985, p. 3).

In 1969 and 1970, Craig (1971, pp. 1, 5) conducted breeding surveys in San Mateo, Orange, and San Diego Counties. Craig estimated 300 pairs at 15 sites in the three counties and made recommendations to prevent the extirpation of the California least tern in California, principally to protect existing sites from human disturbance and create new sites in areas also protected from disturbance and development (Craig 1971, entire). In 1980, 1981, 1982, and 1983, the California least tern breeding population in California was approximately 890 to 1,215; 963 to 1,171; 1,015 to 1,245; and 1,180 to 1,299 pairs, respectively (Service 1985, p. 21). Several studies attributed fluctuations in the number of breeding pairs and productivity to the El Niño Southern Oscillation, which results in limited food availability (Massey et al. 1992, pp. 982–983; Caffrey 1995, p. 12; Robinette et al. 2015, pp. 5, 10, 21–52). The effects on California least terns after a severe El Niño event may last several years (Massey et al. 1992, pp. 976, 978, 982). La Niña events may have similar effects on prey availability resulting in lower productivity and decreased species richness (Ribic et al. 1992, entire) though research is needed on how La Niña events affect California least terns specifically.

Surveys have become more standardized and frequent since the 1990s (Sin 2021, p. 5). Sin reported 4,097 to 5,598 breeding pairs across 45 nesting sites in California over the 2017 breeding season (Sin 2021, p. 3). A few sites contained most of the breeding activity in California during the 2017 season: Camp Pendleton, Naval Base Coronado, Batiquitos, Point Mugu, Huntington, and Alameda Point (Sin 2021, p. 3), a trend consistently observed in previous years (Frost 2016, p. 12, 2017, p. 11). These six sites represented 75 percent of the state nest total and contributed 65 percent of California's fledgling production. The California Department of Fish and Wildlife provides annual reports of nesting California least terns in California; reports include numbers of breeding pairs, nesting sites, and fledgling to breeding pair ratios. Table 1 compiles nesting pair and breeding site data from 1969 to 1974, and 1990 to 2017.

Table 1. Numbers of breeding pairs and nesting sites across California; data compiled from California Department of Fish and Wildlife reports (Craig 1971, p. 1; Bender 1974a, p. 1, b, p. 1; Johnston and Obst 1992, pp. 3, 6; Obst and Johnston 1992, pp. 3, 5; Caffrey 1993, p. 2, 1994, p. 2, 1995, p. 3, 1997, p. 3, 1998, p. 3; Keane 1998, p. 3, 2000, p. 3, 2001, p. 5; Patton 2002, p. 3; Marschalek 2005, p. 3, 2006, p. 3, 2007, p. 3, 2008, p. 3, 2009, p. 3, 2010, p. 3, 2011, p. 3, 2012, p. 3; Frost 2016, p. 3, 2017, p. 3, 2013, p. 3, 2015, p. 3; Sin 2021, p. 3).

Year	*Approximate Number of Breeding Pairs*	*Number of Nesting Sites*
2017	4,097–5,598	45
2016	3,989–4,661	42
2015	4,202–5,295	41
2014	4,232–5,786	41
2012	4,293–6,421	41
2011	4,826–6,108	40
2010	6,437–6,699	41
2009	7,130–7,352	41
2008	8,223–8,226	36
2007	6,744–6,989	35
2006	7,006–7,293	31
2005	6,865–7,341	28
2004	6,354–6,805	32
2000	4,521–4,790	37
1999	3,451–3,674	36
1998	4,141–4,182	30
1997	4,017	38
1996	3,330–3,392	35
1995	2,585–2,611	37
1994	2,792	36
1993	2,400	35
1992	2,106	38
1991	1,830	26
1990	1,706	28
1974	582	20
1973	624	19
1969–1970	300	15

Recovery and Threats

The primary goals outlined in the 1985 recovery plan are to prevent extinction and return the California least tern population to a stable, non-endangered status. We state the Service may consider reclassification to threatened status if 1,200 breeding pairs in California occur in 15 secure management areas with a 3-year mean reproduction rate of 1.0 (one fledgling per breeding pair) (Service 1985, p. 26). We also state the Service may consider delisting if the population reaches 1,200 breeding pairs distributed in at least 20 of 23 coastal management areas with the following provisions:

1. Sufficient habitat to support at least one viable colony (consisting of a minimum of 20 breeding pairs with a 5-year mean reproductive rate of at least 1.0 young fledged per year, per breeding pair) at each of the 20 coastal management areas managed to conserve California least terns (which must include San Francisco Bay, Mission Bay, and San Diego Bay); and
2. Assured land ownership and management objectives for future habitat management for the benefit of California least terns, and assessment of the security and status of Baja California colonies for incorporation into recovery objectives (Service 1985, pp. 25–26).

The breeding population of California least terns currently exceeds Objective 1. The estimated number of California least tern breeding pairs has increased from approximately 624 pairs in 1973 to a peak of approximately 7,100 pairs in 2009. The number of breeding pairs has dropped in the past few years from the peak to estimates of 3,989 pairs in 2016 and 4,097 pairs in 2017. In the 2006 5-year Review, we acknowledged the species had far exceeded this population objective (Service 2006a, p. 3).

Objective 2 does not identify explicitly specific threats to alleviate but rather is a proxy for whether there is a reduction in threats to reproduction and fecundity. In the 2006 5-year review, we concluded that based on the population data at that time, the Service could likely consider the species recovered without meeting this goal (Service 2006a, p. 5), as the sharp growth in pairs had occurred while estimated fledgling rates were below 1.0 fledglings per pair. Objective 2 utilizes this same definition of viability for secure nesting site requirements, though it is unclear from the recovery criteria if sites must maintain this level of viability for 3 or 5 years (Service 1985, pp. 25–26).

Overall, progress is being made toward satisfying the recovery criteria. However, as we concluded in the 2006 5-year review and based on recent data, we should revise the recovery plan and update it to provide threats-based recovery criteria and address the other shortcomings of the recovery plan. Areas of the plan that need updating include inclusion of Mexico populations of California least terns, further analysis of the fledgling per pair ratio, and future impacts from a changing climate, such as seal level rise (Service 2020b, p. 62).

In the five-factor analysis in our 2020 5-year status review, we found that rising sea levels as a result of climate change (Factor A) may in the future pose a substantial threat to nesting habitat of the California least tern; that predation (Factor C) continues to threaten the California least tern (this threat is reduced, though not eliminated, by predator management conducted at the majority of active colonies, and predator management is confounded when the predator is a protected species); that food availability (Factor E) poses a threat to California least terns though its impact varies from year to year with an uncertain overall magnitude; and that cumulative impacts of food availability, predation, and destruction of nesting habitat together pose a substantial threat to the persistence of the California least tern, although management at a majority of the U.S. nesting sites helps to reduce the impact of these combined threats. Though there are few data available on nesting areas in Mexico, lack of legal protection and conservation measures result in a higher degree of threats attributable for nesting California least terns than in the United States (Service 2020b, p. 69).

While the California least tern has met the population size recommended in the recovery plan for downlisting, the population has been recently declining and exhibiting poor reproductive success, and multiple ongoing threats continue to impact the species. Therefore, we determined that current information does not support reclassifying the California least tern at this time. Additional information on threats, management techniques, and current population models should be obtained before reassessing the taxon again in the future (Service 2020b, p. 70).

ENVIRONMENTAL BASELINE

The implementing regulations for section 7(a)(2) (50 CFR 402.02) define the environmental baseline as "the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline."

Action Area

The implementing regulations for section 7(a)(2) of the Act (50 CFR 402.02) define the "action area" as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The action area for this biological opinion includes all areas subject to noise generated from individual launches; areas subject to overpressure as a result of sonic booms generated from launches breaking the sound barrier; areas subject to launch vehicle disposal; four water extraction wells located within the San Antonio Creek Basin and the 9.5 miles of San Antonio Creek downstream habitat; and areas subject to potential mitigation/restoration efforts that may occur as a result of the proposed project.

Appendix A, Figure 1a–c depicts the Launch Noise Effect Area of potential disturbance, Appendix A, Figure 2a–e) depicts the Overpressure Effect Area of potential disturbance associated with the sonic boom produced during vehicle SLC-4 landing, and Appendix A, Figures 4a–b depicts potential mitigation areas associated with the proposed project. The Service considers all areas within the noise and overpressure effect areas, water extraction within the San Antonio Creek Basin, as well as potential mitigation/restoration areas to encompass the entirety of the action area.

Habitat Characteristics of the Action Area

The proposed action includes more frequent utilization of an existing launch site, SLC-4, located in south VSFB. SLC-4 currently contains predominantly ruderal and developed areas. SLC-4 is located immediately north of Spring Canyon, 0.75 mile southwest of Bear Creek, and approximately 0.5 mile east of Surf Beach. Primary vegetation types within the near vicinity of SLC-4 include Central Coast Scrub, Central Dune Scrub, Central Coastal Arroyo Willow Riparian Forest and Scrub, and Bishop Pine Forest (30 CES 2021, Appendix A, Figure 2). Spring Canyon also contains dense Eucalyptus stands. SpaceX currently removes vegetation to just above ground level within a 3.327-acre impact area of Spring Canyon that is affected by liquid and water vapor expelled from the flame duct, an action previously consulted on in 2017 (Service 2017; 2017-F-0480). SpaceX also currently conducts additional mowing surrounding SLC-4.

The Launch Noise Effect and Overpressure Effect Areas include the vast majority of VSFB apart from a small northern portion of the installation. The Launch Noise Effect Area also includes a wide diversity of native and non-native habitat types including multiple riparian features, central dune scrub, maritime chapparal, live oak woodland, and pine forest (30 CES 2021, Appendix A, Figure 2). Honda Creek which is located within the Launch Noise Effects area contains aquatic habitat with deep ponded features as well as Central Coast Arroyo Willow Riparian Forest and Scrub (30 CES 2021, Appendix A, Figure 2). The Overpressure Effect Area includes various sonic boom trajectories consisting of a narrow band across Santa Rosa Island and Santa Cruz Island. The Space Force anticipates this portion of the Overpressure Effect Area to receive irregular and infrequent disturbance (approximately 8 times a year with overpressures typically below 2 psf; Kaisersatt, pers. comm, 2023a, p. 1).

Water extraction and potential mitigation activities would occur within San Antonio Creek, a perennial feature that contains intact Central Coast Arroyo Willow Riparian Forest and Scrub (30 CES 2021, Appendix A, Figure 2).

Existing Conditions in the Action Area

SLC-4 is an active launch site occupying approximately 122 acres in the south base of VSFB. Over the past five years, VSFB has supported an average of 6.2 rocket launches per year with a high of 17 launches in 2022. SpaceX constitutes the majority of all recent launches from VSFB with an increase in launch frequency from SLC-4 since 2016. Other active or permitted launch programs also occur within the Launch Noise Effect Area. At full launch tempo by 2028, existing active or permitted future launch programs would collectively total between 129 to 237 launch disturbance events (launches and static test fires) of at least 100 dB SPL_{max} annually within various portions of the Launch Noise Effect Area between Honda Creek and the Santa Ynez River (MSRS 2022a, pp. 76-77).

Previous Consultations in the Action Area

On May 14, 2021, Vandenberg Air Force Base changed its name to Vandenberg Space Force Base. Consultations prior to this date refer to the Air Force.

1. January 12, 2023: The Service issued a draft biological opinion to the Space Force for the Phantom Launch Program at SLC-5 Project. We determined that the proposed action was not likely to jeopardize the continued existence of the western snowy plover and the California red-legged frog. This action has not yet occurred to date and the draft is still under review.
2. October 4, 2022: The Service issued a final biological opinion to the Space Force for the Terran 1 Launch Program (Relativity Space, Inc.) at SLC-11 Project. We determined that the proposed action was not likely to jeopardize the continued existence of the western snowy plover and the California red-legged frog. This action has not yet occurred to date.
3. November 18, 2020: The Service issued a biological opinion to the Air Force for the Blue Origin Orbital Launch Site at SLC-9 Project. We determined that the proposed action was not likely to jeopardize the continued existence of the California least tern (*Sterna antillarum browni*), beach layia (*Layia carnosa*), western snowy plover, and California red-legged frog. This action has not yet occurred to date.
4. November 21, 2018: The Service issued a reinitiation of a biological opinion to the Air Force on routine mission operations and maintenance activities at VAFB for changes to California red-legged frog-specific avoidance and minimization measures. We concluded the proposed action was not likely to jeopardize the continued existence of the California red-legged frog or alter effects of the proposed activities on the beach layia, Gaviota tarplant (*Deinandra increscens* ssp. *villosa*), Lompoc yerba santa (*Eriodictyon capitatum*), Vandenberg monkeyflower (*Diplacus vandenbergensis*), vernal pool fairy shrimp (*Branchinecta lynchi*), El Segundo blue butterfly (*Euphilotes battoides allyni*), tidewater goby, unarmored threespine stickleback, California least tern, and western snowy plover.
5. December 12, 2017: The Service issued a biological opinion to the Air Force for the proposed launch, boost-back, and landing of the Falcon 9 first stage at Space Launch Complex 4 (SLC-4). We concluded that the proposed action was not likely to jeopardize the continued existence of the El Segundo blue butterfly, California red-legged frog, California least tern, and western snowy plover. This project began in the spring of 2018 and is currently ongoing.
6. February 4, 2015: The Service issued a biological opinion to the Air Force for the proposed beach management plan for VAFB. We concluded that the proposed action was not likely to jeopardize the continued existence of the El Segundo blue butterfly, California red-legged frog, California least tern, and western snowy plover.

7. December 3, 2015: The Service issued a programmatic biological opinion to the Air Force for routine mission operations and maintenance activities at VAFB. We concluded that the proposed action was not likely to jeopardize the continued existence of the Vandenberg monkeyflower, beach layia, Gaviota tarplant, Lompoc yerba santa, vernal pool fairy shrimp, El Segundo blue butterfly, California red-legged frog, tidewater goby, unarmored threespine stickleback, California least tern, and western snowy plover.
8. September 9, 2014: The Service issued a biological opinion to the Air Force for the proposed replacement of the 13th Street Bridge on the Santa Ynez River. We concluded that the proposed action was not likely to jeopardize the continued existence of the tidewater goby and California red-legged frog. The National Marine Fisheries Service also issued a biological opinion (WCR-2014-1093) for effects on the federally endangered southern California Distinct Population Segment of the southern steelhead (*Oncorhynchus mykiss*).

Condition (Status) of the Species in the Action Area

<u>California Red-legged Frog</u>

California red-legged frogs have been documented in nearly all permanent streams and ponds on VSFB as well as most seasonally inundated wetland and riparian sites (MSRS 2022d, p. 33).

Spring Canyon is an ephemeral drainage located approximately 200 feet south of SLC-4. Throughout the majority of the drainage there is no definable channel and minimal evidence of potential pooling or surface water flow. Several small areas of Spring Canyon may constitute suitable habitat for California red-legged frog during wet periods when adequate surface water is present (MSRS 2022a, p. 27). A Permitted Biologist reassessed the drainage following an above-average rain year in July 2017 and found no suitable California red-legged frog breeding habitat within the Vegetation Removal Area or downstream. Since 2017, the Space Force has performed 11 survey efforts within the Spring Canyon Vegetation Removal Area and found no suitable breeding habitat or California red-legged frog individuals, likely a result of the protracted drought conditions in Santa Barbara County (MSRS 2022a, p. 28). It is therefore unlikely that California red-legged frog occupy the existing Vegetation Removal Area on a regular basis, other than as transitory habitat.

Bear Creek, located approximately 0.75 mile to the northeast of SLC-4, is within the Launch Noise Effect and Overpressure Effect Areas. Biologists have documented a moderately sized California red-legged frog population and breeding habitat between 1999 and 2013 across variable survey efforts within Bear Creek. A total of 12 individuals were encountered most recently in 2013, 15 metamorphs in 2000, and 5 egg masses were documented in 2002 (Christopher 2002; USSF, unpublished data, 2022). Noise modeling projects Bear Creek would receive up to 128 dB SPL_{max} of engine noise during launches. Past monitoring results suggest

Bear Creek would receive an instantaneous sonic boom overpressure level between 4 to 5 psf with comparable noise level of over 135 dB SPL_{max} (MSRS 2022b, p. 4, MSRS a, p. 53).

Biologists have also consistently documented a moderately sized population and breeding habitat of California red-legged frogs over the last 10 years across variable survey efforts within Honda Creek. Honda Creek is located approximately 2 miles south of SLC-4 and is within the Launch Noise Effect and Overpressure Effect Areas. Noise modeling projects Honda Creek would receive up to 123 dB SPL_{max} of engine noise during launches. Past monitoring results suggest Honda Creek would receive an instantaneous sonic boom with overpressure level of 2.4 psf (comparable noise level of up to 135 dB SPL_{max}), which were the realized levels recorded during previous Falcon 9 launch monitoring (MSRS 2022b, p. 4). Using protocol night California red-legged frog survey information between 2013 and 2022, adult frogs encountered ranged between 1 to 12 individuals with the current average annual high number being 7.2 adult individuals within the approximate anticipated Launch Noise Effect and Overpressure Effect Areas. Honda Creek includes multiple deep pond features that biologists have documented support breeding with 68 juveniles in 2017 and with 50 tadpoles and over 13 egg masses observed in 2022 (USSF, unpublished data, 2022).

The Santa Ynez River and San Antonio Creek are both large perennial features. Large portions of each feature are included in the Launch Noise Effects and Overpressure Effect Areas. The Santa Ynez River is located approximately 4 miles north of SLC-4 while San Antonio Creek is located approximately 10 miles to the north. Both features are thought to support robust populations of California red-legged frog and breeding habitat (MSRS 2016, p. 37, MSRS 2022d, p. 34). Available noise modeling projects that the Santa Ynez River would receive up to 118 dB SPL_{max} of engine noise during launches and overpressure of 1.5 to 2 psf during the sonic boom produced by terrestrial landing. Modeling also anticipates San Antonio Creek would receive engine noise levels between 100 to 110 dB SPL_{max} during launches and overpressure levels of 0.5 to 1 psf during the sonic boom produced by terrestrial landing. The biological assessment did not provide instantaneous sonic boom noise levels and without past monitoring results to reference, the anticipated sonic boom noise levels for the proposed project are unknown at this time.

San Antonio Creek contains the potential San Antonio Creek Oxbow Restoration expansion area that the Space Force may utilize for project mitigation purposes. Additionally, the proposed well water extraction area is in San Antonio Creek and includes 9.5 miles of downstream habitat between Barka Slough to the estuary. Annual VSFB water use between 2019 and 2021 has averaged 2,794 acre-feet (MSRS 2022d, p. 51). The Space Force is planning to expand additional launch programs that will contribute to this average water extraction in future years. Consequently, the Service considers the current average water use in addition to what has been permitted to constitute the existing water extraction baseline.

Suitable upland dispersal habitat exists throughout VSFB between the various riparian zones and ponds. The vast majority of the Launch Noise Effect and Overpressure Effect Areas support areas of dense vegetation that could provide shelter for dispersing California red-legged frog, especially during periods of wet weather.

The Service includes approximate estimates of the number of California red-legged frog life stages present within the three major features included within the Launch Noise Effect and Overpressure Effect Areas (Table 1; Appendix A, Figures 1a, 2c).

The Service includes estimates provided by the Space Force for Honda Creek. The Space Force includes that these numbers are likely conservative when estimating adults as these are the largest number of individuals observed during surveys. Conversely, the estimated number of metamorphs, larvae, and eggs masses should be considered a less accurate approximation as not all locations have received equal survey effort for these life stages; stochastic events (flash storms) may have resulted in detection difficulty due to survey timing and drought has likely resulted in the failure of many cohorts over the past ten years (USSF, unpublished data, 2022; Kaisersatt, pers. comm., 2022a).

The biological assessment did not provide any specific population estimates for Bear Creek. The Space Force indicates that drought conditions have impacted water availability in Bear Creek in recent years. However, the Service anticipates that above average rainfall levels in the beginning of 2023 will likely support existing available suitable habitat including previously documented breeding features. Consequently, the Service generated estimates using the most recent available existing survey data for Bear Creek. On March 14, 2013, biologists observed 12 adult individuals (USSF, unpublished data, 2022). Biologists have also documented breeding in Bear Creek with 5 egg masses observed in 2002 and 15 metamorphs in 2000 (Christopher 2002).

In 2016, the Space Force estimated that a population of approximately 8,769 California red-legged frog individuals occupied the Santa Ynez River following exhaustive netting seine survey results on VSFB (MSRS 2016, p. 37). A large portion of the Santa Ynez River is included in the action area. The Space Force indicates that drought conditions have also impacted water availability in the Santa Ynez River in recent years. However, the lower Santa Ynez River has remained hydrated throughout the drought and constitutes suitable and occupied California red-legged frog habitat on VSFB (MSRS 2018, p. 13). The Service anticipates that above average rainfall levels in the beginning of 2023 will likely support previously available suitable habitat within the feature at least into the immediate future with the expectation that abundant rainfall will rehydrate previously dried portions and flush potentially high salinity levels within the Santa Ynez River estuary. Considering this, the Service mapped apparent available aquatic and associated riparian habitat from aerial imagery taken in January 2022 within VSFB boundaries. A total of 176 acres of visible habitat within the Launch Noise and Overpressure Effect Areas with VSFB boundaries were mapped. Additional acreage off base was not included. Following further discussion with the Space Force, supplementally provided survey results from 2018 indicate that the majority of the known California red-legged frog population within the Santa Ynez River on VSFB appears to be concentrated around the 13th Street Bridge and that populations were lower than surveys conducted in 2012 to 2013 (MSRS 2018 p. 32). Extended drought conditions, the presence of non-native predatory species such as bullfrogs, as well as vegetation disturbance resulting from the recent construction of the 13th Street Bridge project may have impacted population numbers. The Space Force indicates that they expect recolonization of this area as previously disturbed vegetation recovers (MSRS 2018, p. 13). Consequently, given the assortment of variable factors, current and near-term population estimates of the area are difficult to generate. Using mapped acreage and a USGS mark-recapture study (USGS 2022, entire) as a point of reference, the Service extrapolated a population capacity estimate of 3,654 individuals within the portion of the Santa Ynez that occurs on VSFB. The Service understands that the Santa Ynez River California red-legged frog population within VSFB between 2016 and 2018 was much lower than this estimate (MSRS 2016, p. 34, MSRS 2018, p. 14). However, the Service will use this estimate for the purposes of analysis being that significant changes to habitat conditions have occurred with the rehydration of habitat until updated survey information becomes available.

Table 1. California red-legged frog life stage estimates within the Launch Noise Effect Area on VSFB.

Feature	*Approximate engine noise level and overpressure exposure*	*Adult*	*Metamorph*	*Larvae*	*Egg Mass*
Honda Creek	*123 dB SPL_{max}, 2-3 psf*	*19*	*2*	*90*	*13*
Bear Creek	*128 dB SPL_{max}, 3-4 psf*	*12*	*15*	*50*	*5*
Santa Ynez River*	*118 dB SPL_{max}, 1.5-2 psf*	*3,654*	*439*	*1,157*	*469*

**Capacity estimates extrapolated using available acreage using USGS 2022 mark-recapture study as a point of reference.*

Western Snowy Plover

VSFB provides important nesting and wintering habitat for western snowy plovers, which includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach on north VSFB to the rock cliffs at the south end of Surf Beach on south VSFB (approximately 12.5 miles). VSFB has consistently supported one of the largest populations of breeding western snowy plovers along the west coast of the United States.

The nearest observation of western snowy plover nesting to the action area's Launch Noise Effect Area is on the southern end of Surf Beach, approximately 0.8 mile northwest of SLC-4; however, the Launch Noise Effect Area encompasses nearly the entirety of beaches that western snowy plovers occupy on VSFB (Appendix A, Figure 1b). The northern 0.75-mile end of Minuteman Beach is the only location that falls outside of the Launch Noise Effect Area. The Overpressure Effect Area encompasses all western snowy plover occupied beaches up to 0.75 mile north of Purisima Point (Appendix A, Figure 2d). The breeding population of western snowy plover on VSFB has been highly variable but relatively stable since 2007 with 235 adults and 472 nests initiated in 2021 (Robinette et al. 2021, as cited in MSRS 2022, p. 36).

Tables 2 and 3 outline the number of nests per year within the greater than 3 psf and greater than 2 psf modeled sonic boom contour zones displayed in Appendix A, Figure 2d (USSF 2021, entire). The greater than 3 psf zones encompasses all nests located in the 3 and 4 psf zones displayed in Appendix A, Figure 2d, and the greater than 2 psf zones encompasses all nests located in the 2, 3, and 4 psf zones displayed in Appendix A, Figure 2 d. These zones would receive the highest projected launch and sonic boom disturbances.

Table 2. Number of known western snowy plover nests per year from 2012 to 2018 within the modeled greater than 3 psf contour zones displayed in Appendix A, Figure 2d (USSF 2021, entire; USSF 2023, entire).

Year	Nest Count
2022	27
2021	34
2020	50
2019	40
2018	49
2017	44
2016	31
2015	48
2014	37
2013	29
2012	51

Table 3. Number of known western snowy plover nests per year from 2012 to 2018 within the modeled greater than 2 psf contour zones displayed in Appendix A, Figure 2d (USSF 2021, entire; USSF 2023, entire).

Year	Nest Count
2022	104
2021	111
2020	118
2019	113
2018	150
2017	136
2016	99
2015	127
2014	139
2013	92
2012	98

California Least Tern

Historically, California least terns nested in colonies in several locations along the coastal strand of the north VSFB coastline. The current primary colony site at VSFB for California least tern is at Purisima Point, approximately 8 miles north of SLC-4. This site is on a relatively undisturbed bluff-top in open dune habitat. California least tern forage in the lagoon formed at the mouth of the Santa Ynez River, approximately 3.7 miles north of SLC-4, and at other near-shore locations at VSFB. After young California least tern have fledged in late summer, they will disperse to these locations to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (MSRS 2022a, p. 41). Both the Purisima Point colony site and Santa Ynez River foraging site fall within the Launch Noise Effect Area and Overpressure Effect Area (Appendix A, Figures 1c, 2e).

VSFB supports only a small percentage of California's breeding population of California least tern; however, the population on VSFB remains significant as it is one of only three breeding colonies between Monterey and Point Conception. Though this population is one of the smallest in the range, VSFB tends to be a reproductively successful site with 27 breeding pairs and 34 nests initiated in 2021 and an average productivity of 0.30 fledglings per pair (Table 4; Robinette et al. 2021, pp. 1, 33).

Table 4. Number of known California least tern nests per year from 2012 to 2021 at the Purisima Point colony (Robinette et al. n.d., entire). The median of the data displayed is 23.5 nests.

Year	Nest Count
2021	34
2020	12
2019	47
2018	83
2017	28
2016	27
2015	22
2014	21
2013	15
2012	18

Recovery

California Red-legged Frog

In the recovery plan for California red-legged frog, the Service revised recovery units and identified core areas that are watersheds, or portions thereof, that biologists determined essential to the recovery of the California red-legged frog. VSFB is located within the Northern Transverse Ranges and Tehachapi Mountains Recovery Unit and Core Area 24, Santa Maria

River-Santa Ynez River. This core area is important because it is currently occupied, contains a source population, and provides connectivity between source populations (Service 2002, pp. 6, 146).

In this recovery unit, biologists consider the lower drainage basin of San Antonio Creek, the adjacent San Antonio Terrace, and San Antonio Lagoon to be among the most productive areas for California red-legged frogs in Santa Barbara County (Christopher 1996, as cited in Service 2002, p. 10). Most of this area occurs on VSFB.

Recovery task 1.24 identifies that the conservation needs in Core Area 24 are (1) to protect existing populations; (2) reduce contamination of habitat (e.g., clean contaminated ponds on VSFB); (3) control non-native predators; (4) implement management guidelines for recreation; (5) cease stocking dune ponds with non-native, warm water fish; (6) manage flows to decrease impacts of water diversions; (7) implement guidelines for channel maintenance activities; and (8) preserve buffers from agriculture such as in lower reaches of Santa Ynez River and San Antonio Creek (Service 2002, p. 75).

Western Snowy Plover

In the recovery plan for western snowy plover, the Service designated six recovery units across the range. VSFB is located within Recovery Unit (RU) 5, which includes San Luis Obispo, Santa Barbara, and Ventura Counties. RU5 supports the greatest number of western snowy plovers in the range (approximately half of the U.S. population) and has the greatest amount of available suitable habitat (Service 2007, p. 142).

The population trajectory of RU5 since 2007 is stable, positive, and has had minimal annual fluctuation (Service 2019b, p. 5). The population has not attained or exceeded the recovery target in any survey year. Annual monitoring reports from several of the larger sites, including VSFB, report fecundity results that exceed the recovery criterion in most years (Service 2019b, p. 5).

In 2022, VSFB comprised approximately 26 percent of breeding adults in RU5, 12 percent of California's breeding population, and 10 percent of breeding adults rangewide (Service 2022b, entire). Table 5 outlines average numbers of breeding adults counted during breeding window surveys from 2014 to 2022. Percentages illustrate the numbers of breeding western snowy plovers at VSFB relative to numbers rangewide, across California, and within RU5.

Table 5. 2014–2022 breeding adult averages from uncorrected (raw) breeding window survey numbers for the Pacific Coast range of western snowy plover, California, RU5, and VSFB with relative percentages (Service 2022b).

Area Surveyed	2014–2022 Averages	Percent of Range	Percent of CA	Percent of RU5
Rangewide	2,283	100	-	-
California Only	1,843	81	100	-
RU5	857	38	47	100
VSFB	226	10	12	26

California Least Tern

In the recovery plan for California least tern, the Service identified the Purisima Point and Santa Ynez River locations on VSFB, but not VSFB itself, as part of Management Area D. The Service identified Purisima Point as a location to develop and implement management plans/programs for secure nesting habitat. The Service identified Santa Ynez River Mouth as a known post-breeding site. Ten or 12 pairs of California least terns were historically known to have nested at the Santa Ynez River mouth; however, biologists have not observed breeding at this location in more than 20 years. The Space Force observed some fledglings but did not take a census. The recovery plan stated that enhancing nesting in the area should be investigated (Service 1985, pp. 13, 22, 57–58).

In the 2020 5-year status review, the Service described VSFB as a secure and managed site with a minimum of 20 breeding pairs within the Santa Maria Basin region with increasing reproductive success, suitable and occupied habitat, and threats of predation and food availability. In 2016, breeding pairs on VSFB accounted for less than 1 percent of breeding pairs in the range. Most breeding pairs (60 percent) breed in San Diego County. In 2017, the Space Force reported a minimum of 19 breeding pairs with a min-max fledglings per pair ratio of 0.30–0.42 (Service 2020b, pp. 10, 24, 49, 96).

EFFECTS OF THE ACTION

The implementing regulations for section 7(a)(2) define effects of the action as “all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action” (50 CFR 402.02).

In conducting this analysis, we have considered factors such as previous consultations, 5-year reviews, published scientific studies and literature, and the professional expertise of Service personnel and other academic researchers with aspects directly related to the sensitive species involved in determining whether effects are reasonably certain to occur. We have also determined that certain consequences are not caused by the proposed action, such as the increase or spread of disease, poaching, or collecting, because they are so remote in time, or geographically remote, or separated by a lengthy causal chain, so as to make those consequence not reasonably certain to occur.

This reinitiation will address the change in the proposed action to increase the Falcon 9 annual first stage launch number and recovery cadence that was described in the 2017 biological opinion (Service 2017; 2017-F-0480). The change from the original project description includes changing launch frequency from one launch a month approximately three launches monthly with launches separated between 8 to 10 days. Additionally, overall launch number would increase from 12 to 36 launches annually from SLC-4 on VSFB and include additional downrange offshore landing locations in the Pacific Ocean. This effects analysis only incorporates the launch operational components previously analyzed in the 2017 biological opinion while addressing novel impacts of increased launch frequency and magnitude.

Effects of the Proposed Action on the California Red-legged Frog

Launch Operations

Flame Duct Use

The proposed project constitutes an increase in Falcon 9 launch frequency, increasing launch cadence from 1 to 3 times a month and increasing the annual launch number from 12 to 36. Each launch requires water release associated with the flame bucket with liquid water directed to the SLC-4 v-ditch feature and a minimum amount of water vapor directed towards Spring Creek. The maximum temperature of the water vapor would be 130 degrees Fahrenheit at the point it would reach Spring Canyon. More frequent launches and associated water vapor releases may cause higher potential for injury or mortality of California red-legged frogs through scalding individuals in the Spring Creek area. The wet season would magnify these effects when California red-legged frogs are more active and are more likely to be present in Spring Canyon. However, since 2017, the Space Force has performed 11 survey efforts within the Spring Canyon Vegetation Removal Area and found no suitable breeding habitat or California red-legged frog individuals (MSRS 2022a p. 28). It is therefore unlikely that California red-legged frog occupy the existing Vegetation Removal Area on a regular basis, other than for transitory upland habitat. SpaceX would minimize potential impacts by implementing minimization measures. Previous monitoring requirements included within the 2017 biological assessment included that a Qualified Biologist would conduct pre-activity surveys for California red-legged frog in the water release area following each launch (MSRS 2017a, p. 14). Given the previous negative survey findings that followed 11 individual launches, the Space Force will now require a Qualified Biologist to perform one California red-legged frog survey annually during peak breeding season (November to May) in Spring Canyon when individuals are most likely to be present and detectable. If the Qualified Biologist does not encounter California red-legged frog at the time of this survey, the Space Force will not require any other subsequent pre-/post-launch surveys. If California red-legged frogs are present during the annual survey, the Space Force will require pre- and post-launch surveys and relocation of any California red-legged frog encountered for each subsequent launch event (AM-2). These avoidance measures should reduce the potential for California red-legged frog death or injury; however, biologists may not detect some individuals during pre-activity surveys resulting in California red-legged frog death or injury. We expect such effects would occur infrequently.

Additionally, following the description in the 2017 biological opinion, SpaceX has constructed a civil diversion structure and retention basin to minimize the amount of water entering Spring Creek from water release activities. SpaceX will continue to avoid and minimize these effects by implementing measures described in the 2017 biological assessment (MSRS 2017a) which include: (1) SpaceX will follow the site-specific Stormwater Pollution Prevention Plan already implemented for SLC-4; (2) SpaceX will implement the Best Management Practices within the latest California Stormwater Quality Association's Stormwater Best Management Practices Handbook; (3) SpaceX will collect any rocket propellant in the retention basin using absorbent pads prior to discharge to the spray field; and (4) SpaceX will fully implement the procedures in VSFB's Hazardous Materials Emergency Response Plan in the event of a hazardous materials spill. The civil diversion structure and collection of fuel with absorbent pads should reduce the potential for effects to California red-legged frogs. Provided the various plans and practices to control contaminants and sedimentation are effective, these measures should also reduce the potential for such impacts on California red-legged frog habitat.

Approximately 17,500 gallons of hot water (130 degrees Fahrenheit) is expelled from the flame duct during each individual launch and ultimately reaches the v-ditch feature located within the fenceline of SLC-4. The Space Force has indicated that this water is temporarily stored within the feature and dissipates rapidly (Kaisersatt, pers. comm., 2023e). The Service consequently assumes that water is no longer present within 24 hours of an individual launch. The temporarily stored water would not reach a depth level or hydroperiod that would support California red-legged frog breeding. The Service understands that associated hydrophytic vegetation may be present and the Space Force would conduct feature maintenance on a regular basis (Kaisersatt, pers. comm., 2023e). The v-ditch feature may consequently constitute suitable transitory California red-legged frog habitat as a result and individuals may be attracted to the feature in response to increased water presence associated with more frequent launching. Consequently, the Service assumes that any California red-legged frogs that come in contact with the v-ditch have the potential to be injured or result in mortality from associated contact with scalding water. The Service also assumes that v-ditch maintenance including sediment and vegetation removal may also result in the injury or death of adult California red-legged frogs if present.

The Space Force anticipates the proposed project's launches would produce a diminutive amount of soot biproduct. If soot or other similar launch related biproducts contact dispersing California red-legged frogs or enter adjacent occupied waterbodies, the Service assumes it has the potential to injure or kill California red-legged frogs due to their highly permeable skin and susceptibly to waterborne pollutants (Jung 1996, p. i; Llewelyn et al. 2019, p. 1). However, the Space Force references a comparable launch assessment (FAA 2020, entire) and expects that the actual amount of soot produced would be diminutive being that it would subsequently burn up in the exhaust plume (Kaisersatt, pers. comm., 2022b). Consequently, the Service assumes that the proposed project's launch biproducts are unlikely to impact dispersing California red-legged frog or their aquatic habitats.

Capture and relocation of California red-legged frogs in the area prior to individual launches may cause injury or death as a result of improper handling, containment, transport, or release into unsuitable habitat. Although we do not have an estimated survivorship for translocated California red-legged frogs, intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, and increased risk of predation reduces survivorship of translocated wildlife in general. The Space Force will minimize effects by using Qualified Biologists as proposed, limiting the duration of handling, requiring proper transport of individuals, and identifying suitable relocation sites (AM-1, 2). The Service expects the relocation of individuals from vegetation management and water release areas to greatly reduce the overall level of injury and mortality, if any, which would otherwise occur. Having only experienced biologists engage in the activity would greatly reduce the potential for injury or mortality due to mishandling.

Water Extraction

The Space Force would authorize a maximum of 4.28 million gallons (13.1 acre-feet) of water per year to support the project. The current water source for VSFB consists of four water wells located within the San Antonio Creek Basin. Water withdrawal from the San Antonio Creek wells has the potential to reduce streamflow and water levels within San Antonio Creek. This could adversely affect all life stages of California red-legged frog downstream of Barka Slough by reducing associated wetland and riparian habitats supported by the existing groundwater level and extent of inundated area. Annual VSFB water use between 2019 through 2021 has averaged 2,794 acre-feet (MSRS 2022d, p. 51). Utilizing available data for purposes of comparison, a previous analysis for a separate project involving groundwater extraction within the Barka Slough estimated that a 5.1 percent decrease in average annual base flow (up to 0.07 cubic feet per second) in near normal precipitation years could occur within the associated downstream creek channel as a result of pumping a maximum of 921 additional acre-feet under current conditions (USGS 2019b, p. 5). When using this provided ratio for reference, the Service assumes that pumping 13.1 acre-feet annually would likely result in less than an approximate 0.07 percent decrease in average annual base flow with a correspondingly low level of associated aquatic habitat within the creek channel. Discussion with hydrologists involved with the previously generated hydrological modeling indicate that a 13.1 acre-feet extraction amount alone is not anticipated to result in measurable decline of streamflow or aquatic habitat (C. Faunt and G. Cromwell, USGS, pers. comm. 2021). The Service considers the proposed extraction level of 13.1 acre-feet to be insignificant at this time based on the information provided.

Factors including future surrounding water usage (e.g., collective existing and future launch program needs, surrounding agriculture, etc.) as well as increased variability of annual precipitation due to climate change, including shorter wet seasons and longer dry periods, may influence true effects (Myers et al. 2017, p. 15, 59). An additional hydrological model incorporating various precipitation scenarios predicts that an extraction amount of 921 acre-feet would decrease inundated area between 0.14 and 10.14 percent (AECOM 2019b, p. 6). Similarly, given that the maximum annual extraction amount of 13.1 acre-feet is approximately 1.4 percent of the 921 acre-feet used for the supplemental model analysis, it is not reasonably foreseeable that it would result in a discernable reduction of inundated area. Although potential impacts to associated riparian terrestrial habitat were not initially characterized, based on the best available information (USGS 2019b; AECOM 2019b), the Service does not anticipate measurable decline in the quality or overall extent of these associated habitats as a result of the proposed extraction amount of 13.1 acre-feet annually at this time. However, the Service understands that there has been a level of habitat change within Barka Slough driven by increasing groundwater withdrawals from the San Antonio Creek groundwater basin for agriculture on and off VSFB. Since the 1980's, withdrawals have exceeded the recharge rate for the basin since the 1980's (Public Works 2020 as referenced in MSRS 2022c, p. 5). Since the 1950's, ground water levels have dropped between 10 to over 30 meters (USGS 2019 as referenced in MSRS 2022c, p. 5). The Service also understands that there are additional launch programs currently permitted that represent the existing water extraction baseline. However, the Space Force did not provide the total permitted extraction amounts. Without this information, the Service is unable to make clear quantifiable reference for how the proposed project would add to the existing baseline of water extraction. Consequently, additional monitoring and analysis would be necessary to understand the impacts of the proposed project's extraction levels in the event the existing baseline continues to overdraft over time.

Launch Noise and Overpressure

The Service anticipates that launch and static test fire events have the potential to create associated ground vibration within the vicinity of SLC-4. We cannot anticipate the level of substrate vibration that the proposed project may produce at this time but assume conservatively that low levels of vibration may occur routinely for a short period (from 7 seconds to up to 2 mins every 3-4 days) during the operation of SLC-4. The Service assumes that potential launch related vibration may be of low frequency which attenuates less readily than high frequency (Norton et al. 2011, p. 658). We have no specific data on the response of California red-legged frogs to varying levels or duration of exposure to launch operation vibration. We consequently use available research on the effects of vibration on related anurans (frogs) as a surrogate. In a laboratory study, researchers investigated the effects of low frequency vibrations on early embryonic development of African clawed frog (*Xenopus laevis*). The study demonstrated that vibrating embryos in petri dishes overnight during the embryo development process at 3 low frequency levels (7, 15, and 100 hertz) induced significant levels of physiological effects (heterotaxia defined by the abnormal position of the heart, gall bladder, and/or gut loop), with some treatments inducing neural tube defects as well as bent tail morphology (Vandenberg et al.

2012, pp. 3-5). Other research has demonstrated negative effects of anthropogenic vibration on anuran communication. Researchers carried out field based vibratory playbacks during 13 days from sunset until dawn when male common midwife toads (*Alytes obstetricans*) were calling. During vibratory playback stimuli, call rate of the common midwife toad significantly decreased with a smaller number of toads ceasing calling activity completely or abandoning their calling sites (Caorsi et al. 2019, p. 2). These findings suggest that if launch related vibration occurs during the breeding season, routine exposure to low frequency vibration may adversely affect California red-legged frogs and has the potential to negatively impact breeding success during launch operations. Launch operations on SLC-4 would occur within approximately 1.5 miles of California red-legged frog breeding habitat within Bear Creek. However, the biological assessment did not provide vibration modeling for the purposes of this assessment. The Service cannot anticipate the specific vibration levels that the proposed project may produce but understands short duration vibration could occur up to 84 times a year considering 36 launches, 36 static test fires, and 12 sonic booms. Although more information is needed to predict the magnitude of potential effects, the Service assumes that the proposed project would generate short term, infrequent vibration and the project site is located a sufficient distance from California red-legged frog breeding habitat to preclude any associated effects that would result from routine vibration.

The proposed project's increased frequency of launch operations would produce noise and overpressure levels that may adversely affect California red-legged frogs. There are no studies on the effects of noise and overpressure on California red-legged frogs, but available literature on the effects of noise disturbance on anurans in general has grown in recent years (Zaffaroni-Caorsi et al. 2022, entire). A previous study reviewed the effects of noise exposure on American bullfrogs (*Lithobates* (*Rana*) *catesbeianus*), which are closely related to California red-legged frogs. Although no specific acoustic thresholds were determined during the study, researchers exposed American bullfrogs to sound levels greater than 150 dB SPL for 20 to 24 hours straight, which produced observable damage to their inner ears (Simmons et al. 2014a, p. 1629). American bullfrogs' inner ears showed physical signs of recovery between 3 to 9 days after noise exposure (Simmons et al. 2014b). A moderate population of breeding California red-legged frogs are known to occur approximately 0.75 mile northeast of SLC-4 within Bear Creek and 2 miles south within Honda Creek. A larger population of California red-legged frogs is located approximately 4 miles north within the Santa Ynez River. The biological assessment indicates that California red-legged frogs would receive noise and overpressure levels of 128 dB SPL_{max} and 4 to 5 psf at Bear Creek, 123 dB SPL_{max} and 2 to 3 psf at Honda Creek, and 118 dB SPL_{max} and 1.5 to 2 psf at the Santa Ynez River. Any California red-legged frogs present in upland habitat near SLC-4 may experience modeled noise levels of 150 dB SPL_{max} with overpressure up to 8.5 psf (MSRS 2022a, p. 53). California red-legged frogs within these features and throughout the remainder of the Launch Noise Effect Area would experience routine (approximately for 1 to 2 minutes multiple times a month) noise levels between 100 to 150 dB SPL_{max} as a result of the proposed project. Within the Overpressure Effect Area, California red-legged frog populations would also experience overpressure levels between 0.5 to 8.5 psf up to twelve times a year, separated by a minimum of 8 days, as a result of boost-back landings on SLC-4. Although the proposed project's maximum noise levels are only slightly lower than those documented to produce observable damage to American bullfrog ears, the duration of the noise events would be much shorter than the exposure duration used in this study. However, the specific acoustic thresholds of California red-legged frog are unknown. If the proposed project's noise levels did result in hearing damage to California red-legged frogs, it may temporarily deafen them. The Service assumes the California red-legged frog inner ear recovery period may be similar to the 3- to 9-day recovery period exhibited by American bullfrogs. If the proposed project's noise levels physically damage the inner ears of California red-legged frog and given that the project's noise events may occur six times a month when considering launches and static test fires, this may lead to routine deafening. Routine deafening of a substantial portion of breeding populations within Bear Creek, Honda Creek, and the Santa Ynez River may alter California red-legged frogs' ability to effectively communicate across the breeding season when frogs are calling with the potential to result in overall lower likelihood of reproductive success. California red-legged frogs that exhibit hearing loss may have a decreased ability to detect danger which increases their risk of predation.

However, without refined specific acoustic threshold information, the Service is unable to determine if the proposed project will result in routine deafening of the specified California red-legged frog populations. The Service considers that although specific acoustic thresholds are not available, the American bullfrog surrogate study used higher noise levels (greater than 150 dB) with significantly longer exposure duration (20 to 24 hours). The same study reported that shorter duration (4 hours) of levels below 150 dB did not produce observable morphological damage (Simmons et al. 2014b). Further, noise modeling for the proposed action did not account for topography, and it is possible that surrounding topographic features may serve to attenuate or enhance noise levels produced from the proposed project (Bermingham 2013, pp. 19-21). The incised topography associated with Honda Canyon for example may influence the received noise levels produced by the proposed action within Honda Creek. The Space Force has suggested this may result in lower levels within the action area than what noise modeling predicted in the biological assessment (MSRS 2021, p. 51). Past noise monitoring indicates that the sonic boom recorded during a boost-back produced realized instantaneous noise levels of 135 dB SPL_{max} within Honda Creek. The Service assumes that levels lasted less than 1 second. These levels are higher than what is discussed within the biological assessment (MSRS 2022b, p. 4, MSRS a, p. 53). However, the specific acoustic thresholds for California red-legged frog are unknown and the Service does not anticipate physiological effects to the inner ears of California red-legged frog at this time due to the considerably shorter duration of the project's anticipated noise disturbance events. Being that observed call rate changes could be correlated with hearing loss, the Service has reviewed the Space Force's previous short-term California red-legged frog call rate monitoring conducted following a single Falcon 9 launch event (MSRS 2022b, entire; MSRS 2023, pp. 12, 15-16). Although monitoring documented notable increases in call rate following an individual launch, data was collected over an insufficient time period (six days) to be able to analyze results in a meaningful manner. The Service has determined that significantly more monitoring information is necessary. To address the need for better information and the potential for effects, the Space Force will implement annual long-term, passive bioacoustic monitoring during the California red-legged frog breeding season at Honda Creek to characterize the baseline noise environment and determine if there are changes to call rate that may indicate inner ear damage (AM-4 and 5). This additional monitoring will help detect changes in calling behavior to ensure consistency with this analysis.

In addition to call rate, changes in other signal characteristics including amplitude, frequency, duration, and complexity may be impacted with the introduction of novel noise disturbance. Changes (increases or decreases) to an individual's signal characteristics may represent energetic and vocal performance trade-offs. Receiver interpretation of altered signals may influence assessment of signaler quality. This may have implications on the long-term fitness of anuran populations which rely heavily on acoustic signals to attract females and to defend resources against rivals. Previous research looking at traffic noise has demonstrated a trade-off between call rate and call duration in *Hyla versicolor* (Schwartz et al. 2002). Females were found to prefer calls that were delivered at high rates with longer durations (Gerhardt et al. 1996; Gerhardt and Brooks 2009), suggesting that environmental factors that influence the tradeoff of call rate and call duration may potentially impact overall fitness over the long-term. Multiple related frog species have been shown to alter call amplitudes during motorbike noise exposure (Cunnington and Fahrig 2010). The energetic costs of calling increases exponentially with call amplitude with an approximate doubling in energetic cost for each 3 dB increase in amplitude (Parris 2002). Previous work suggests that increased energetic costs of calling may inhibit growth rate as a result of allocating more energy towards call effort (Given 1988). This may result in lower reproductive output (Gibbons and McCarthy 1986) and increased risk of desiccation (Heatwole et al. 1969 as referenced in Yi and Sheridan 2019) both of which can lead to decreases in population size. Potential changes in signal frequency could also reduce transmission distance and overall reduce signal efficiency. In bird species, adjustments in signal frequency can decrease song complexity which can profoundly affect reproductive success (Montague et al. 2013). Few studies have considered the long-term implications of adjusted signaling performance in anurans and more information is needed to understand how changes in signal characteristics may impact anuran populations over the long term.
Similarly, overpressure associated with sonic booms may directly and indirectly impact all California red-legged frogs in the action area by altering their behaviors. California red-legged frog populations are anticipated to experience overpressure levels of 4 to 5 psf at Bear Creek, 2 to 3 psf at Honda Creek, 1.5 to 2 psf at the Santa Ynez River as a result of the proposed project. Any dispersing California red-legged frogs present in upland habitat near SLC-4 may experience modeled overpressure of up to 8.5 psf. California red-legged frogs within these features and throughout the remainder of the Overpressure Effect Area, would experience overpressure levels between 0.5 to 8.5 up to twelve times a year as a result of Falcon 9 landings on SLC-4 as was previously analyzed in the 2017 biological opinion. California red-legged frogs may react to individual project related launch noise and overpressure created by sonic booms by startling or remaining immobile making them more susceptible to predation or desiccation. They may also react to launch related disturbances by diving into water or retreating away from the affected areas. In the 2017 biological opinion, we did not expect project-related noise to induce a behavioral response greater than momentary startling or freezing by individual frogs from noise

levels as high as 146 dB and overpressure as high as 8.5 psf (Service 2017, pp. 48-49). The previous analysis considered relatively infrequent disturbance of up to 1 to 2 minutes once a month. However, the proposed project would subject California red-legged frogs to more frequent launch related disturbances and consequently may result in novel adverse effects as a result of chronic acute stress.

In certain frog species, acute stress has been shown to induce an immediate increase in stress hormone (corticosterone) production (Hammond et al. 2018). Chronic stress, such as frequent exposure to noise and overpressure disturbance, can cause chronically high levels of stress hormone (Troïanowski et al. 2017). Prolonged elevated stress hormone concentrations can have deleterious effects on growth, survival, reproduction, and immune function (Sapolsky et al. 2000; Tennessen et al. 2014). Relatively recent research demonstrates that increases in advertisement calling rate may be correlated with stress hormone production, which can result in an overall tradeoff in energy otherwise allocated for immunocompetence (Troïanowski et al. 2017; Park and Do 2022). Research has documented cases of anuran spatial displacement in response to traffic noise playback experiments (Caorsi et al. 2017, pp. 9, 14), with different movement effects depending on land cover type (Nakano et al. 2018, entire). Somewhat conversely, it has been suggested that noise can trigger tonic immobility, a paralysis-like fear response, in anurans as a result of increased stress levels (Tennessen et al. 2014, p. 6) which may make them more vulnerable to predation. Stress incurred during the wet season, when California red-legged frogs are more active, may magnify the effect of these behavioral responses by altering breeding behaviors such as migration and calling. However, no specific thresholds of disturbance level or frequency are known. The Service considers that although the project may result in effects to dispersal behavior, calling, and stress hormone accumulation that could have deleterious physiological effects, until the novel effects of the project activity are studied, we are unable to adequately anticipate the magnitude of any specific response at this time.

California red-legged frogs would be startled between 6 to 9 times a month as a result of the proposed project alone when considering that each launch would include a static test fire and could include a terrestrial landing. When reviewing the proposed project in addition to other active/permitted launch programs (collectively totaling 129 to 217 launch related disturbance events between the Santa Ynez River and Honda Creek; MSRS 2022b, p. 76), the Service understands that launch activities would startle California red-legged frogs in these areas frequently each month, although the Space Force has clarified that multiple launch related disturbance events would not occur on the same day (Kaisersatt, pers. comm. 2023c). The Service anticipates the potential for long-term effects from chronic stress caused by routine intermittent acute noise from the proposed project's launch disturbance. These may include long-term population level effects including reduced reproductive success, survival, fitness, and spatial displacement. Although we do not have an estimated survivorship of displaced California red-legged frogs, this could result in injury or death to individuals as a result of increased intraspecific competition, lack of familiarity with new locations of potential breeding, feeding, and sheltering habitats, and increased risk of predation. However, it is unknown how California red-legged frogs would react to repetitive launch events of variable disturbance levels with increasing frequency. Improved monitoring information is needed to help identify thresholds that quantify what level of noise or frequency of disturbance would elicit stress hormone responses that may lead to impacts to breeding and reproduction or other negative population level effects.

The Space Force provided preliminary audiogram analysis which suggests there would not be overlap in the species' hearing sensitivity and low frequency noise produced by rocket launches. Specifically, the provided audiogram analysis suggests that California red-legged frog may only be able to perceive a portion of the launch noise, hearing less than 25 dB across the entire launch event (MSRS 2022d, pp. 55-56). However, subsequent subject matter expert review indicates the provided hearing curve and corresponding weighting function are not established and there is still significant uncertainty around the hearing capabilities of California red-legged frog (J. Tennessen, pers. comm., 2022). Referencing current best available information, specific disturbance levels and frequency thresholds that may impact California red-legged frogs are unknown. Consequently, the Service cannot adequately determine the anticipated effects of the proposed project's 84 launch disturbance events on the residential and breeding California red-legged frog populations within Bear Creek, Honda Creek, the Santa Ynez River, and dispersing individuals across the remainder of the action area.

The proposed project has the potential to contribute to long-term adverse effects that result from routine intermittent acute noise disturbance. The Service understands that the proposed project would contribute to the frequency of an existing launch disturbance baseline. Over the past five years, VSFB has supported an average of 6.2 rocket launches per year with a maximum of 17 in 2022. However, other proponents have recently initiated several adjacent launch programs within the vicinity of SLC-4. Of these, those that will have noise impacts on Honda Creek, Bear Creek, and/or the Santa Ynez River of at least 100 dB SPL_{max} include Phantom Daytona-E (SLC-8) and Minotaur (SLC-8), Phantom Daytona-E/Laguna-E (SLC-8), ULA Vulcan (SLC-3), Blue Origin New Glenn (SLC-9), and Relativity Terran 1 (SLC-11). If all these programs, achieve full launch tempo by 2028, the total number of launch disturbance events over 100 dB SPL_{max} would be up to 169 within the action area. With the addition of the proposed project, this permitted total would raise to 217 launch disturbance events. Consequently, the proposed project would constitute approximately one third of the permitted total. Currently, no specific information is available on California red-legged frog response to specific launch disturbance thresholds at certain temporal frequency. Using the best available information, the Service considers that related amphibians demonstrate sensitivity to noise disturbance at certain thresholds. However, the Service cannot adequately determine how the proposed project's 84 launch disturbance events would contribute to the existing launch baseline average of 6.2 events or the current permitted annual launch baseline of up to 169 events. The Service considers that although the project has the potential to significantly contribute to the collective effects of the existing and permitted launch disturbance baseline and result in long-term population level effects, until the novel effects of the project activity are studied, we are unable to anticipate the magnitude of response at this time.

Following review of the effects of the proposed action, the Service anticipates the proposed project would likely result in the sustained degradation in the quality of adjacent California red-legged frog aquatic and dispersal habitat due to associated noise and overpressure disturbance from routine launching. The proposed project also has the potential to constitute population level effects over time. The potential mitigation actions for California red-legged frog include the creation of new breeding habitat at a 2:1 ratio (habitat enhanced: habitat affected) within the San Antonio Creek Oxbow Restoration 'expansion area' (Appendix A, Figure 4a). Mitigation actions that may occur as result of the project include site preparation via herbicide application, plowing, container plant installation, seeding, willow pole planting, and watering via water truck. These activities have the potential to effect California red-legged frog. An existing biological opinion (2016-F-0103; Service 2018) addresses the associated effects of this portion of the proposed action for California red-legged frog, and the Space Force will implement all required avoidance, minimization, and monitoring measures. The Space Force has formerly conducted restoration work over the past three years at this site to improve San Antonio Creek California red-legged frog habitat. The Space Force indicates that restoration methods have proven successful at creating deep water aquatic habitat suitable for California red-legged frog breeding and riparian woodland that simulate naturally occurring high-flow channels. However, previous survey efforts have not yet detected California red-legged frog at this site or demonstrated that California red-legged frog will newly colonize these areas for breeding (Evans 2022, p. 4; Kephart 2022b, p. 2). The Service considers the Space Force's commitment to continue to develop restoration methods to ensure the objectives of proposed mitigation are met and able to clearly demonstrate quantifiably that no net loss in occupied California red-legged frog habitat and population size, as stated in the Description of the Proposed Action above, will result from project activities (MSRS 2022a, p. 59).

Effects of the Proposed Action on the Western Snowy Plover

<u>Launch Operations</u>

Known western snowy plover nesting locations are approximately 0.8 mile northwest of the SLC-4 facility and extend within the northern portion of the Launch Noise Effect Area (Appendix A, Figure 1b). Western snowy plovers in this area would experience up to 36 launch events with noise levels between approximately 100 to 130 dB SPL_{max}, up to 36 static fire events with noise levels between approximately 100 and 125 dB SPL_{max}, and up to 12 boost-back landings at SLC-4 with noise levels between 100 to 110 dB SPL_{max} (Appendix A, Figure 1b). Launch noise events (including boost-back landings) would last less than 1 minute and static fire noise events would last less than 7 seconds. Western snowy plovers in this area would also experience sonic boom overpressures between 1.5 to 5 psf during SLC-4 boost-back landings (Appendix A, Figure 2d). The biological assessment did not provide conversions of sonic boom overpressure into instantaneous noise disturbance (SPL_{max}) for the proposed project; however, the Service utilized past monitoring results of Falcon 9 launches and boost-backs at SLC-4 for comparison which ranged from 135.8 to 138.8 SPL_{max} at the western snowy plover monitoring location on South Surf Beach (Robinette and Rice 2019, p. 14, 2022, p. 13). The Service assumes the proposed project will have similar sonic boom disturbance levels as it is the same launch vehicle from the same location. Using the information provided and for the purposes of this analysis, the Service assumes 84 launch related disturbance events would occur annually with no more than 12 sonic booms affecting western snowy plovers at VSFB (36 launch events, 36 static fire events, and 12 sonic boom events that include both noise and overpressure disturbances totaling 84 potential disturbance events).

The Space Force conducted prior monitoring of western snowy plovers during individual launches to understand immediate impacts from launch related noise events. Biologists monitored nesting western snowy plovers on April 17, 2022, during a SpaceX Falcon 9 NROL-85 with boost-back at 137 dB SEL from SLC-4E, located approximately 0.9 mile from western snowy plover habitat. Although monitoring did not capture behavioral responses, the biologists reported no detectable effects on abundance or nest attendance of western snowy plover after this single launch (Point Blue Conservation Science 2022, p. 1). Biologists also monitored western snowy plovers during a Titan IV launch at 130 dBA from SLC-4E and observed no adverse reactions from western snowy plovers due to the launch (SRS 2006, as cited in MSRS 2022a, pp. 63–64). However, after a launch event during the 1998 western snowy plover breeding season of a Titan II from SLC-4W at 119 dB, monitors found one of three eggs broken in the nest located closest to the launch facility. The cause of the damaged egg was not determined (Applegate and Schultz 1998, as cited in MSRS 2021, p. 54).

On June 12, 2019, the SpaceX Falcon 9 boost-back from SLC-4 created an estimated sonic boom overpressure of 3.63 psf which converts to an instantaneous noise disturbance of 138 dB SPL_{max} and 130 dB SEL at the western snowy plover monitoring location on South Surf Beach (Robinette and Rice 2019, p. 14). They noted that incubating western snowy plovers did not react to the sound produced by the launch; however, they did react to the sonic boom produced by the boost-back (Robinette and Rice 2019, pp. 1, 10). Biologists reported that incubating western snowy plovers startled and then either jumped or hunkered down in response to the sonic boom. One western snowy plover egg showed signs of potential damage; this egg was one of a three-egg clutch in which two of the eggs hatched. This can intermittently occur naturally for western snowy plovers; thus, biologists could not attribute egg damage to a western snowy plover reacting to the sonic boom, but they could not conclusively discount it either. Hatching rates were similar to those from previous years when no launches occurred. Biologists reported no difference in nest attendance or bird abundance before and after the launch and boost-back, and they concluded that this launch and boost-back did not significantly affect western snowy plover nesting on VSFB (Robinette and Rice 2019, pp. 1, 14–15).

More recently, biologists monitored the June 18, 2022 Falcon 9 SARah-1 mission with boost-back and first stage recovery at SLC-4 that created an estimated sonic boom overpressure of 2.57 psf which converts to an instantaneous noise disturbance of 135.8 dB SPL_{max} at the western snowy plover monitoring location on South Surf Beach (Robinette and Rice 2022, p. 13). They noted that incubating western snowy plovers reacted to both the launch and sonic boom produced by the return flight of the first-stage with more intense reactions to the sonic boom (Robinette and Rice 2022, p. 1). They observed a startle effect in response to the sonic boom for all five western snowy plover nests with cameras, and two of the five incubating birds hunkered down on their eggs in response to the sonic boom. Biologists note that it is possible the startle and hunker behavior observed can lead to damage to one or more eggs (Robinette and Rice 2022, p. 1). One western snowy plover egg at north Wall Beach (outside of the monitoring area) showed signs of potential damage in which it had a long crack. The damaged egg had an approximately three-week-old embryo that may have stopped developing around the time of the launch. However, it is common for one or more eggs from a successful nest to fail to hatch and there currently is no data on how often eggs undergo damage under normal (i.e., non-launch) circumstances. The nest with the damaged egg did not have a camera set on it, so biologists could not determine what caused the damage. Biologists reported no difference in nest attendance or bird abundance before and after launch and boost-back, and they concluded that this launch and boost-back did not significantly affect western snowy plover nesting on VSFB (Robinette and Rice 2022 pp. 1–2, 13).

These past monitoring results suggest that western snowy plovers exhibit some level of tolerance to high thresholds of sound pressure level and that they are nest tenacious during the breeding season (typically March 1 to September 30). However, the proposed action may result in short-term adverse effects including interruption of courtship or breeding activities, flushing from nests, interruptions in foraging, and behavioral reactions, such as head raising, body shifting, moving short distances, and flapping of wings. Startle responses during nesting may result in nest abandonment or dislodging of eggs from nest scrapes; adults may leave chicks unattended and vulnerable to elements or predation. We do not expect abandoned eggs and chicks to survive if adults do not return to the nest. Non-observable physiological responses of western snowy plover to noise disturbance may include an increased heart rate or altering of metabolism and hormone balance. These responses may cause energy expenditure, reduced feeding, habitat avoidance, reproductive losses, and bodily injury resulting in increased vulnerability to predation (Radle 2007, p. 5). Although we need more information on specific noise level and frequency thresholds that may impact western snowy plover at various stages during the breeding season, we anticipate the proposed project's noise disturbance to be of short duration (1 minute during launches and boost-backs and less than 7 seconds during static test fire events). Additionally, noise and overpressure modeling for the proposed action did not account for topography and consequently projected noise and overpressure levels are likely an overestimate as topographic features can attenuate noise (MSRS 2021a, p. 51, MSRS 2022a, p. 8). The SLC-4 area is approximately 400 feet above sea level.

Considering the increase in launch cadence, the proposed project has the potential to contribute to long-term adverse effects that result from routine intermittent acute noise disturbance. The Service understands that the proposed project would contribute to the disturbance frequency of the existing launch noise disturbance baseline. Over the past five years, VSFB has supported an average of 6.2 launches per year with a maximum of 17 in 2022. However, other proponents have recently initiated several adjacent launch programs within the vicinity of SLC-4. The Service has permitted existing noise disturbance events of at least 100 dB SPL_{max} across Surf

Beach within the proposed project's Launch Noise and Sonic Boom Effect Areas that affect the same populations of western snowy plover. If all these programs achieve full launch tempo by 2028, the total number of launch disturbance events over 100 dB SPL_{max} would be up to 189 that would impact South Surf Beach. The proposed project in combination with these other planned and permitted launch programs would produce a total of 237 noise disturbance events of at least 100 dB annually that would impact South Surf Beach (MSRS 2022a, p. 77). The biological assessment does not indicate if this includes static fire and sonic boom events so this number may be greater. Consequently, the proposed project would constitute approximately one third of the permitted total.

Although no information is available on western snowy plover response to specific noise disturbance thresholds at certain temporal frequency, western snowy plovers do appear to demonstrate sensitivity to frequent noise disturbance. Biological monitors reported that a 20-minute fireworks display (lower levels of more frequent acute noise; variable intermittent disturbances that ranged from 59 dB to 80 dB for 20 minutes) at Coal Oil Point Reserve in Goleta, California, visibly agitated western snowy plovers (BRC 2018, entire). Camera footage captured western snowy plovers displaying stress responses (i.e., shallow breathing, frantic head turning, flushing) during the noise events. Although this described disturbance profile is at dramatically lower levels than the proposed project and occurs significantly more frequently, we use this information as one of the best available references when considering the species tolerance thresholds for disturbance frequency. Chronically elevated stress hormone concentrations can have deleterious effects on species. Responses may cause energy expenditure, reduced feeding, reproductive losses, bodily injury resulting in increased vulnerability to predation, and habitat avoidance (Radle 2007, p. 5). Referencing current best available information, the Service cannot adequately determine the anticipated impacts of the proposed project's 84 disturbance events annually on the western snowy plover population at Surf Beach. Similarly, the Service cannot adequately determine how the proposed project's 84 disturbance events would contribute to the existing launch baseline average of 6.2 events or the current permitted annual launch baseline of up to 189 events. The Service considers that although the project has the potential to significantly contribute to the collective effects of the existing launch disturbance baseline and result in long term population level effects, until the novel effects of the project activity are studied, we are unable to anticipate the magnitude of response at this time.

The proposed project's disturbance frequency has the potential to displace western snowy plover populations, potentially stimulating migration away from noisy areas. Although we do not have an estimated survivorship of displaced western snowy plover, this could result in injury or death to individuals as a result of increased intraspecific competition, lack of familiarity with new locations of potential breeding, feeding, and sheltering habitats, and increased risk of predation. All of which reduces survivorship of displaced wildlife in general.

Potential mitigation actions for western snowy plover include predator control in the Predator Management Area (Appendix A, Figure 4b), including trapping, shooting, and tracking known western snowy plover predators with particular focus on raven removal at and adjacent to VSFB beaches. An existing biological opinion (8-8-12-F-11R; Service 2015a) analyzes and permits these actions, and the Space Force will implement all required avoidance, minimization, and monitoring measures. Additionally, the Space Force will continue pursuing other beneficial actions including recovery opportunities outlined in the western snowy plover recovery plan (Service 2007) and 5-year review (Service 2019b) following mutual agreement by the Service and the Space Force annually (MSRS 2022a, p. 67). The Service considers that the Space Force will continue to develop restoration methods to ensure they meet the objectives of the proposed mitigation and are able to clearly demonstrate quantifiably that no net loss in occupied western snowy plover habitat and population size, as stated in the Description of the Proposed Action above, will result from project activities (MSRS 2022a, p. 67).

Due to the location of the SLC-4 facility in relation to the subject western snowy plover habitat on Surf Beach, western snowy plovers may experience visual disturbance from launch operations. We expect effects would not be greater than the noise disturbance effects occurring simultaneously as described above.

Effects of the Proposed Action on the California Least Tern

Launch Operations

The known California least tern nesting location at Purisima Point is approximately 8 miles north of the SLC-4 facility and the known roosting location at the Santa Ynez River lagoon is approximately 3.7 miles north of the SLC-4 facility, both within the northern portion of the Launch Noise Effect Area (Appendix A, Figure 1c). California least terns at Purisima Point would experience noise levels of approximately 108 dB SPL_{max} during launch events, 102 dB SPL_{max} during static fire events, and less than 80 dB SPL_{max} during boost-back landings at SLC-4 (Appendix A, Figure 1c). Launch noise events (including boost-back landings) would last less than 1 minute and static fire noise events would last less than 7 seconds. California least terns in this area would also experience sonic boom overpressures between 1 to 3 psf during SLC-4 boost-back landings (Appendix A, Figure 2e). The biological assessment did not provide conversions of sonic boom overpressure into instantaneous noise disturbance (SPL_{max}) for the proposed project; however, the Service utilized past monitoring results of Falcon 9 launches and boost-backs at SLC-4 for comparison which ranged from 128.6 to 135.9 SPL_{max} at the California least tern monitoring location at Purisima Point (Robinette and Rice 2019, p. 14, 2022, p. 13). The Service assumes the proposed project will have similar sonic boom disturbance levels as it is the same launch vehicle from the same location. California least terns at the Santa Ynez River lagoon would experience noise levels of approximately 115 dB SPL_{max} during launches, 110 dB SPL_{max} during static fire events, and less than 80 dB SPL_{max} and a 1.5 to 4 psf sonic boom overpressure during boost-back landings at SLC-4.

Using the information provided and for the purposes of this analysis, the Service assumes 84 launch related disturbance events would occur annually with no more than 12 sonic booms affecting California least terns at VSFB. However, the Space Force includes that due to time requirements for refurbishing vehicle components, payload preparation, and site preparation, only approximately 12 of the proposed 36 annual launches would overlap the period when California least tern are typically present at VSFB (April 15 through August 15), resulting in California least terns potentially experiencing 12 launches and 12 static fire events (MSRS 2022a, p. 57). The Space Force did not indicate the number of boost-back landings that may occur while California least tern are present, so the Service assumes they may experience up to 12 boost-back landings which includes noise and overpressure disturbances. The 12 launches, 12 static fire events, and 12 sonic boom events total to 36 potential disturbance events that may impact California least terns. The 2017 biological opinion also authorized 36 potential disturbance events, but this was over the course of a year with one launch/static fire event/sonic boom per month. In this reinitiation, these 36 disturbance events are over the course of a 4-month nesting season with up to 3 launches/static fire events/sonic booms per month.

Although pre- and post-launch monitoring have reported variable responses to launch noise, California least terns have shown substantial launch related disturbance during the breeding season (typically April 15 to August 15). Two Delta II launches occurred in May and July of 1997 at SLC-2, located 0.4 mile east of Purisima Point, and subjected the California least tern breeding site to sound levels greater than 124 dB. During California least tern monitoring, biologists observed abandonment of up to five nests and the death of a chick due to exposure (BioResources 1997, pp. 13, 21). These two Delta II launches reduced reproductive success of the 1997 breeding season (Service 2015c, p. 123). Additionally, Delta II launches from SLC-2 in 2002 and 2005, when California least terns were arriving at the colony, may have caused temporary or permanent emigration from the colony as attendance decreased following the launches (Robinette et al. 2003, p. 17; Robinette and Rogan 2006, pp. 15, 19). For comparison, the Space Force characterized the sound profile for launch noise generated by this Delta II vehicle at SLC-2 at the Purisima Point nesting colony during the April 1999 launch. Sound reaching the recording site had an unweighted peak of 135.5 dB (SRS 1999, as cited in MSRS 2021a, p. 52). For the purpose of this analysis, when actual sound levels were not provided, the Service assumes Delta II vehicles produced this same sound level at the Purisima Point nesting colony as it is the same vehicle at the same launch pad and is reasonably expected to have produced similar sound levels at the Purisima Point colony. Also of note, SLC-2 is significantly closer than SLC-4 to the California least tern nesting colony, and thus launches from SLC-4 would have a reduced visual disturbance on the nesting colony. The 1997, 2002, and 2005 Delta II launches that resulted in nest abandonment and potentially temporary or permanent emigration from the colony, do have similar noise impacts as the sonic boom noise levels anticipated from the proposed action; however, the Delta launch noise that produced impacts occurred over a period of minutes while the proposed project’s sonic boom would be instantaneous.

In contrast to the above launches, monitoring of non-breeding California least tern for the June 2007 Delta II launch, and monitoring of nesting California least tern during the June 2008 and June 2011 Delta II launches did not document any mortality of adults, young, or eggs, or any abnormal behavior as a result of the launches (MSRS 2007, 2008, 2011, as cited in MSRS 2021a, p. 52). These launches also occurred at SLC-2, and consequently the Service assumes they generated comparable noise levels to the 1999 Delta II sound profile discussed above. Additionally, on June 12, 2019, the SpaceX Falcon 9 boost-back created an estimated sonic boom overpressure of 2.66 psf which converts to an instantaneous noise disturbance of 135.9 SPL_{max} and 127.7 dB SEL at the California least tern monitoring location at Purisima Point. Biologists reported that incubating California least terns began flushing off their nests before they heard the sonic boom from the boost-back landing in the video and that it is possible the birds were reacting to boost-back noise not captured by the video or to something unrelated. All California least terns returned to their nests within minutes after the boost-back. They did find one California least tern egg damaged, and although they could not attribute the egg damage to a California least tern reacting to the sonic boom, they could not conclusively discount it either. Hatching rates were similar to those from previous years when no launches occurred. Biologists reported no difference in nest attendance or bird abundance before and after the launch and boost-back, and they concluded that this launch and boost-back did not significantly affect California least terns nesting on VSFB (Robinette and Rice 2019, pp. 1, 14–15).

More recently, biologists monitored California least tern for the June 18, 2022 Falcon 9 SARah-1 mission with boost-back and first stage recovery at SLC-4 that created an estimated sonic boom overpressure of 1.1 psf which converts to an instantaneous noise disturbance of 128.6 dB SPL_{max} at the California least tern monitoring location at Purisima Point (Robinette and Rice 2022, p. 13). They noted that incubating California least tern reacted to both the launch and sonic boom produced by the return flight of the first-stage with more intense reactions to the sonic boom (Robinette and Rice 2022, p. 1). They observed a response to the launch and sonic boom for all five California least tern nests with cameras in which reactions ranged from alert with minor head movements to a startle effect (i.e., calm before the sonic boom with a jolt and quick head movements when the sonic boom hit). One incubating adult displayed a startle effect and lifted both wings slightly as the boom sounded; however, all California least terns remained on their nests for both the launch and sonic boom (Robinette and Rice 2022, p. 9). Notably, however, 38 non-incubating California least terns flushed in the background of cameras in response to the launch and sonic boom disturbances (Robinette and Rice 2022, p. 10). Biologists reported no difference in nest attendance or bird abundance before and after launch and boost-back, and they concluded that this launch and boost-back did not significantly affect California least tern nesting on VSFB (Robinette and Rice 2022 pp. 1–2, 13).

These past monitoring results suggest that California least tern response to noise is related to timing within the nesting cycle and that launch operations that occur during the breeding season, particularly the early courtship season, may disturb nesting. At the beginning of the nesting season when California least tern are arriving at the breeding colony, noise occurrences seem to disturb adults more easily, but once courtship and nest-tending begins, the adults are more tenacious (MSRS 2021a, p. 52). Additionally, studies show that a closely related species, the crested tern (*Sterna bergii*), began to exhibit startle responses at approximately 85 dBA of aircraft noise when exposed for 30 seconds to 35 seconds (Brown 1990, pp. 587–588). Considering this and past monitoring reports, we expect the nesting colony at Purisima Point and the foraging California least terns at the Santa Ynez River lagoon may startle if projected noise levels occur. We expect the proposed action could result in short-term adverse effects including interruption of courtship or breeding activities, flushing from nests, interruptions in foraging, and behavioral reactions, such as head raising, body shifting, moving short distances, and flapping of wings. Startle responses during nesting may result in nest abandonment or dislodging of eggs from nest scrapes; adults may leave chicks unattended and vulnerable to elements or predation. We do not expect abandoned eggs and chicks to survive if adults do not return to the nest. Non-observable physiological responses of California least tern to noise disturbance may include an increased heart rate or altering of metabolism and hormone balance. These responses may cause energy expenditure, reduced feeding, habitat avoidance, reproductive losses, and bodily injury resulting in increased vulnerability to predation (Radle 2007, p. 5).

Although we need more information on specific noise level and frequency thresholds that may impact California least tern at various stages during the breeding season, we anticipate the proposed project's noise disturbance to be of short duration (1 minute during launches and boost-backs and less than 7 seconds during static test fire events). Additionally, noise and overpressure modeling for the proposed action did not account for topography and consequently projected noise and overpressure levels are likely an overestimate as topographic features can attenuate noise (MSRS 2021a, p. 51, MSRS 2022a, p. 8). The SLC-4 area is approximately 400 feet above sea level. However, several factors can play a part in the overall stability of a nesting colony including past reproductive success, food availability, and the size of the colony (Robinette et al. 2003, pp. 25–26). California least terns are more likely to return to a colony that experienced good reproductive success in the past and that had an adequate food source, and larger colonies tend to be more stable than smaller colonies (Robinette et al. 2003, pp. 25–26). Thus, even though later in the nesting season adults may exhibit more tenacity, there are other factors that could contribute to instability within the colony.

Considering the increase in launch cadence, the proposed project has the potential to contribute to long-term adverse effects that result from routine intermittent acute noise disturbance. The Service understands that the proposed project would contribute to the disturbance frequency of the existing launch noise disturbance baseline. Over the past five years, VSFB has supported an average of 6.2 launches per year with a maximum of 17 in 2022. However, other proponents have recently initiated several adjacent launch programs within the vicinity of SLC-4. The Service has permitted existing noise disturbance events of at least 100 dB SPL_{max} across Purisima Point and the Santa Ynez River lagoon within the proposed project's Launch Noise and Sonic Boom Effect Areas that affect the same populations of California least terns. If all these programs achieve full launch tempo by 2028, the total number of launch disturbance events over 100 dB SPL_{max} would be up to 47 annually that would impact Purisima Point and the Santa Ynez River lagoon (MSRS 2022a, p. 77). The biological assessment does not indicate if this includes static fire and sonic boom events so this number may be greater. Consequently, the proposed project would constitute approximately half of the permitted total.

Referencing current best available information, the Service cannot adequately determine the anticipated impacts of the proposed project's 36 disturbance events annually on the California least tern population at Purisima Point and the Santa Ynez River lagoon. Similarly, the Service cannot adequately determine how the proposed project's 36 disturbance events would contribute to the existing launch baseline average of 6.2 events or the current permitted annual launch baseline of up to 47 events. The Service considers that although the project has the potential to significantly contribute to the collective effects of the existing launch disturbance baseline and result in long term population level effects, until the novel effects of the project activity are studied, we are unable to anticipate the specific response at this time.

The proposed project's disturbance frequency has the potential to displace California least tern populations, potentially stimulating migration away from noisy areas. Although we do not have an estimated survivorship of displaced California least tern, this could result in injury or death to individuals as a result of increased intraspecific competition, lack of familiarity with new locations of potential breeding, feeding, and sheltering habitats, and increased risk of predation. All of which reduces survivorship of displaced wildlife in general.

Potential mitigation actions for California least tern include predator control in the Predator Management Area (Appendix A, Figure 4b), including trapping, shooting, and tracking known California least tern predators with particular focus on raven removal at and adjacent to VSFB beaches. An existing biological opinion (8-8-12-F-11R; Service 2015a) analyzes and permits these actions, and the Space Force will implement all required avoidance, minimization, and monitoring measures. Additionally, the Space Force will continue pursuing other beneficial actions including recovery opportunities outlined in the California least tern recovery plan (Service 1970a) and 5-year reviews (Service 2006a, 2020b) following mutual agreement by the Service and the Space Force annually (MSRS 2022a, p. 69). The Service considers that the Space Force will continue to develop restoration methods to ensure they meet the objectives of the proposed mitigation and are able to clearly demonstrate quantifiably that no net loss in occupied California least tern habitat and population size, as stated in the Description of the Proposed Action above, will result from project activities (MSRS 2022a, p. 69).

Due to the location of the SLC-4 facility in relation to the subject California least tern habitat at Purisima Point and the Santa Ynez River lagoon, California least terns may experience visual disturbance from launch operations. We expect effects would not be greater than the noise disturbance effects occurring simultaneously as described above.

Effects on Recovery

California Red-legged Frog

We do not anticipate the proposed project to interfere with the specific recovery goals for Core Area 24 (Santa Maria-Santa Ynez River) provided in the Service's 2002 recovery plan for the species. Although the function of Honda Creek, Bear Creek, and the Santa Ynez River is not specified within the recovery plan, the recovery plan states the goal of protecting existing California red-legged frog populations within Core Area 24 (Service 2002, p. 75). Project operations create the potential for long-term population level effects and result in overall habitat degradation from routine and frequent launch disturbance events across a larger portion of occupied California red-legged frog breeding habitat within Bear Creek, Honda Creek, the Santa Ynez River, and potentially other portions of VSFB. We are unable to anticipate the magnitude of potential effects from increased launch frequency at this time with the available information.

We expect the proposed project is likely to adversely affect California red-legged frogs. Routine and frequent launch operations, the associated water release, and capture and relocation efforts may cause injury or mortality. However, based on the available information and minimization measures, including potential mitigation and the Space Force's commitment to ensure no net loss to the species, we expect adverse effects to the recovery of California red-legged frogs would be low. Although adverse effects are likely to occur as a result of the proposed action, we do not anticipate they will dimmish the VSFB population's contribution to the recovery of the California red-legged frog at this time.

Western Snowy Plover

We do not currently anticipate that the proposed project would interfere with the recovery goals provided in the 2007 recovery plan for the species (Service 2007, entire). The proposed project does not include any construction activities and thus will not remove any western snowy plover habitat; however, project operations create the potential for long-term effects that may result in overall habitat degradation across occupied western snowy plover breeding habitat at Surf Beach. Although potential long-term effects of increased launch noise disturbance frequency may occur, we are unable to anticipate the magnitude of potential effects at this time with the available information. With mitigation actions ensuring no net loss in place if the Space Force detects a population decline, we do not anticipate the proposed action will diminish the VSFB population's contribution to the recovery of the western snowy plover.

California Least Tern

We do not currently anticipate that the proposed project would interfere with the recovery goals provided in the 1985 recovery plan for the species (Service 1985, entire). The proposed project does not include any construction activities and thus will not remove any California least tern habitat; however, project operations create the potential for long-term effects that may result in overall habitat degradation across occupied California least tern breeding habitat at Purisima Point. Although potential long-term effects of increased launch noise disturbance frequency may occur, we are unable to anticipate the magnitude of potential effects at this time with the available information. With mitigation actions ensuring no net loss in place if the Space Force detects a population decline, we do not anticipate the proposed action will diminish the VSFB population's contribution to the recovery of the California least tern.

Summary of Effects

California Red-legged Frog

In summary, we expect adverse effects to California red-legged frog are likely to occur due to the proposed action. The project's associated flame bucket and deluge system may produce temporary high intensity flame and steam that could result in the injury or mortality of any California red-legged frogs within Spring Canyon during launch or test fire events. Given the previous negative survey findings that followed 11 individual launches, the Space Force will now require a Qualified Biologist to perform one California red-legged frog survey annually during peak breeding season (November to May) in Spring Canyon when individuals are most likely to be present and detectable. Avoidance measures employed during launches should reduce the potential for California red-legged frog death or injury; however, biologists may not detect some individuals during pre-activity surveys resulting in California red-legged frog death or injury. We expect such effects would occur infrequently.

Increased periods of standing water within the flame duct or v-ditch within SLC-4 associated with increased launch frequency may attract California red-legged frog to the area. We expect California red-legged frog may be injured or killed if attracted to and found within these features as a result of scalding water.

In the event enough soot or other similar launch related biproducts contact dispersing California red-legged frogs or enter adjacent occupied waterbodies, the Service assumes it has the potential to injure or kill California red-legged frogs due to their highly permeable skin and susceptibly to waterborne pollutants (Jung 1996, p. i; Llewelyn et al. 2019, p. 1). However, the Space Force references a comparable launch assessment (FAA 2020, entire) and expects that the actual amount of soot produced would be diminutive being that it would subsequently burn up in the exhaust plume (Kaisersatt, pers. comm., 2022b). The civil diversion structure and collection of fuel with absorbent pads should also reduce potential effects to California red-legged frogs by controlling potential exposure to launch related contaminants. Consequently, the Service assumes that the proposed project's launch biproducts are not likely to impact dispersing California red-legged frogs or their aquatic habitats.

The Space Force would authorize a maximum of 4.28 million gallons (13.1 acre-feet) of water extraction from San Antonio Creek Basin per year to support the project. Using provided information as well as existing hydrological modeling for reference, the Service does not anticipate measurable decline in the quality or overall extent of these associated habitats as a result of the annual extraction at this time although more information is needed.

Project operational noise, overpressure, and vibration from routine launching may induce long-term behavioral and physiological responses in California red-legged frog that may be present in the action area. Using the best available information, the Service does not anticipate routine deafening or physiological effects on California red-legged frog populations within occupied features on base at this time. However, the Service considers that portions of the base's population could experience negative effects that develop over the long term from routine exposure to sensory pollutants and subsequent chronic production of stress hormone. The Service considers that although the project has the potential to result in effects to dispersal behavior, calling, and stress hormone accumulation that may have deleterious physiological effects, until the novel effects of the project activity are studied, we are unable to anticipate the specific response at this time. The Service also cannot adequately determine the anticipated impacts of how the proposed project's disturbance events in combination with the existing permitted launch related disturbance baseline in the near vicinity may affect residential and breeding California red-legged frog populations. To address the need for better information, the Space Force will implement annual long-term, passive bioacoustic monitoring during the California red-legged frog breeding season to characterize the baseline noise environment and determine if there are unanticipated changes to calling behaviors (AM-4 and 5). In the event that call rate or population declines are observed, the Space Force will implement proposed mitigation and has ensured their goal to achieve no net loss of occupied California red-legged frog habitat and population size (MSRS 2022a, p. 59).

Following review of the effects of the proposed action, the Service anticipates the proposed project is likely to result in the sustained degradation in the quality of adjacent California red-legged frog aquatic habitat due to launch operations and associated sensory pollutants. The proposed project may result in population level effects over time. In the event the Space Force detects an unanticipated decline in California red-legged frog distribution and abundance across, not directly attributed to other factors (e.g., drought or wildfire), they will implement mitigation actions for California red-legged frog by creating new breeding habitat at a 2:1 ratio (habitat enhanced: habitat affected) within the San Antonio Creek Oxbow Restoration expansion area. The Service considers the Space Force's commitment to ensure they meet the objectives of the proposed mitigation and are able to clearly demonstrate that no net loss in occupied California red-legged frog habitat or population size has resulted from project activities.

Based on the available information and minimization measures, including potential mitigation ensuring no net loss, we expect adverse effects to the recovery of California red-legged frogs would be low. Although adverse effects are likely to occur as a result of the proposed action, we do not anticipate they will dimmish the VSFB population's contribution to the recovery of the California red-legged frog at this time.

<u>Western Snowy Plover</u>

In summary, we expect adverse effects to western snowy plover may occur due to the proposed action. Project operation noise and overpressure from routine launching may induce behavioral and physiological responses in western snowy plover that may be present in the action area. The Service cannot adequately determine the anticipated impacts of how the proposed project's launch disturbance events in combination with the existing launch disturbance baseline from other launch operations in the near vicinity may affect breeding western snowy plover populations located across Surf Beach until the novel effects of the project activity are studied. However, with mitigation actions in place ensuring no net loss if the Space Force detects a population decline, we do not anticipate the proposed action will diminish the VSFB population's contribution to the recovery of the western snowy plover.

California Least Tern

In summary, we expect adverse effects to California least tern may occur due to the proposed action. Project operation noise and overpressure from routine launching may induce behavioral and physiological responses in California least tern that may be present in the action area. The Service cannot adequately determine the anticipated impacts of how the proposed project's launch disturbance events in combination with the existing launch disturbance baseline from other launch operations in the near vicinity may affect breeding California least tern populations located across Purisima Point until the novel effects of the project activity are studied. However, with mitigation actions in place ensuring no net loss if the Space Force detects a population decline, we do not anticipate the proposed action will diminish the VSFB population's contribution to the recovery of the California least tern.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. We do not consider future Federal actions that are unrelated to the proposed action in this section because they require separate consultation pursuant to section 7 of the Act. We are unaware of any future State, tribal, local or private actions that are reasonably certain to occur in the action area.

CONCLUSION

The regulatory definition of "to jeopardize the continued existence of the species" focuses on assessing the effects of the proposed action on the reproduction, numbers, and distribution, and their effect on the survival and recovery of the species being considered in the biological opinion. For that reason, we have used those aspects of the California red-legged frog, western snowy plover, and California least tern status as the basis to assess the overall effect of the proposed action on the species.

California Red-legged Frog

Reproduction

The proposed project would not result in the physical loss of California red-legged frog breeding habitat. However, the proposed project may constitute sustained degradation of breeding habitat within Bear Creek, Honda Creek, and portions of the Santa Ynez River due to sensory pollutants (e.g., noise, overpressure, and potential for vibration) associated with the proposed action's increase in launch operations. Until the novel effects of the project activity are studied, the Service is unable to anticipate the specific response at this time using available information. If the proposed project's increased launch frequency demonstrates a reduction in reproductive success the Space Force indicates they will implement mitigation as described at the San Antonio Creek Oxbow Restoration expansion area to ensure no net loss in California red-legged frog occupied breeding habitat and overall population size. We expect the Space Force will demonstrate successful colonization and breeding within the San Antonio Creek Oxbow Restoration expansion area to offset potential project impacts at a 2:1 ratio. Should the Oxbow Restoration site not meet mitigation requirements depicted in the project description, we expect that the Space Force will implement other recovery objectives coordinated with the Service that quantifiably demonstrate no net loss to be consistent with this effects analysis. We consequently conclude that the proposed project would not reduce overall California red-legged frog reproduction on VSFB, in the Northern Transverse Ranges and Tehachapi Mountains Recovery Unit, or rangewide.

Numbers

We are unable to determine the exact number of California red-legged frogs that could occur in the action area that the proposed project may affect because existing survey data are insufficient to estimate population numbers, and the numbers of individuals in the action area likely vary from year to year. Proposed project activities could affect individual California red-legged frogs to the point of injury or death. Project operations may result in sustained stress on the California red-legged frog population within Honda Creek, Bear Creek, and portions of the Santa Ynez River that may reasonably cause cumulative sublethal effects that lead to gradual decline over the long term. Until the novel effects of the project activity are studied, the Service is unable to anticipate the specific response at this time using available information. The number of California red-legged frogs that the proposed activities may affect would constitute a moderate portion of the total VSFB population. However, we assume this number would be relatively small across the entirety of the species' range. Additionally, if the proposed project's increased launch frequency demonstrates a reduction in California red-legged frog numbers the Space Force will implement mitigation as described at the San Antonio Creek Oxbow Restoration expansion area to ensure no net loss in California red-legged frog abundance. We expect the Space Force will demonstrate successful colonization and subsequent species abundance within the San Antonio Creek Oxbow Restoration expansion area to offset impacts. Should the Oxbow Restoration site not meet mitigation requirements depicted in the project description, we expect that the Space Force will implement other recovery objectives coordinated with the Service that quantifiably demonstrate no net loss to be consistent with this effects analysis. Therefore, we conclude that the proposed project would not appreciably reduce the number of California red-legged frog on VSFB, in the Northern Transverse Ranges and Tehachapi Mountains Recovery Unit, or rangewide.

Distribution

The proposed project would likely constitute sustained degradation of occupied aquatic California red-legged frog habitat across the majority of the base including Honda Creek, Bear Creek, and the Santa Ynez River due to sensory pollutants (e.g., noise, overpressure, potential vibration) associated with the proposed action's operations. Until the novel effects of the project activity are studied, the Service is unable to anticipate specific response in potential distribution of California red-legged frog at this time using available information. If the proposed project's increased launch frequency demonstrates a reduction in species abundance and distribution in these features, the Space Force indicates they will implement mitigation as described at the San Antonio Creek Oxbow Restoration expansion area to ensure no net loss in occupied habitat. However, the proposed mitigation site is in north base, over ten miles from Honda Creek. The Space Force has not identified other locations of mitigation activities that may contribute to the Space Force's goal of no net loss at this time. Consequently, in the event the proposed project results in reduced occupation of California red-legged frog within Honda Creek, Bear Creek, or the Santa Ynez River, this may constitute a large reduction in the overall distribution of the species across south base and across the VSFB population as a whole. However, any observed reduction would not appreciably reduce the distribution across the Northern Transverse Ranges and Tehachapi Mountains Recovery Units, or rangewide. We consequently conclude that the proposed project may reduce California red-legged frog distribution in the action area and across VSFB but would not appreciably reduce distribution within the Northern Transverse Ranges and Tehachapi Mountains Recovery Unit, or rangewide.

Recovery

We do not anticipate that the proposed project would interfere with the specific recovery goals for Core Area 24 (Santa Maria-Santa Ynez River) provided in the Service's 2002 recovery plan for the species. Although the function of Bear Creek, Honda Creek, and the Santa Ynez River is not specified, the recovery plan states the goal of protecting existing California red-legged frog populations within Core Area 24 (Service 2002, p. 75). Using the available information and considering minimization measures, including potential mitigation ensuring no net loss, we expect adverse effects to the recovery of California red-legged frogs on VSFB would be low. We expect the Space Force will demonstrate successful colonization and subsequent species abundance within the San Antonio Creek Oxbow Restoration expansion area to offset impacts. Should the Oxbow Restoration site not meet mitigation requirements depicted in the project description, we expect that the Space Force will implement other recovery objectives coordinated with the Service that quantifiably demonstrate no net loss to be consistent with this effects analysis. Therefore, we conclude that the proposed action would not appreciably reduce the likelihood of recovery of the California red-legged frog on VSFB, in the Northern Transverse Ranges and Tehachapi Mountains Recovery Unit, or rangewide.

Conclusion

After reviewing the current status of the California red-legged frog, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the California red-legged frog, because:

1. We anticipate that project effects could reduce the reproductive success of California red-legged frogs at the local population level. However, the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss, the project would not appreciably reduce numbers of the California red-legged frog locally across VSFB, or rangewide.
2. We anticipate that project effects could reduce the number of California red-legged frogs at the local population level. However, the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss, the project would not appreciably reduce numbers of the California red-legged frog locally across VSFB, or rangewide.
3. The project has the potential to reduce the species' distribution locally across VSFB but is not anticipated to appreciably reduce the distribution rangewide.
4. We do not anticipate the proposed project would interfere with the specific recovery goals for Core Area 24 because of the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss. Consequently, the project would not cause any effects that would appreciably preclude our ability to recover the species.

Western Snowy Plover

Reproduction

Monitoring of nesting western snowy plovers for past individual launches have reported no difference in nest attendance or hatching rates compared to previous years when no launches occurred. Construction will not occur and thus will not remove any western snowy plover habitat; however, project operations create the potential for long-term effects that may result in overall habitat degradation across occupied western snowy plover breeding habitat at Surf Beach. Although potential long-term effects of increased launch noise disturbance frequency may occur, the Service is unable to anticipate the magnitude of potential effects at this time with the available information. In the event the Space Force detects a population decline, we expect the Space Force's proposed mitigation actions ensuring no net loss will quantifiably demonstrate successful offset of impacts to reproductive success to be consistent with this effects analysis. Consequently, we do not anticipate the proposed action will appreciably reduce the reproductive capacity of western snowy plover populations locally on VSFB or rangewide.

Numbers and Distribution

RU5 comprises nearly 40 percent of breeding western snowy plovers rangewide, and we expect the Space Force to continue managing and monitoring the VSFB population within RU5. Monitoring of nesting western snowy plovers for past individual launches have not reported notable differences in abundance or distribution. Although potential long-term effects of increased launch noise disturbance frequency may occur, the Service is unable to anticipate the magnitude of potential effects at this time with the available information. In the event the proposed project results in reduced occupation of western snowy plover at South Surf Beach, this would constitute a reduction in the overall distribution of the species across south base and across the VSFB population. However, with mitigation actions ensuring no net loss in place, any observed reduction would not appreciably reduce the numbers or distribution within RU5 or rangewide. We consequently conclude that the proposed project may reduce western snowy plover distribution in the action area and across VSFB, but we do not anticipate the proposed action will appreciably reduce the numbers or distribution of western snowy plover populations within RU5 or rangewide.

Recovery

When reviewing breeding window survey numbers from 2014 to 2022, VSFB contributed an average of approximately 216 breeding adults, which we anticipate is approximately 26 percent of RU5 and 10 percent of the range. Several sites do not record productivity data (fledglings per breeding male); however, larger sites within the range, including VSFB, meet or exceed the criteria of 1.0 fledgling per breeding male in most years. VSFB being a military installation is likely to continue having additional natural resource benefits as part of their Integrated Natural Resource Management Plan. The shape of the population trajectory of RU5 since 2007 is linear, positive, and gradual, with minimal annual fluctuation. With mitigation actions ensuring no net loss in place, we expect effects of the proposed action would not diminish these trends at VSFB, and consequences of the proposed action would not appreciably interfere with recovery goals or overall recovery of the western snowy plover.

Conclusion

After reviewing the current status of the western snowy plover, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the western snowy plover, because:

1. We anticipate that project effects could reduce the reproductive success of western snowy plover at the local population level. However, the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss, the project would not appreciably reduce numbers of the western snowy plover locally across VSFB, or rangewide.

2. We anticipate that project effects could reduce the number of western snowy plover at the local population level. However, the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss, the project would not appreciably reduce numbers of the western snowy plover locally across VSFB, or rangewide.
3. The project may reduce the species' distribution locally across VSFB but is not anticipated to appreciably reduce the distribution in RU5 or rangewide.
4. We do not anticipate the proposed project would interfere with the specific recovery goals for western snowy plover because of the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss. Consequently, the project would not cause any effects that would appreciably preclude our ability to recover the species.

California Least Tern

Reproduction

Monitoring of nesting California least tern for past individual launches have reported variable responses to launch noise disturbances. Construction will not occur and thus will not remove any California least tern habitat; however, project operations create the potential for long-term effects that may result in overall habitat degradation across occupied California least tern breeding habitat at Purisima Point. Although potential long-term effects of increased launch noise disturbance frequency may occur, the Service is unable to anticipate the magnitude of potential effects at this time with the available information. In the event the Space Force detects a population decline, we expect the Space Force's proposed mitigation actions ensuring no net loss will quantifiably demonstrate successful offset of impacts to reproductive success to be consistent with this effects analysis. Consequently, we do not anticipate the proposed action will appreciably reduce the reproductive capacity of California least tern populations locally on VSFB or rangewide.

Numbers and Distribution

VSFB supports only a small percentage of California's breeding population of California least tern; however, the population on VSFB remains significant as it is one of only three breeding colonies between Monterey and Point Conception, and we expect the Space Force to continue managing and monitoring the VSFB colony. Monitoring of nesting California least tern for past individual launches have not reported notable differences in abundance or distribution. Although potential long-term effects of increased launch noise disturbance frequency may occur, the Service is unable to anticipate the magnitude of potential effects at this time with the available information. In the event the proposed project results in reduced occupation of California least tern at Purisima Point, this would constitute a reduction in the overall distribution of the species across the VSFB population. However, with mitigation actions ensuring no net loss in place, any observed reduction would not appreciably reduce the numbers or distribution within VSFB or rangewide. We consequently conclude that the proposed project may reduce California least tern distribution in the action area and across VSFB, but we do not anticipate the proposed action will appreciably reduce the numbers or distribution of California least tern populations rangewide.

Recovery

Though VSFB has not achieved its recovery goals, a minimum of 20 breeding pairs annually and 1.0 fledgling per breeding pair, the rangewide numbers of California least terns have exceeded recovery goals of 1.0 fledgling per breeding pair for an overall population increase. Additionally, though threats of predation and food availability exist, we consider VSFB a secure and managed site with increasing reproductive success and suitable and occupied habitat. VSFB being a military installation is likely to continue having additional natural resource benefits as part of their Integrated Natural Resource Management Plan. With mitigation actions ensuring no net loss in place, we expect effects of the proposed action would not diminish these trends at VSFB, and consequences of the proposed action would not appreciably interfere with recovery goals or overall recovery of the California least tern.

Conclusion

After reviewing the current status of the California least tern, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the California least tern, because:

1. We anticipate that project effects could reduce the reproductive success of California least tern at the local population level. However, the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss, the project would not appreciably reduce numbers of the California least tern locally across VSFB, or rangewide.
2. We anticipate that project effects could reduce the number of California least tern at the local population level. However, the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss, the project would not appreciably reduce numbers of the California least tern locally across VSFB, or rangewide.
3. The project may reduce the species' distribution locally across VSFB but is not anticipated to appreciably reduce the distribution rangewide.
4. We do not anticipate the proposed project would interfere with the specific recovery goals for California least tern because of the Space Force's commitment to monitor and mitigate reductions of individuals to meet their proposed goal of no net loss.

Consequently, the project would not cause any effects that would appreciably preclude our ability to recover the species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened wildlife 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 in the definition of "take" in the Act means an act which actually kills or injures wildlife. Such [an] act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose 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.

For purposes of clarification, this incidental take statement supersedes the previous incidental take statement outlined within the 2017 biological opinion (Service 2017, pp. 62-65; 2017-F-0480).

AMOUNT OR EXTENT OF TAKE

California Red-legged Frog

We anticipate that some California red-legged frogs could be taken as a result of the proposed action. We expect the incidental take to be in the form of capture, injury, harm, and mortality. We cannot quantify the precise number of California red-legged frogs that may be taken as a result of the actions that Space Force has proposed because California red-legged frogs move over time; for example, animals may have entered or departed the action area since the time of pre-construction surveys. The protective measures proposed by Space Force are likely to prevent direct mortality or injury of most individuals during launch operation at SLC-4. In addition, finding a dead or injured California red-legged frog is unlikely. Consequently, we are unable to reasonably anticipate the actual number of California red-legged frogs that would be taken by the proposed project; however, we must provide a level at which formal consultation would have to be reinitiated. The Environmental Baseline and Effects Analysis sections of this biological opinion indicate that adverse effects to California red-legged frog may be moderate given the potential for moderate abundance of California red-legged frog in the vicinity of SLC-4 within Honda Creek, Bear Creek, and the Santa Ynez River. We, therefore, anticipate that take of California red-legged frogs may also be moderate. We also recognize that for every California red-legged frog found dead or injured, other individuals may be killed or injured that are not detected, so when we determine an appropriate take level, we are anticipating that the actual take would be higher, and we set the number below that level.

Similarly, for estimating the number of California red-legged frog that would be taken by capture, we cannot predict how many may be encountered for reasons stated earlier. While the benefits of relocation (i.e., minimizing mortality) outweigh the risk of capture, we must provide a limit for take by capture at which consultation would be reinitiated because high rates of capture may indicate that some important information about the species in the action area was not apparent (e.g., it is much more abundant than thought). Conversely, because capture can be highly variable, depending upon the species and the timing of the activity, we do not anticipate a number so low that reinitiation would be triggered before the effects of the activity were greater than what we determined in the Effects Analysis.

Therefore, the Space Force must contact our office immediately to reinitiate formal consultation if they observe any of the following scenarios during Launch Operations (Table 6):

i. The California red-legged frog established baseline within Honda Creek (AM-3) or Bear Creek (see Term and Condition 8) is 15 or more individuals and a greater than 20 percent (up to 8 frogs) decline is observed from the established baseline three years consecutively or on average across 5 years across operations;

ii. the California red-legged frog established baseline within Honda Creek (AM-3) or Bear Creek (see Term and Condition 8) is less than 15 individuals and a greater than 25 percent decline is observed from the established baseline three years consecutively or on average across 5 years of operations;

iii. the California red-legged frog established baseline within Santa Ynez River (see Term and Condition 8) is 100 or more individuals and a greater than 20 percent (up to 20 frogs) decline is observed from the established baseline three years consecutively or on average across 5 years across operations;

iv. the California red-legged frog established baseline within Santa Ynez River (see Term and Condition 8) is less than 100 individuals and a greater than 20 percent decline is observed from the established baseline three years consecutively or on average across 5 years across operations;

v. 3 adult or juvenile California red-legged frogs are found killed or wounded, including during capture and relocation, annually over the course of operations;

vi. and/or, 10 adults or juveniles are captured and relocated annually over the course of operations.

Project activities that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9.

Table 6. Summary of incidental take for the California red-legged frog life stages during Launch Operations of the proposed project revised during this reinitiation.

Life Stage	*Quantity during Operations*	*Type of Take*
Adults or juveniles (Within Honda or Bear Creek)	Scenario 1- If the Established Baseline* is greater than 15 individuals: 20% decline (up to 8 frogs) from established baseline three years consecutively or on average across 5 years. OR Scenario 2 – If the Established Baseline* is less than 15 individuals: 25% decline from established baseline three years consecutively or on average across 5 years.	Harm – Habitat modification disrupting sheltering/breeding
Adults or juveniles (Within Santa Ynez River)	Scenario 1- If the Established Baseline* is greater than 100 individuals: 20% decline (up to 20 frogs) from established baseline three years consecutively or on average across 5 years. OR Scenario 2 – If the Established Baseline* is less than 100 individuals: 20% decline from established baseline three years consecutively or on average across 5 years.	Harm – Habitat modification disrupting sheltering/breeding
Adults or juveniles	3 per year	Killed or wounded (including during capture and relocation)
Adults or juveniles	10 per year	Captures and relocation

*Established Baseline within monitoring plan described in AM-3 and Term and Condition 8.

Western Snowy Plover

We anticipate that all western snowy plovers present in the action area could be taken as a result of the proposed action. We expect the incidental take to be in the form of injure or kill if launch or sonic boom noise and/or overpressure disturb nesting to the degree of causing nest or chick abandonment, damage to eggs, or physiological responses that result in bodily injury; or harm from the potential degradation of suitable habitat resulting from increased frequency of noise disturbance associated with routine launch activities. We cannot quantify the precise number of individuals that may be taken due to fluctuations in population. Take may rise to a statistically significant level of decreased western snowy plover occupancy, nesting establishment, or nesting success from the established baseline across the entirety of Surf Beach. We anticipate that if the Space Force observes any decline that proposed mitigation efforts will be effective in offsetting the impact and will result in no net loss to the species.

However, in the event that mitigation efforts are not successful, the Space Force must contact our office immediately to reinitiate formal consultation if they observe any of the following scenarios:

i. Available western snowy plover monitoring data indicates that in any single year western snowy plover nesting establishment exhibits fewer than 27 nests within the modeled greater than 3 psf zones displayed in Appendix A, Figure 2d, *or* fewer than 92 nests in the modeled greater than 2 psf zones displayed in Appendix A, Figure 2d;

ii. the Space Force observes a 10 percent reduction in the basewide population from the prospective 10-year baseline (AM-8) of nest establishment consecutively across 3 years (see Term and Condition #8b below);

iii. or, if more than 5 western snowy plovers of any life stage (egg, chick, or adult) are injured or killed as a result of project activities, including any camera-monitored nests on Surf Beach that indicate nest abandonment, injury, or mortality to eggs or chicks immediately following launch activities (see Term and Condition #9 and #10 below).

The Service considers a nest abandoned if the attending western snowy plover adults documented via camera monitoring do not return to the nest for more than eight hours. Project activities that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9.

California Least Tern

We anticipate that all California least tern present in the action area could be taken as a result of the proposed action. We expect the incidental take to be in the form of injure or kill if launch or sonic boom noise and/or overpressure disturb nesting to the degree of causing nest or chick abandonment, damage to eggs, or physiological responses that result in bodily injury; or harm from the potential degradation of suitable habitat resulting from increased frequency of noise disturbance associated with routine launch activities. We cannot quantify the precise number of individuals that may be taken due to fluctuations in population. Take may rise to a statistically significant level of decreased California least tern occupancy, nesting establishment, or nesting success from the established baseline across the entirety of the Purisima Point colony. We anticipate that if the Space Force observes any decline that proposed mitigation efforts will be effective in offsetting the impact and will result in no net loss to the species.

However, in the event that mitigation efforts are not successful, the Space Force must contact our office immediately to reinitiate formal consultation if they observe any of the following scenarios:

i. Available California least tern monitoring data indicates that in any two consecutive years California least tern nesting establishment exhibits fewer than 18 nests at the Purisima Point colony with the exception of years that demonstrate similar population declines across the species range (e.g., El Niño/La Niña, avian flu, etc.); OR colony abandonment in any given year that results from project operations.

ii. or, if more than 3 California least tern of any life stage (egg, chick, or adult) are injured or killed as a result of project activities, including any camera-monitored nests at the Purisima Point colony that indicate nest abandonment, injury, or mortality to eggs or chicks immediately following launch activities (see Term and Condition #9 and #11 below).

The Service considers a nest abandoned if the attending California least tern adults documented via camera monitoring do not return to the nest for more than eight hours. Project activities that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9.

REASONABLE AND PRUDENT MEASURES

For purposes of clarification, the following reasonable and prudent measures supersede all previous reasonable and prudent measures outlined within the 2017 biological opinion (Service 2017, pp. 66-67; 2017-F-0480).

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

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of the incidental take of California red-legged frog, western snowy plover, and California least tern:

1. The Space Force must ensure that biologists used for survey, monitoring, training, and capture and relocation tasks are skilled and experienced.
2. The Space Force must reduce potential for injury or mortality of California red-legged frogs, western snowy plovers, and California least terns.
3. The Space Force must monitor effects to ensure they are consistent with this analysis.

TERMS AND CONDITIONS

For purposes of clarification, the following terms and conditions supersede all previous terms and conditions outlined within the 2017 biological opinion (Service 2017, pp. 66-67; 2017-F-0480).

To be exempt from the prohibitions of section 9 of the Act, the Space Force must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

The following term and condition implements reasonable and prudent measure 1:

1. The Space Force must request Service approval of any biologist who will conduct activities related to this biological opinion at least 30 days prior to any such activities being conducted. The Space Force must provide biologist resumes listing their experience and qualifications to conduct specific actions that could potentially affect listed species and their habitats (please refer to and use Appendix B, Biologist Authorization Request Field Experience Tracking Form). A Qualified Biologist(s) is more likely to reduce adverse effects based on their expertise with the covered species. Please be advised that possession of a 10(a)(1)(A) permit for the covered species does not substitute for the implementation of this measure. Authorization of Service Approved Biologists is valid for this consultation only.

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

2. The Space Force must maintain exhaust ducts and associated v-ditch to be free of standing water to the maximum extent possible between launches to help minimize the potential to attract California red-legged frogs to SLC-4.
3. The Space Force must require that a biologist survey the SLC-4 v-ditch feature for California red-legged frogs prior to any maintenance activities and relocate any encountered individuals.
4. The Space Force must rescue any western snowy plover eggs abandoned on Surf Beach and California least tern eggs abandoned at the Purisima Point colony during disturbance events. The Space Force must develop and/or fund a program to incubate any rescued abandoned eggs and release fledglings.

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

5. The Space Force must sample water quality in lower Spring Canyon once annually when ponded water is present to ensure no project related biproducts (i.e., launch combustion residue, operations-related run-off, etc.) have entered the waterway in a manner not previously considered in this analysis. The Space Force must perform sampling a minimum of once a year for three years of project operations. The Space Force must design water quality sampling to detect potential project related biproducts and any resulting associated changes in aquatic habitat (i.e., salinity, pH, etc.). Sampling must consider and utilize the most recent applicable advances in water quality sampling

technology. The Space Force must include maps depicting sampling locations during annual reporting. The Space Force must collect and clearly present data including any associated chemical and nutrient presence, dissolved oxygen, water temperature, turbidity, and any other pertinent observations regarding ecosystem condition for purposes of annual comparison. If the Space Force finds that project related water contamination occurs, the Space Force must coordinate with the Service, address sources of input, and remediate.

6. Prior to project implementation the Space Force must establish a pre-project baseline for hydrodynamic data within San Antonio Creek. During project operations the Space Force must collect hydrodynamic data annually using consistent data collection methodologies for purposes of comparison against the established baseline. The Space Force must use this data to ensure that the proposed project's water extraction, when viewed in addition to the unknown total water extraction amount of permitted launch projects, is not measurably affecting flow rate or water level within San Antonio Creek.
7. The Space Force must develop a proposed mitigation plan and provide it to the Service for approval within three months of project implementation. The plan must detail how the Space Force would calculate mitigation acreages in the event mitigation threshold triggers are met. The plan must also reiterate scenarios when mitigation would not occur as described in AM-5. The plan must include specific quantifiable success criteria the Space Force will obtain within 5 years' time from when the proposed project triggers mitigation that will serve to address the Space Force's goal of no net loss in species' distribution and abundance. In the event the Space Force does not obtain the success criteria, the Space Force must reduce project effects to align with our analysis until they achieve alternative effective mitigation.
8. The Space Force must implement long-term monitoring of annual population and distribution trends associated with California red-legged frog populations within Honda Creek, Bear Creek, and Santa Ynez River, western snowy plover along Surf Beach, and California least tern at Purisima Point to ensure that novel effects of increased launch frequency are capable of detection across the action area over time. The Space Force must develop a monitoring plan that adequately addresses potential short- and long-term project effects that may result from sensory pollutants. The Space Force must coordinate with the Service during plan development and provide the Service the monitoring plan for review and approval within three months of project implementation to ensure that potential project related short and long-term effects are detectable and clearly defined.
    a. The California red-legged frog monitoring plan must at a minimum clearly establish pre-project baseline of California red-legged frog average population level within each impacted breeding feature (Honda Creek, Bear Creek, and Santa Ynez River). Survey area and methodology must be clearly defined. Following project implementation, the Space Force must conduct annual surveys utilizing the same methodology within each impacted breeding feature during the breeding season when California red-legged frogs are most likely to be encountered.

i. As part of the proposed monitoring plan, the Space Force must include the bioacoustics monitoring design for review and approval by the Service. The Space Force must clearly define how they will establish California red-legged frog calling behavior baseline within each impacted breeding feature (Honda Creek, Bear Creek, and Santa Ynez River) and any necessary appropriate control sites for purposes of signal characteristic comparison within 90 days of project implementation. California red-legged frog calling behavior baseline must include applicable call characteristics (e.g., changes in signal rate, call frequency, amplitude, call timing, call duration, etc.). The Space Force must ensure that bioacoustic monitoring conducted is designed to best address confounding factors in order to appropriately characterize impacts of launch, static fire, and SLC-4W landing events on calling behavior. Results must be analyzed in conjunction with long term population data to ensure any observed changes in signal characteristics are not resulting in observable declines in population.

b. The western snowy plover and California least tern monitoring plan must also include a clear, established baseline annual variation and decline threshold that would trigger proposed mitigation. The western snowy plover and California least tern monitoring plan must address the potential for effects discussed in this biological opinion.

9. To assess potential novel effects that may result from frequent launching, the Space Force must employ camera technology that is capable of long-term recording and time marking the moment of disturbance events. The Space Force must review western snowy plover nest camera recordings from Surf Beach and California least tern nest camera recordings from Purisima Point as soon as possible.

10. When conducting the proposed camera monitoring of individual western snowy plover nests, the Space Force must monitor at whichever of the following is greater within the modeled 4 psf zone displayed in Appendix A, Figure 2d to assess potential novel effects that may result from frequent launching: (*i)* 10 percent of active western snowy plover nests, or *(ii)* 4 active western snowy plover nests. The Space Force must monitor at whichever the following is greater within the modeled 3 to 4 psf zone displayed in Appendix A, Figure 2d: (*iii*) 10 percent of active western snowy plover nests, or (*iv*) 2 active western snowy plover nests. The Space Force must monitor at whichever the following is greater within the modeled 2 to 3 psf zone displayed in Appendix A, Figure 2d: (*v*) 5 percent of active western snowy plover nests, or (*vi*) 4 active western snowy plover nests.

a. The Space Force must review western snowy plover nest camera recordings as soon as possible.

b. If any launch events occur during the breeding season for western snowy plover, then the Space Force must implement landscape level camera monitoring in conjunction with individual nest cameras to document western snowy plover response to launch and sonic boom noise and overpressures. The landscape level camera(s) must be capable of long-term recording, time marking the moment of disturbance events, and deployed adjacent to areas of highest density nesting to best capture population level reaction. The Space Force must coordinate camera installation and placement with a Service Approved Biologist to ensure no additional effects would occur (i.e., perching for raptors).

11. When conducting the proposed camera monitoring of individual California least tern nests, the Space Force must monitor at whichever of the following is greater within the Purisima Point colony: (*i*) 10 percent of active California least tern nests, or (*ii*) 4 active California least tern nests.
    a. The Space Force must review California least tern nest camera recordings as soon as possible.
    b. If any launch events occur during the breeding season for California least tern, then the Space Force must implement landscape level camera monitoring in conjunction with individual nest cameras to document California least tern response to launch and sonic boom noise and overpressures. The landscape level camera(s) must be capable of long-term recording, time marking the moment of disturbance events, and deployed adjacent to areas of highest density nesting to best capture population level reaction. The Space Force must coordinate camera installation and placement with a Service Approved Biologist to ensure no additional effects would occur (i.e., perching for raptors).

REPORTING REQUIREMENTS

For purposes of clarification, the following reporting requirements supersede all previous reporting requirements outlined within the 2017 biological opinion (Service 2017, pp. 66-67; 2017-F-0480).

Pursuant to 50 CFR 402.14(i)(3), the Space Force must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement.

The Space Force must provide a written annual report due by January 30 for each fiscal year (October through September) that activities are conducted pursuant to this biological opinion. The Space Force must also submit a final report to the Service's Ventura Fish and Wildlife Office via electronic mail within 90 days following completion of the proposed project. The reports must describe all activities that were conducted under this biological opinion, including activities and conservation measures that were described in the proposed action and required under the terms and conditions, and discuss any problems that were encountered in implementing conservation measures or terms and conditions and any other pertinent information. The report(s) must also include the following information:

1. Documentation of the impacts of the proposed activities on California red-legged frog, western snowy plover, and California least tern; results of biological surveys and

observation records; documentation of the number of individuals of any life stage of California red-legged frogs, western snowy plovers, or California least terns captured or injured or killed; the date, time, and location of any form of take; approximate size and age of those individuals taken; and a description of relocation sites or rehabilitation outcomes for captured individuals.

2. The Space Force must include a discussion of annual monitoring of the population of California red-legged frog populations within Honda Creek, Bear Creek, and the Santa Ynez River, western snowy plovers along Surf Beach, and California least terns at Purisima Point. This discussion must include a summary of all monitoring activities and address any observed changes in population and distribution trends documented over time that may be associated with long-term effects of increased launch frequency. The discussion must also address any potential improvements to the monitoring plan design efficacy, including advances in technology that may aid in sublethal effects detection for consistency with the above analysis.

    a. The California red-legged frog monitoring discussion must also include: (*i*) date and times of launches and static test fires that impacted Honda Creek, Bear Creek, and the Santa Ynez River, as well as received noise levels at each feature of static test fire, launch, and sonic boom events including psf conversions to SPL_{max}; (*ii*) documentation and an analysis of effects by the activities evaluated in this biological opinion, including effects related to produced sound and overpressure levels at the experienced frequency of launching; (*iii*) discussion of effects that result in take of California red-legged frog as well as any observed changes to habitat use pattern, reproduction, or behavior over the long-term as a result of routine launching; and, (*iv*) any other pertinent information as required by this biological opinion.

        i. A discussion of the bioacoustics monitoring results within Honda Creek, Bear Creek, and the Santa Ynez River. The report will include software analysis methods (can refer to Higham et al. 2020, Kruger et al. 2016) to document changes in calling characteristics as well as estimate chorus size. The report will include results and discussion of any changes to California red-legged frog calling behavior baseline (e.g., changes in signal rate, call frequency, amplitude, call timing, call duration, etc.) in conjunction with changes in California red-legged frog annual population data within each feature.

    b. The western snowy plover and California least tern monitoring discussion must include: (*i*) date and times of launches and static test fires that impacted Surf Beach and Purisima Point as well as received noise levels of static test fire, launch, and sonic boom events including psf conversions to SPL_{max}; (*ii*) visual or video monitoring results of birds and nests; (*iii*) documentation and an analysis of effects by the activities evaluated in this biological opinion, including effects related to produced sound or overpressure levels at the experienced frequency of launching; (*iv*) discussion of effects that result in take of western snowy plover and California least tern as well as any observed changes to habitat use pattern or behavior of birds; and, (*v*) any other pertinent information as required by this biological opinion.

3. The Space Force must include a description of mitigation activities implemented and any relevant coordination with the Service. The Space Force must include discussion of whether implemented mitigation has attained applicable success criteria outlined in Term and Condition #7. The Space Force must also include quantifiable metrics to clearly demonstrate that they have achieved no net loss in species abundance or overall distribution and that mitigation efforts are consistent with this analysis.
4. The Space Force must submit federally listed species observations over the course of the project to the California Natural Diversity Database (CNDDB).

The report should also include a discussion of any problems encountered implementing the terms and conditions and other protective measures, recommendations for modifying the terms and conditions to enhance the conservation of federally listed species, and any other pertinent information.

DISPOSITION OF DEAD OR INJURED SPECIMENS

As part of this incidental take statement and pursuant to 50 CFR 402.14(i)(1)(v), upon locating a dead or injured California red-legged frog, western snowy plover, or California least tern, initial notification within 3 working days of its finding must be made by telephone and in writing to the Ventura Fish and Wildlife Office (805-644-1766). The report must include the date, time, location of the carcass, a photograph, cause of death or injury, if known, and any other pertinent information.

The Space Force must take care in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. The Space Force must transport injured animals to a qualified veterinarian. Should any treated California red-legged frog, western snowy plover, or California least tern survive, the Space Force must contact the Service regarding the final disposition of the animal(s).

The remains of California red-legged frogs, western snowy plovers, and California least terns must be placed with educational or research institutions holding the appropriate State and Federal permits, such as the Santa Barbara Natural History Museum (Contact: Paul Collins, Santa Barbara Natural History Museum, Vertebrate Zoology Department, 2559 Puesta Del Sol, Santa Barbara, California 93460, (805) 682-4711, extension 321), Western Foundation of Vertebrate Zoology (Contact: Linnea S. Hall, Ph.D., Executive Director, Western Foundation of Vertebrate Zoology, 439 Calle San Pablo Camarillo, CA 93012, (805) 388-9944), or the Cheadle Center for Biodiversity and Ecological Restoration (CCBER) (CCBER, Herpetological Collection, University of California, Santa Barbara, Harder South, Building 578, MS-9615 Santa Barbara, CA 93106-9615.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The conservation recommendations below are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information and can be used by the Space Force to fulfill their 7(a)(1) obligations.

1. We recommend that the Space Force work with project proponents to design the launch schedule such that launches, particularly launches with associated boost-backs involving terrestrial landing, occur to the maximum extent possible outside of sensitive breeding windows for western snowy plover and California least tern. We specifically recommend avoiding launching during the first three weeks when California least tern are arriving to the Purisima Point colony when they have documented higher levels of sensitivity to launch disturbance (Robinette et al. 2003; Robinette & Rogan 2005 p. 67). Previous monitoring and comparable literature indicate that routine and frequent exposure during these sensitive windows and corresponding accumulation of stress hormone has the potential to significantly impact the long-term breeding success of these species and overall population level fitness. In the event that impacts to breeding success, abundance, and distribution are observed in response to increased launch cadence, we strongly recommend proactively working with project proponents on designing the launch schedule to avoid sensitive windows to help preclude associated effects and build in temporal separation between disturbance events to minimize the induced stress on species.
2. We recommend that the Space Force proactively require their project proponents to design launch vehicles to attenuate sensory pollutants, similar to what is being done with aircraft at other installations (e.g., Edwards Air Force Base, X-59 Quiet SuperSonic Technology; NASA 2022, entire). Design considerations in combination with new sensory pollutant attenuation technologies may prove to be pertinent based on a growing body of evidence that suggests noise, vibration, and light can have detrimental impacts on natural ecosystems as previously discussed.
3. We recommend that the Space Force implement proposed mitigation proactively to ensure these actions can demonstrate quantifiable success in increasing abundance and distribution of species to be consistent with this analysis.
4. We recommend and encourage the Space Force to proactively coordinate with the Service during the early stages of project development. This will improve efficiencies for both agencies and promote the development of meaningful recommendations to avoid and minimize impacts to listed species.
5. We recommend that the Space Force proactively conduct a small-scale California red-legged frog egg-mass relocation study into the existing Oxbow Restoration site. Previous

survey efforts have not yet detected California red-legged frog at this site or demonstrated that California red-legged frog will newly colonize these areas for breeding (Evans 2022, p. 4; Kephart 2022b, p. 2). This study could help determine whether manual facilitation of California red-legged frog establishment to ensure no-net loss of species abundance is achievable.

6. We recommend that the Space Force coordinate with researchers familiar with study design involving short- and long-term ecological effects of sensory pollutants in the development of the effects monitoring plan for the project. We also recommend that the Space Force implement a basewide monitoring strategy to address the potential for compounding impacts of collective launches across the base.
7. We recommend that the Space Force work with researchers to develop a habitat suitability model that addresses launch disturbance frequency. The Space Force could use a model to inform the number, spacing, and distribution of the collective launch scheduling to avoid altering the existing baseline of 'intermittent acute noise disturbance' to what would be more akin to 'chronic acute' noise disturbance. We recommend modeling results incorporate sensitive time windows, such as breeding seasons, and be used to inform launch scheduling to promote recovery goals and adhere to the Space Force's 7(a)(1) obligations.
8. We recommend that the Space Force coordinate with National Park Service partners to inform them of potential project related impacts to Channel Islands (Annie Little, Channel Islands National Park, Supervisory Natural Resource Manager, 1901 Spinnaker Drive Ventura, CA 93001, Office: 805-658-5763, annie_little@nps.gov)
9. We recommend that the Space Force monitor and assess potential effects of project launch and associated boost back activities on the adjacent western monarch butterfly overwintering site located in Spring Canyon and elsewhere in the near vicinity. As applicable, we would recommend that the Space Force address observed effects by incorporating management actions that benefit the species. We recommend that the Space Force implement measures outlined in Appendix C.

The Service requests notification of the implementation of any conservation recommendations so we may be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the reinitiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) may have lapsed and any further take could be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending reinitiation.

If you have any questions about this biological opinion, please contact Sarah Termondt and Erin Arnold of my staff by electronic mail at sarah_termondt@fws.gov and erin_arnold@fws.gov.

Sincerely,

Stephen P. Henry
Field Supervisor

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APPENDIX A

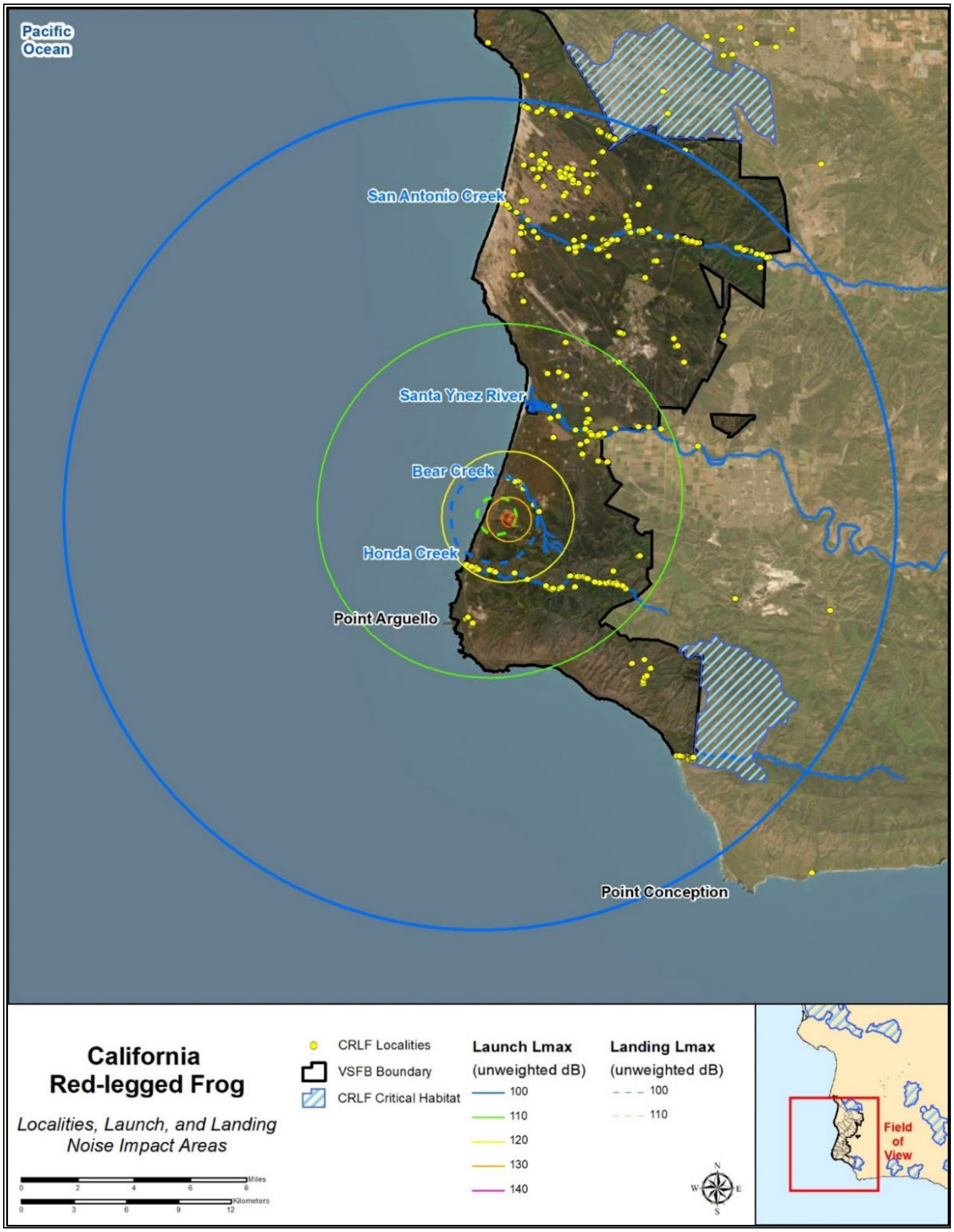

Figure 1a. California red-legged frog occurrences and the projected Launch Noise Effect Area.

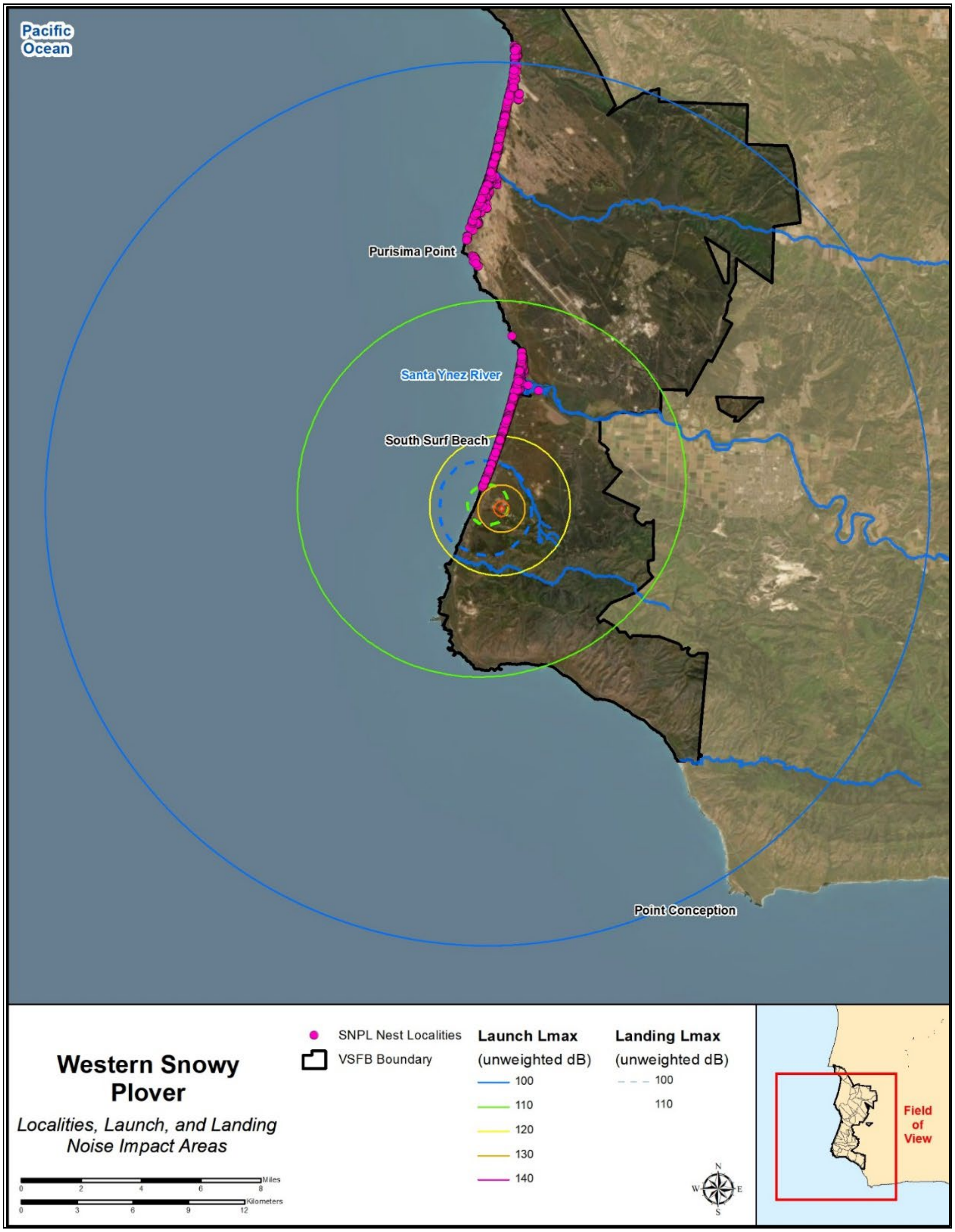

Figure 1b. Western snowy plover nesting occurrences and the projected Launch Noise Effect Area.

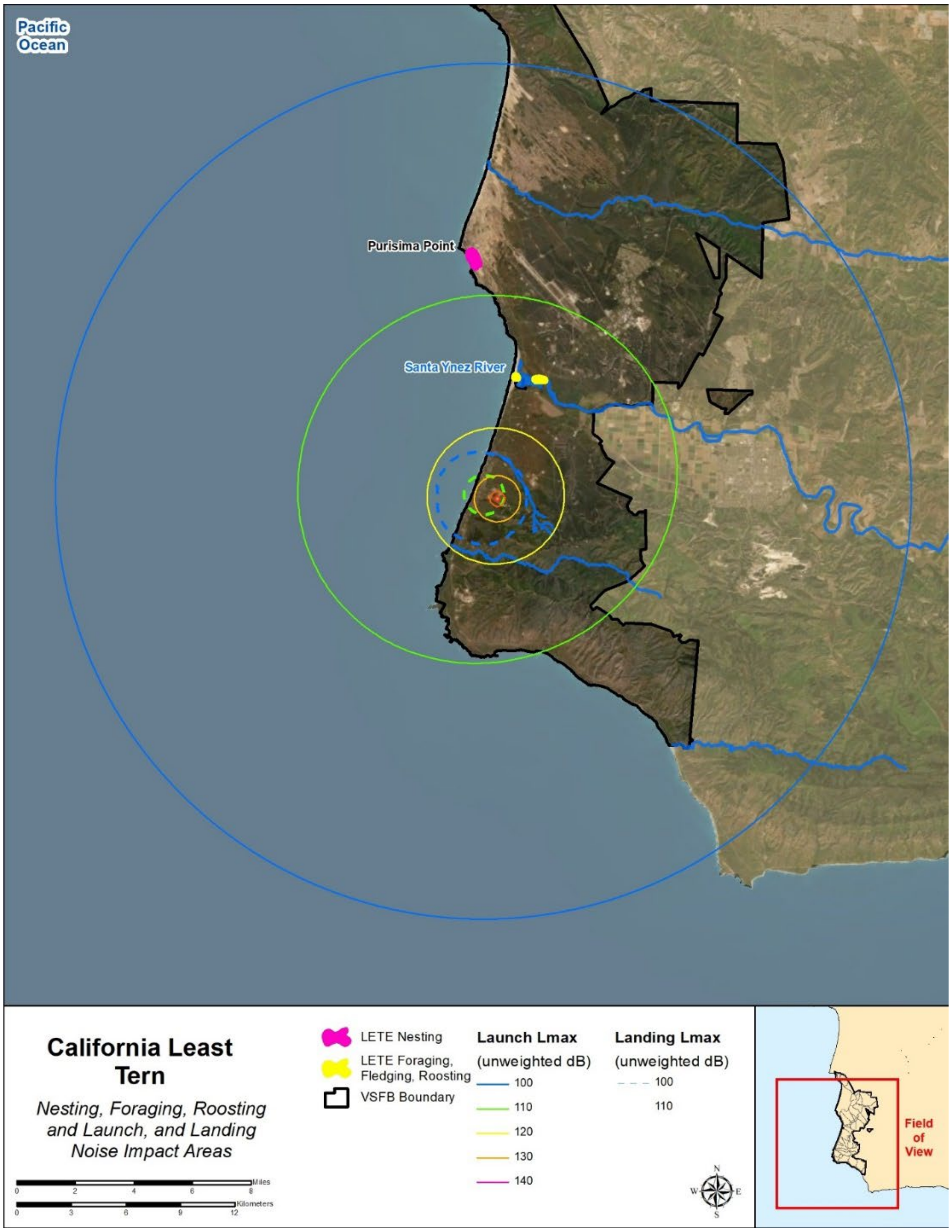

Figure 1c. California least tern nesting occurrences and the projected Launch Noise Effect Area.

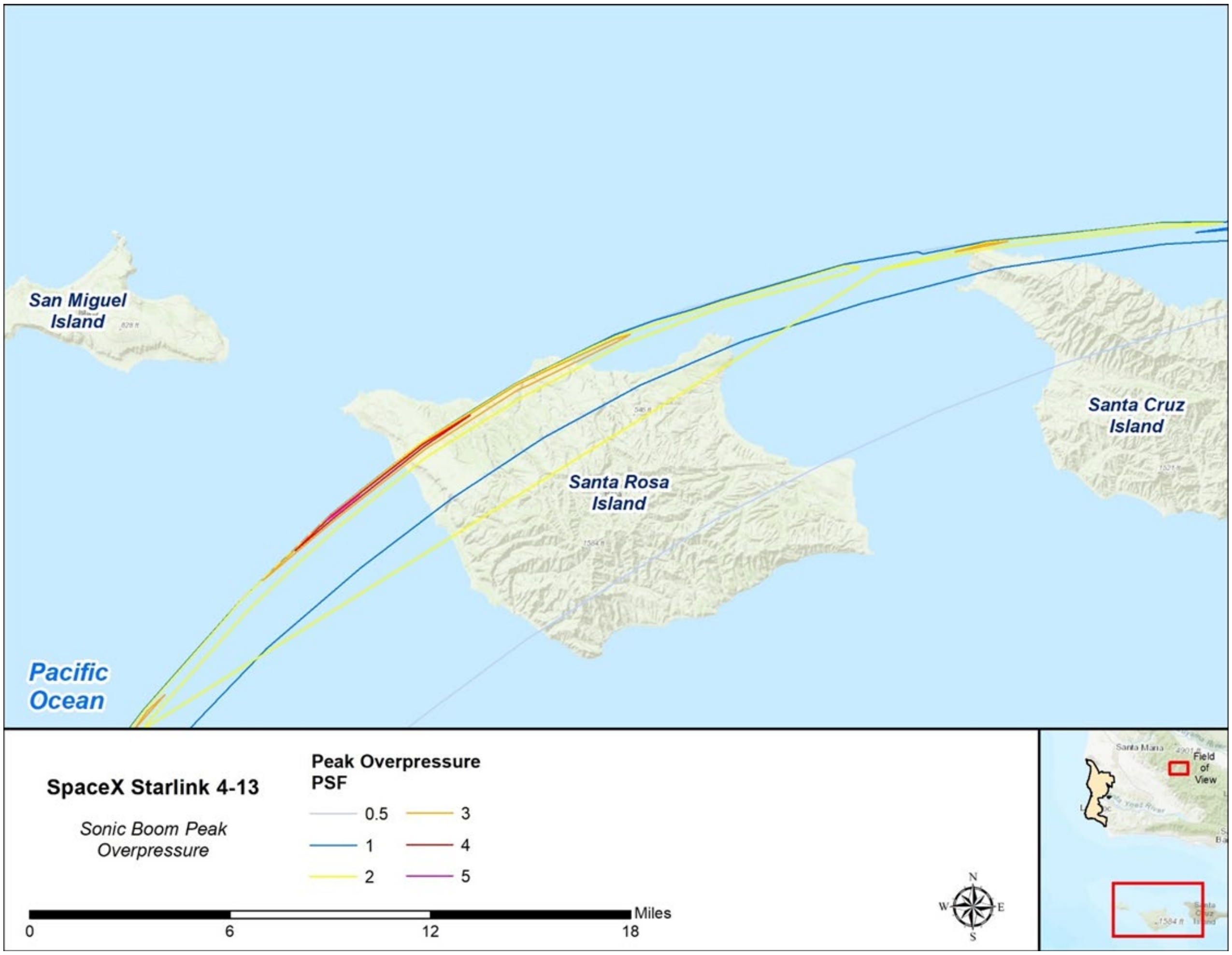

Figure 2a. Portion of the Sonic Boom Overpressure Effect Area impacting the Northern Channel Islands during launch ascent.

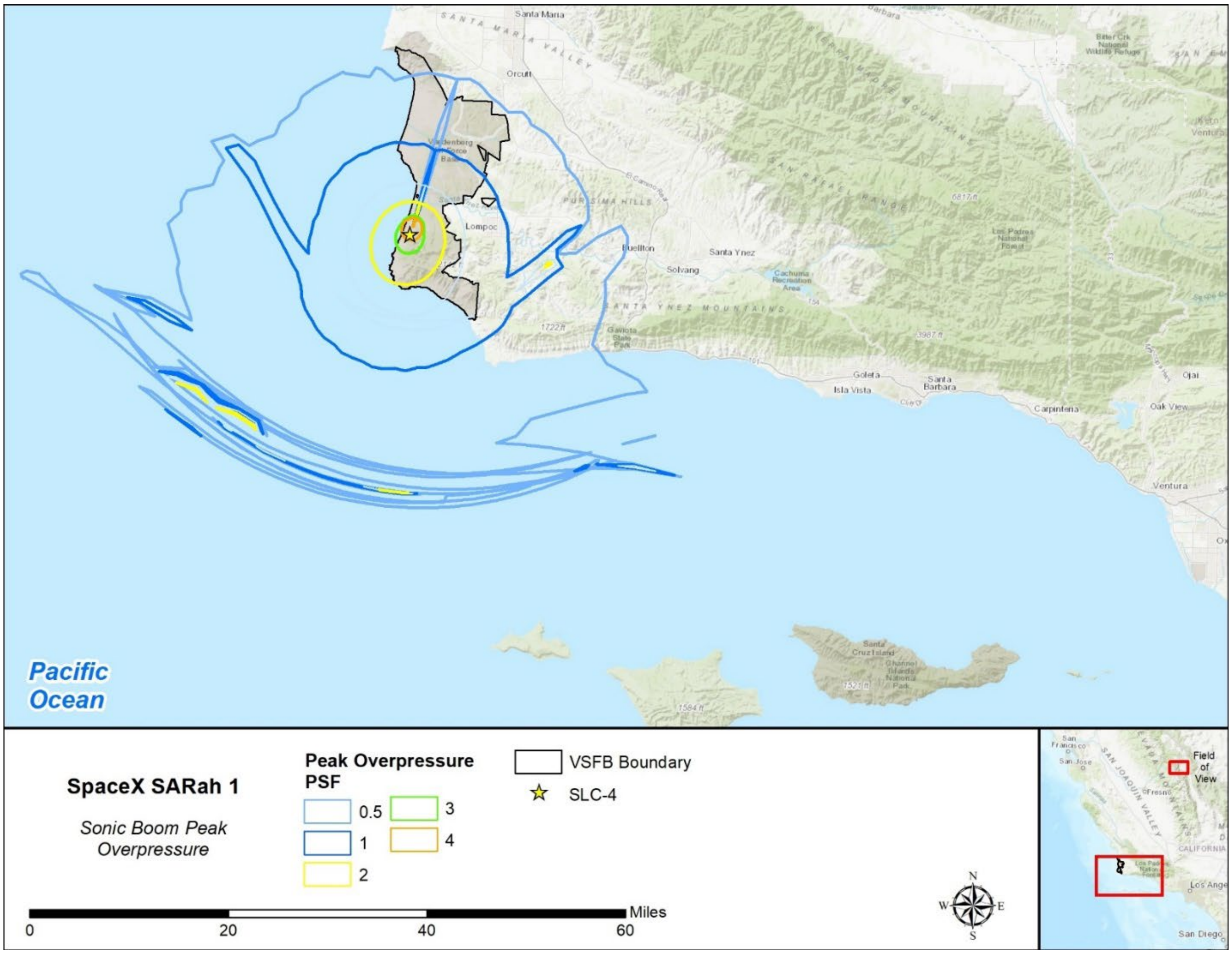

Figure 2b. The Sonic Boom Overpressure Effect Area impacting VSFB during launch descent to SLC-4.

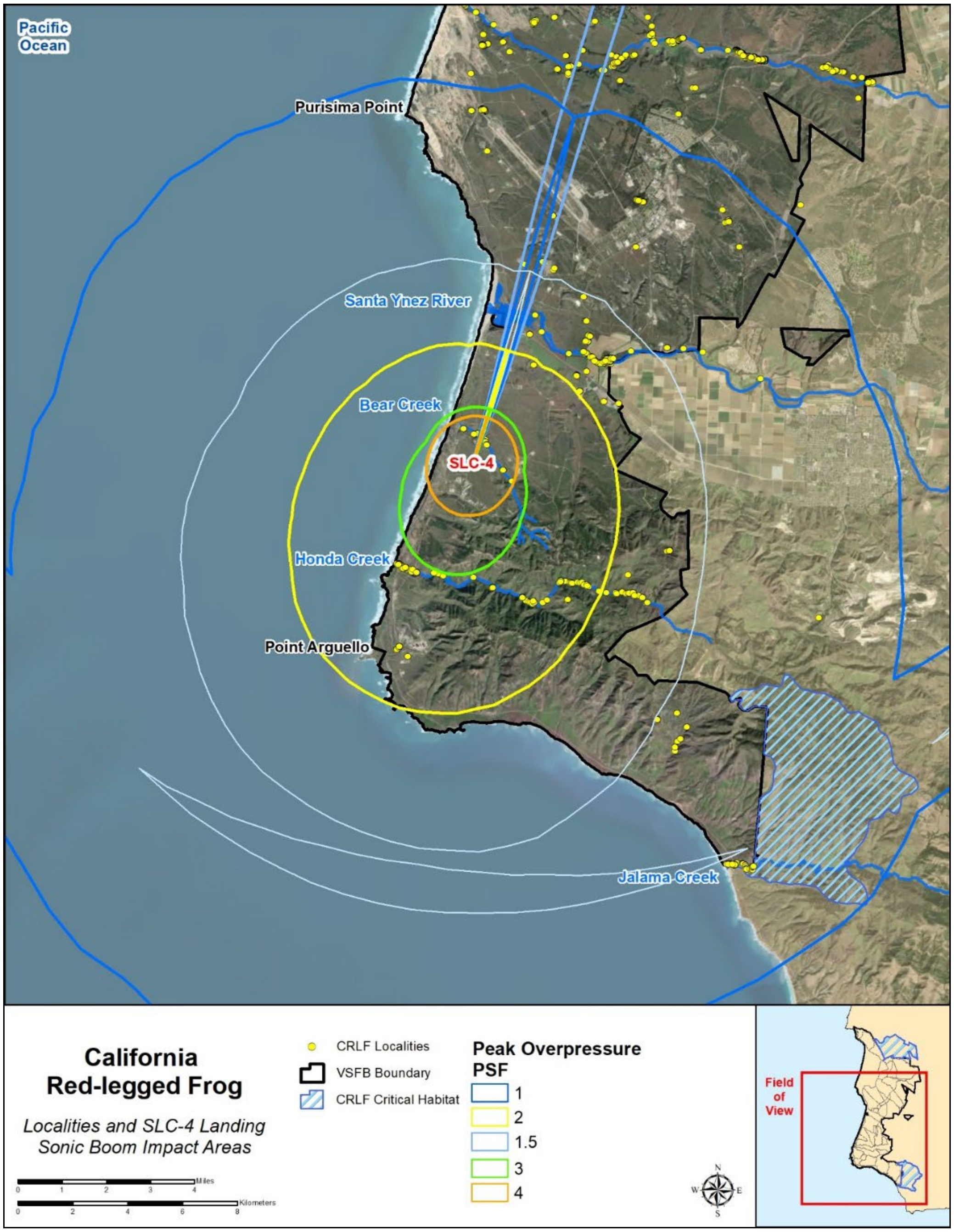

Figure 2c. California red-legged frog occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

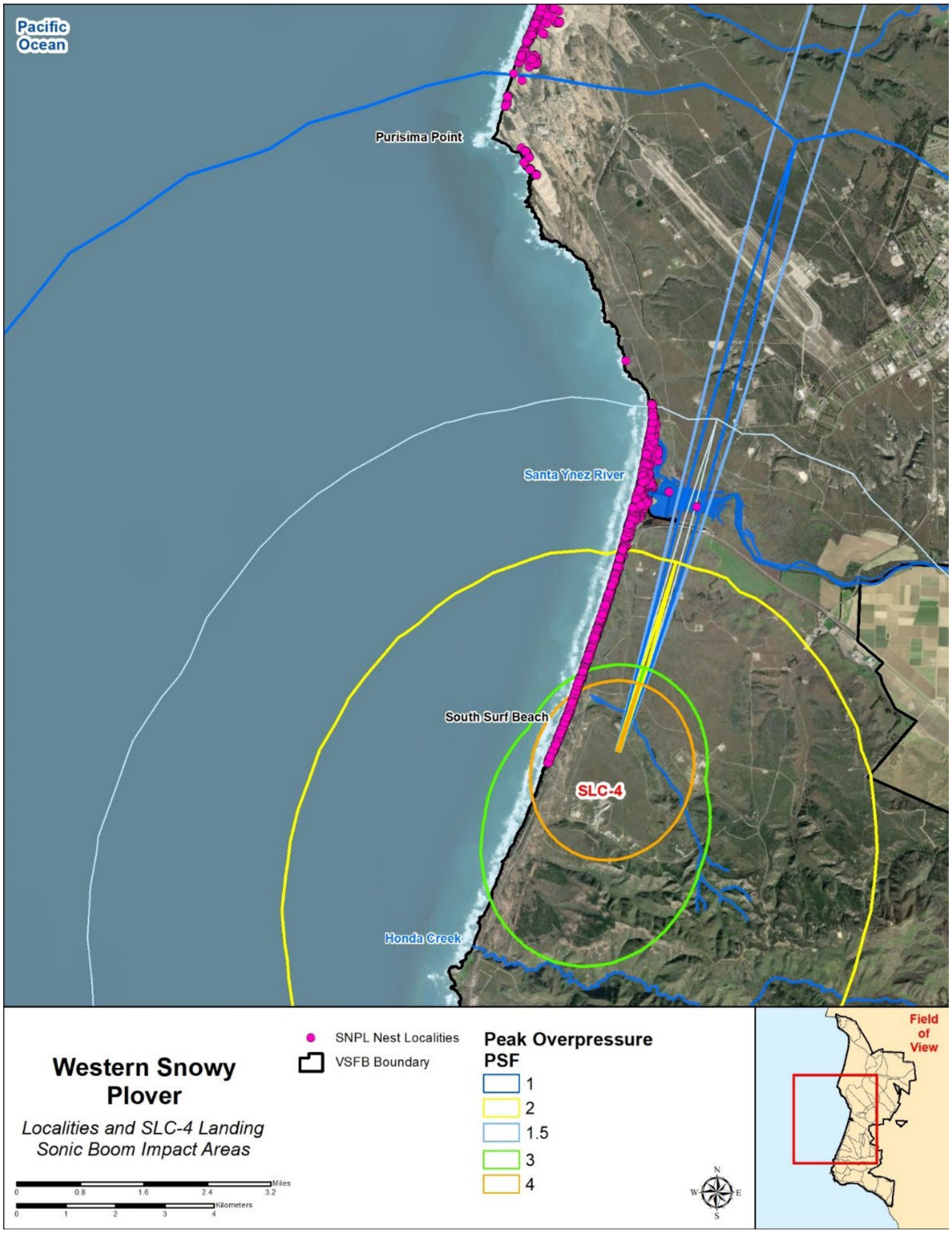

Figure 2d. Western snowy plover occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

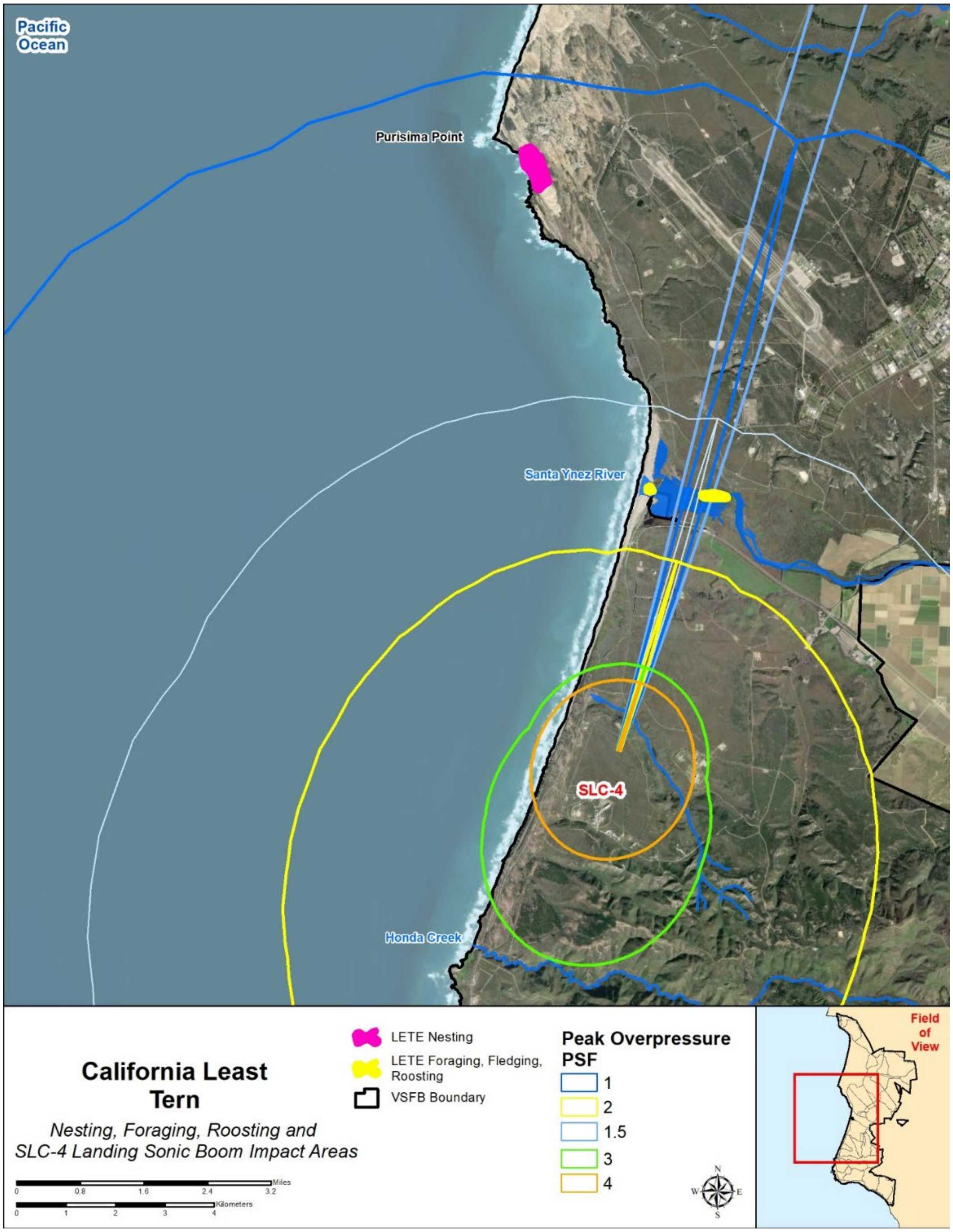

Figure 2e. California least tern occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

Figure 3. Vehicle Landing Effect Area within the Pacific Ocean on a mobile barge ship and at SLC-4E.

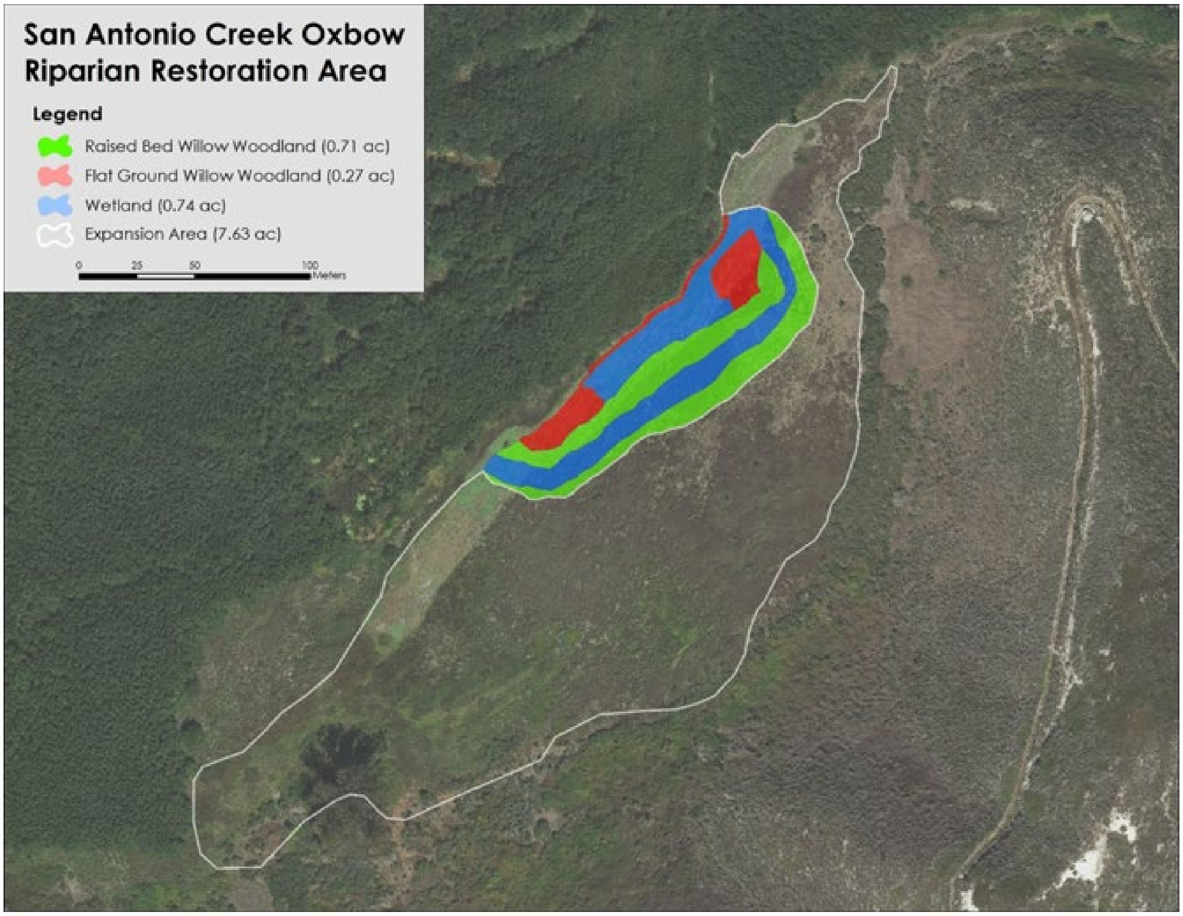

Figure 4a. Potential mitigation area (San Antonio Creek Oxbow Restoration Area) for California red-legged frog. Current restoration efforts depicted in green, red, and blue.

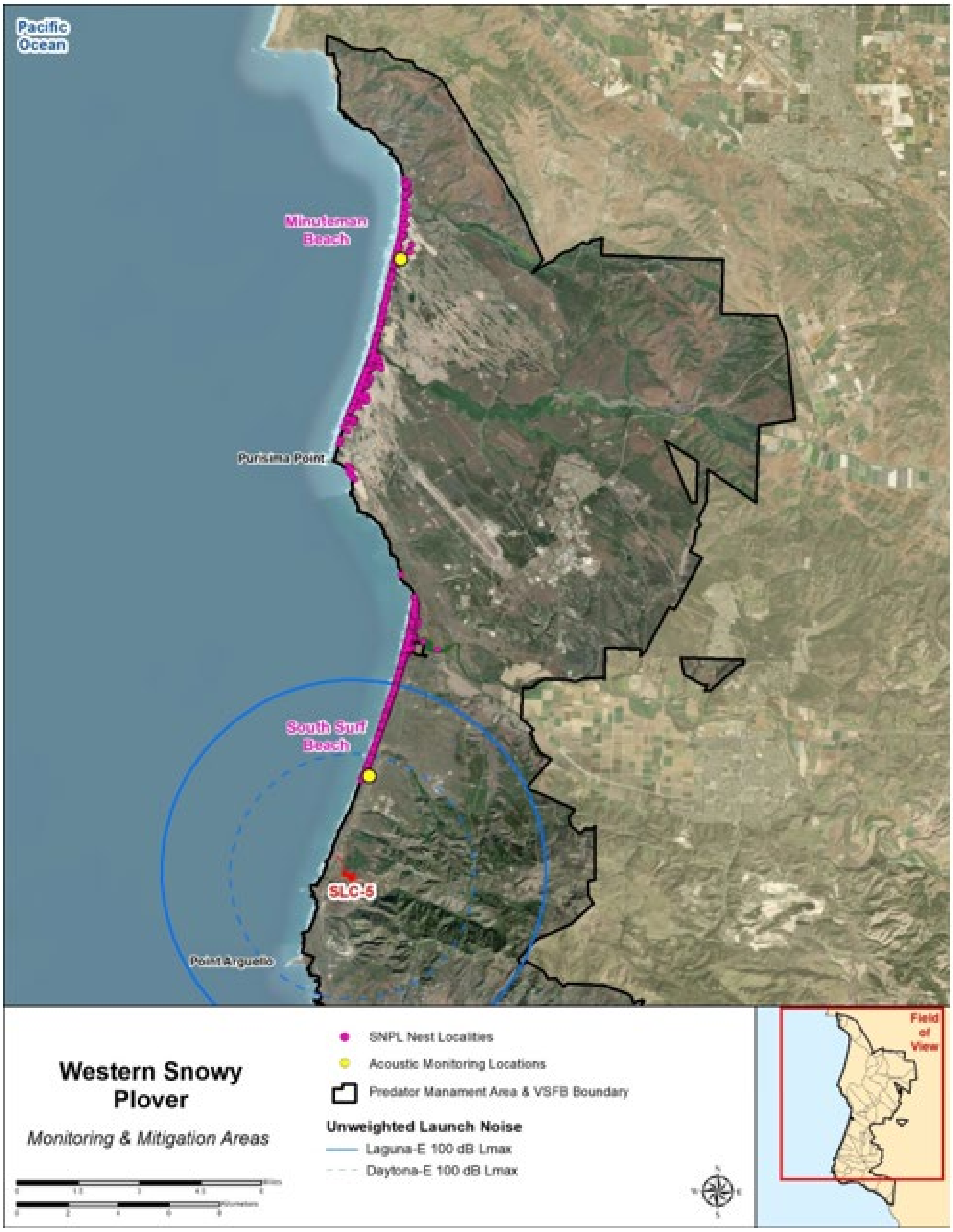

Figure 4b. Potential mitigation area (Predator Management Area) for western snowy plover and California least tern. Note that the figure references a separate project's (Phantom) launch noise effect area to be disregarded (Kaisersatt, pers. comm, 2023c; MSRS 2022d).

APPENDIX B

Biologist Authorization Request

Field Experience Tracking Form

Please be as detailed as possible when submitting your qualifications with your resume. The Service must determine, based on the verifiable information you provide, that you have the expertise to conduct the requested activity with the target species under the applicable Biological Opinion. This field experience tracking document is provided to assist you in providing detailed information to support your overall qualifications.

Basic Information (to be filled in by the Action Agency)

Biologist Name

Activity Authorization Request Type (For Each Species Requested)

e.g., California red-legged frog relocation, Western snowy plover surveys and monitoring, etc.

Project Name and Biological Opinion #

Relevant Experience

Please Enter Recovery Permit:

OR populate table below as necessary to demonstrate adequate experience.

Project Name, approximate dates, and Survey or Activity Type	# of Hrs.	# of Individuals detected, handled, etc. (Please include lifestage as applicable)

Picture 1. First page of the Biologist Authorization Request Field Experience Tracking Form.

Other pertinent notes or experience acquired. Include work under supervision by authorized individuals.

Service Assessment (to be completed by the Service)

- ☐ Individual is authorized to conduct requested activity
- ☐ Individual is authorized to conduct requested activity under direct supervision
- ☐ Individual is not authorized to conduct requested activity
- ☐ More information is needed
- ☐ Remarks (attach additional information)

Description of additional information needed and/or clarifying remarks

Electronic Signatures and Authorizations

Vandenberg SFB Official's Title and Office	Date	VFWO Title USFWS	Date

Picture 2. Second page of the Biologist Authorization Request Field Experience Tracking Form.

APPENDIX C

Western Monarch Butterfly Conservation Recommendations:

Purpose: Section 7(a)(1) of the Endangered Species Act of 1973 (ESA), directs federal agencies to use their authorities to further the purpose of the ESA, by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid and minimize the adverse effects of a proposed action, implement recovery plans, or to develop information that is useful for the conservation of listed species. The purpose of the following conservation recommendations is to encourage federal agencies to incorporate monarch butterflies as applicable into their Environmental Assessments and Biological Assessments associated with Section 7 Biological Opinions, when in consultation with the U.S. Fish & Wildlife Service.

Background: The western migratory monarch butterfly population has declined by more than 99 percent since the 1980s. An estimated 4.5 million monarchs overwintered on the California coast in the 1980s, whereas in 2020, the population estimate for overwintering monarchs was less than 2,000 butterflies. This extreme population decline is likely due to multiple stressors across the monarch's range, including the loss and degradation of overwintering groves; pesticide use, particularly insecticides; loss of breeding and migratory habitat; climate change; parasites and disease. Historically, the majority of western monarchs spent the winter in forested groves near the coast from Mendocino County, California, south into northern Baja California, Mexico. In recent years, monarchs have not clustered in the southern-most or northern-most parts of their overwintering range, and there are year-round residents in some areas of the coast. This resident phenomenon is likely due to a combination of climate change and an abundance of residential-planted non-native, tropical milkweed that is available for monarchs year-round. Migratory western monarchs depart the overwintering groves in mid-winter to early-spring. Throughout the spring and summer, monarchs breed, lay their eggs on milkweed, and migrate across multiple generations within California and other states west of the Rocky Mountains. In an attempt to reverse the severe population decline of western monarch butterflies, and to protect other pollinators as well, we encourage implementation of the conservation recommendations listed below. Please see Figure 1 for suggested areas to focus voluntary conservation actions in California. Western monarch conservation actions outside of California are also important, especially for the larger pollinator community. Recommendations for other western states are addressed in the "All Breeding and Migratory Zones" section of this document.

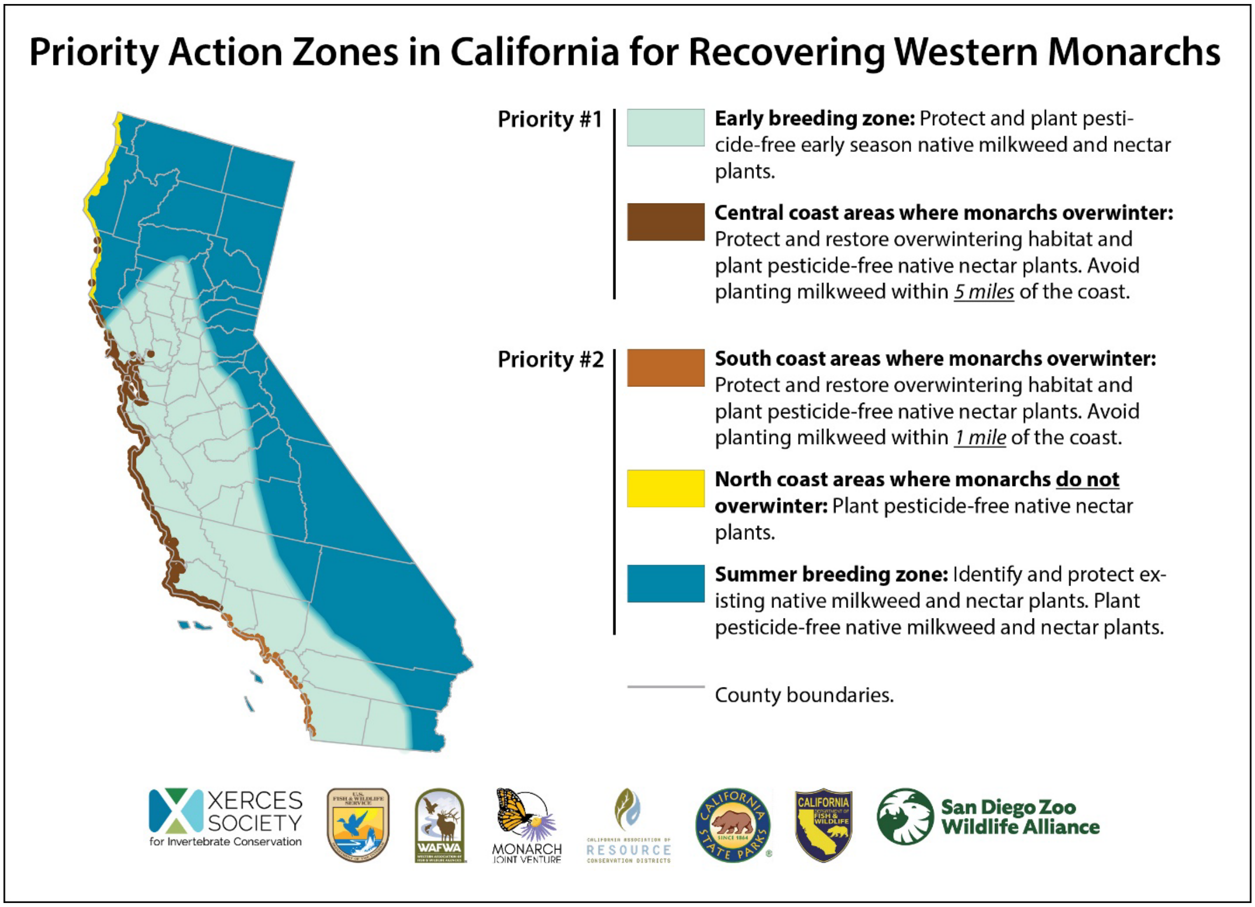

Figure 1. Priority Monarch Habitat Restoration Areas in California.

<u>Coastal California Overwintering Habitat</u>: Western monarchs migrate to the California coast, and cluster in a specific set of forested tree groves during the fall and winter each year. Overwintering groves provide protection from inclement weather and possess suitable vegetation and microclimate conditions for monarchs (e.g., roosting trees, wind protection, dappled sunlight, nectar sources, water and/or dew for hydration, high humidity, and an absence of freezing temperatures). In the overwintering zone of the coast (i.e., within five miles of the coast from Mendocino County south through Santa Barbara County, and within one mile of the coast from Ventura County south through San Diego County), we recommend the following:

1. Protect, manage, enhance and restore monarch butterfly overwintering groves (Find An Overwintering Site).

2. Use only native, insecticide-free plants for habitat restoration and enhancement actions.

3. Conduct overwintering grove habitat assessment(s), and develop and implement long-term grove management plans, as applicable. Management plan actions for groves may include, but are not limited to:

    a. Enhance roosting trees within overwintering groves and within 1/2 mile of groves by planting trees (e.g., Monterey pine *(Pinus radiata)*, Monterey cypress

(Cupressus macrocarpa), Coast redwood *(Sequoia sempervirens)*, coast live oak *(Quercus agrifolia),* Douglas fir *(Pseudotsuga menzesii),* Torrey pine (*Pinus torreyana*), western sycamore *(Platanus racemosa),* bishop pine *(Pinus muricata)* and others, as appropriate for location).

b. Avoid the removal of trees or shrubs within 1/2 mile of overwintering groves, except for specific grove management purposes, and/or for human health and safety concerns. The maintenance of trees and shrubs within a 1/2 mile of these sites provides a buffer to preserve the microclimate conditions of the winter habitat.

c. Conduct management activities (e.g., tree trimming, mowing, burning and grazing) in monarch overwintering groves from March 16-September 14 (outside of estimated timeframe when monarchs are likely present), in coordination with a monarch biologist.

d. Enhance nectar sources by planting fall/winter blooming forbs or shrubs within overwintering groves and within one mile of the groves (Nectar Planting Lists).

4. Protect monarchs, other pollinators, and their habitats from pesticides (i.e., insecticides and herbicides). Specific recommendations may vary by site.

    a. Avoid the use pesticides within one mile of overwintering groves, particularly when monarchs may be present. If pesticides are used, then conduct applications from March 16-September 14, when possible.

    b. Screen all classes of pesticides for pollinator risk to avoid harmful applications, including biological pesticides such as *Bacillus thuringiensis* (UC Integrated Pest Management).

    c. Avoid the use of neonicotinoids or other systemic insecticides, including coated seeds, any time of the year in monarch habitat due to their ecosystem persistence, systemic nature, and toxicity.

    d. Consider non-chemical weed control techniques, when possible (Cal-IPC Non-chemical BMPs).

    e. Avoid herbicide application on blooming flowers. Apply herbicides during young plant phases, when plants are more responsive to treatment, and when monarchs and other pollinators are less likely to be nectaring on the plants.

    f. Whenever possible, use targeted application herbicide methods, avoid large-scale broadcast applications, and take precautions to limit off-site movement of herbicides (e.g., drift from wind and discharge from surface water flows).

g. Separate habitat areas from areas receiving chemical treatments with a pesticide-free spatial buffer and/or evergreen vegetative buffer of coniferous, non-flowering trees to capture chemical drift. The appropriate monarch and pollinator habitat spatial buffer size depends on several factors, including weather and wind conditions, but at a minimum, the habitat should be at least 40 feet from ground-based pesticide applications, 60 feet from air-blast sprayers, and 125 feet from any systemic insecticide applications or seed-treated plants.

5. To minimize the spread of the pathogen *Ophryocystis elektroscirrha* (OE), and to encourage natural monarch migration, do not plant non-native tropical milkweed (*Asclepias curassavica*). OE is able to build up on tropical milkweed, because these plants are evergreen, and they do not die back in the winter. OE can be debilitating and/or lethal to monarchs.

6. Remove tropical milkweed that is detected, and replace it with nectar plants suitable for the location (Nectar Planting Lists).

7. To assist in maintaining normal migration behavior, do not plant any type of milkweed within five miles of the coast from Mendocino County south through Santa Barbara County, and within one mile of the coast south of Santa Barbara County.

8. After appropriate training, conduct grove monitoring for butterflies during the Western Monarch Counts each fall and winter. When possible, report when monarchs arrive and depart the groves each year (Western Monarch Count).

9. To provide benefits for monarchs and other pollinators anywhere on the landscape within the overwintering zone, install a mosaic of nectar plants that bloom throughout the year, as is feasible (Nectar Planting Lists).

Breeding and Migratory Habitat: Monarch butterflies breed and migrate across multiple generations each year throughout the western U.S. The early breeding zone (i.e., Priority 1) is an estimated area in California where monarchs are likely to breed and/or lay their eggs on milkweed after departing the overwintering groves in mid-winter to early spring each year (See Figure 1, above). Early emerging milkweed species are likely a limiting factor on the landscape in the early breeding zone and may be associated with the severe population decline of western monarchs, and these plants are essential to successfully create the next generation of migratory butterflies. For monarch breeding and migratory habitat, we recommend the following:

Priority 1 Zone:

1. Enhance and maintain habitat in the Priority 1 early breeding zone of California, (Figure 1, above), by identifying and protecting existing habitat, and planting native, insecticide-free early-emerging milkweed species (e.g., *Asclepias vestita, A. californica, A. eriocarpa, A. cordifolia, A. erosa*), and flowering plants that are available to monarchs

from January-April, as appropriate for the project location (Nectar Planting Lists; Milkweed Seed Finder).

For All Breeding and Migratory Zones:

2. Use only native, insecticide-free plants for habitat restoration and enhancement actions.

3. Enhance and maintain habitat in the Priority 2 zone of California (Figure 1, above) and in other western States, by identifying and protecting existing habitat, and planting milkweed species and flowering plants that are appropriate for the location (Nectar Planting Lists; Milkweed Seed Finder).

4. Conduct management activities such as mowing, burning and grazing in monarch breeding and migratory habitat outside of the estimated timeframe when monarchs are likely present (Figure 2, Recommended Management Timing Map, below).

5. Protect monarchs, other pollinators, and their habitats from pesticides (i.e., insecticides and herbicides).

    a. Avoid the use of pesticides when monarchs may be present, when feasible (Figure 2, Recommended Management Timing Map, below).

    b. Screen all classes of pesticides for pollinator risk to avoid harmful applications, including biological pesticides such as *Bacillus thuringiensis* (UC Integrated Pest Management).

    c. Avoid the use of neonicotinoids or other systemic insecticides, including coated seeds, any time of the year in monarch habitat due to their ecosystem persistence, systemic nature, and toxicity.

    d. Consider non-chemical weed control techniques, when feasible (Cal-IPC Non-chemical BMPs).

    e. Avoid herbicide application on blooming flowers. Apply herbicides during young plant phases, when plants are more responsive to treatment, and when monarchs and other pollinators are less likely to be nectaring on the plants.

    f. Whenever possible, use targeted application herbicide methods, avoid large-scale broadcast applications, and take precautions to limit off-site movement of herbicides (e.g., drift from wind and discharge from surface water flows).

    g. Separate habitat areas from areas receiving treatment with a pesticide-free spatial buffer and/or evergreen vegetative buffer of coniferous, non-flowering trees to capture chemical drift. The appropriate monarch and pollinator habitat spatial buffer size depends on several factors, including weather and wind conditions, but at a minimum, the habitat should be at least 40 feet from ground-based pesticide applications, 60 feet from air-blast sprayers, and 125 feet from any systemic insecticide applications or seed-treated plants.

6. To minimize the spread of the pathogen *Ophryocystis elektroscirrha* (OE), do not plant non-native tropical milkweed (*Asclepias curassavica*). OE can build up on tropical milkweed and infect monarchs, because these plants are evergreen and do not die back in the winter. OE can be lethal to monarchs.

7. Remove tropical milkweed that is detected, and replace it with milkweed and nectar plants appropriate for the location (Nectar Planting Lists; Milkweed Seed Finder).

8. Report milkweed and monarch observations from all life stages, including breeding butterflies, to the Monarch Milkweed Mapper or via the project portal in the iNaturalist smartphone app.

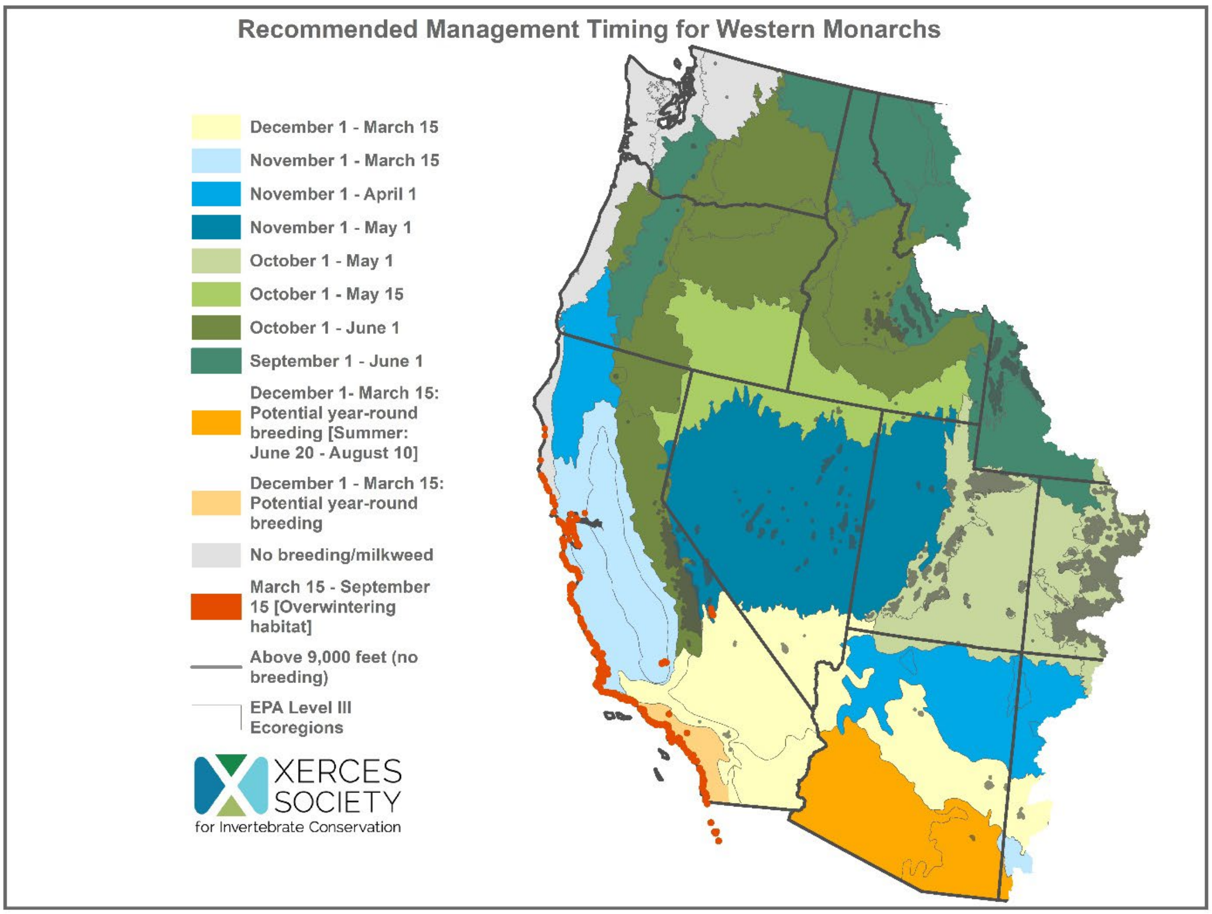

Figure 2. Recommended Management (i.e., mowing, burning, grazing, pesticide applications) Timing Windows in the western U.S. by Zone.

Notes: The management timing windows illustrated in Figure 2 represent approximate recommendations of timeframes to conduct management actions. These timeframes are based upon the best available current information and may be updated in the future. Each year and site is different, so when possible, please consider surveying milkweed plants for the early life stages of monarchs prior to burning, mowing, grazing or applying pesticides.

Draft Biological Assessment for Falcon 9 Cadence Increase at Vandenberg Space Force Base, California and Offshore Landing Locations

28 November 2022

Prepared for

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ac	acre(s)
BA	Biological Assessment
C.F.R.	Code of Federal Regulations
CRLF	California red-legged frog
dB	decibel(s) unweighted
dBA	A-weighted decibel(s)
E	east
ESA	Endangered Species Act
^{o}F	degrees Fahrenheit
FR	Federal Register
ft	foot or feet
ha	hectare(s)
INRMP	Integrated Natural Resources Management Plan
km	kilometer(s)
kHz	kilohertz
km^2	square kilometers
LETE	California least tern
MAMU	marbled murrelet
m	meter(s)
mi	mile(s)
MSRS	ManTech SRS Technologies, Inc.
OCA	other carnivores in-air
PBO	Programmatic Biological Opinion
PCA	phocids in-air
psf	pounds per square foot
RORO	roll-on-roll-off
SLC	Space Launch Complex
SLC-4E	Space Launch Complex 4 East
SLC-4W	Space Launch Complex 4 West
SLM	sound level meter
SNPL	western snowy plover
TWG	tidewater goby
USAF	United States Air Force
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USSF	United States Space Force
UTS	unarmored threespine stickleback
VSFB	Vandenberg Space Force Base
W	west

1 Introduction

1.1 Background & Consultation History

The purpose of this Biological Assessment (BA) is to address the effects of a proposed increase in the annual cadence for SpaceX Falcon 9 operations at Space Launch Complex (SLC) 4, Vandenberg Space Force Base (VSFB), California, on federally listed (endangered and threatened) species and their Critical Habitat as required by section 7 of the Endangered Species Act (ESA) of 1973 (16 United States Code [U.S.C.] section 1536). Pursuant to section 7(a)(2) of the ESA of 1973 (16 U.S.C. section 1536), as amended, the United States Space Force (USSF), is required to consult with the United States Fish and Wildlife Service (USFWS) for those actions it has determined may affect ESA-listed species or their Critical Habitat. The USSF is the lead agency for the purposes of this BA.

The USFWS has previously completed four biological opinions (BO; USFWS 2010, 2011, 2014a, 2017a), two concurrence letters (USFWS 2014b, 2015a), and one email transmittal of concurrence (USFWS 2022) regarding the effects of operations performed to support this launch program at SLC-4.

In the BO dated 10 December 2010 (USFWS 2010), the USFWS consulted on the modification and operation of SLC-4 East (SLC-4E) for the new Falcon 9 and Falcon 9 Heavy Space Vehicle Program. The USFWS concurred that modification of SLC-4E, launch noise, and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect the California least tern (LETE, *Sternula antillarum browni*), western snowy plover (SNPL, *Charadrius nivosus*), or southern sea otter (*Enhydra lutris nereis*).

The USAF requested reinitiation on 25 May 2011 due to a change in the effects determination for the California red-legged frog (CRLF; *Rana draytonii*), from "no effect" to "may affect, not likely to adversely affect." In the resulting BO (USFWS 2011), the USFWS concurred that launch noise and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect the CRLF, LETE, SNPL.

On 10 October 2013, the USSF informed the USFWS of potential unauthorized impacts on CRLF resulting from the discharge of water into Spring Canyon during the launch of a Falcon 9 rocket on 29 September 2013. The USSF stated that all future launches from SLC-4E would be conducted with a dry flame duct to prevent discharge to Spring Canyon. In a letter dated 29 August 2014, the USFWS concurred that launch activities at SLC-4E may affect, but were not likely to adversely affect CRLF that may occur in suitable habitat in Spring Canyon (USFWS 2014b).

In the BO dated 22 December 2014 (USFWS 2014a), the USAF consulted with the USFWS on the proposed in-flight abort test and improvements at SLC-4 West (SLC-4W) which included constructing a 300-foot (ft) diameter concrete pad to accommodate future landings of Falcon 9 first stage, two new access roads, and a new "FireX" fire control system. The USFWS concurred that the proposed activities may affect, but were not likely to adversely affect the LETE, SNPL, or southern sea otter. The USFWS authorized incidental take of CRLF resulting from site improvements and, for frogs, capture, and relocation.

On 2 July 2015, the USAF consulted with the USFWS on Falcon 9 boost-back landing operations, which would occur up to 10 times per year at SLC-4W or at sea. The anticipated engine noise at landing would be less than the noise generated during launch, and the anticipated sonic boom overpressure would be up to a maximum of 2.0 psf. The USFWS concurred that boost-back landings of the Falcon 9 first stage at SLC-4W may affect, but were not likely to adversely affect the CRLF, LETE, SNPL, or southern sea otter (USFWS 2015a).

In the BO dated 12 December 2017 (USFWS 2017a), the USSF consulted with the USFWS on the launch of the Falcon 9 from SLC-4E, followed by first stage boost-back and landing at SLC-4W up to 12 times per year, use of up to 200,000 gallons of water in the flame duct, construction of a civil structure and retention basin to divert and retain a portion of the water expelled from the flame duct, removal of vegetation in Spring Canyon to minimize potential effects to nesting birds, and habitat enhancement to mitigate for impacts on riparian vegetation. The USFWS concurred that these activities may affect, but were not likely to adversely affect the California condor (*Gymnogyps californianus*), marbled murrelet (MAMU; *Brachyramphus marmoratus*), and southern sea otter, and may affect, and would likely adversely affect CRLF, LETE, and SNPL. The USFWS also concurred that the proposed project would not affect designated critical habitat for any species.

In an email communication dated 13 October 2022, the USFWS agreed that the effects from increasing the number of Falcon 9 launches from 12 to 14 in 2022 was consistent with existing analyses and reinitiation was not warranted (USFWS 2022).

As part of the Programmatic Biological Opinion for routine operations and maintenance activities at VSFB (USFWS 2015), the impacts of maintaining the firebreaks surrounding both SLC-4E and SLC-4W and activities conducted at the harbor have been analyzed.

This BA examines the potential effects of an increase in the SpaceX Falcon 9 launch cadence from 12 to 36 launches per year at SLC-4 on VSFB on the tidewater goby (TWG; *Eucyclogobius newberryi*), unarmored threespine stickleback (UTS; *Gasterosteus aculeatus williamsoni*), CRLF, MAMU, SNPL, LETE, California condor, southern sea otter, and Critical Habitat for these species, if designated.

1.2 Other Species Considered

Four additional ESA-listed species were considered during the analysis of this project but dismissed, one vertebrate and three plants. Potential habitat for southwestern willow flycatcher (*Empidonax traillii extimus*) exists within riparian corridors on VSFB and adjacent areas. However, there are no records of this species within the areas impacted by loud launch noise and historically occupied breeding habitat along the Santa Ynez River on VSFB has been degraded and is unlikely to support breeding in the future (Seavy et al. 2012). As a result, this species is not carried forward in this BA. Three ESA-listed plant species were considered. These were Lompoc yerba santa (*Eriodictyon capitatum*), beach layia (*Layia carnosa*), and Gaviota tarplant (*Deinandra increscens* ssp. v*illosa*). There are no new ground disturbing activities associated with this project and physical impacts would not extend into areas occupied by federally listed plants; consequently, consideration of these species is not carried forward in this BA.

In addition, the results of a study published in 2020 indicate the El Segundo blue butterflies (*Euphilotes battoides allyni*) in Los Angeles County are genetically distinct from the *Euphilotes* in northern Santa Barbara County (Depuis et al. 2020). The *Euphilotes* on VSFB and adjacent areas of northern Santa Barbara County were therefore determined not to be the federally endangered El Segundo blue, but a separate genetically distinct population (Depuis et al. 2020). Therefore, although the El Segundo blue had been included in prior consultations for SpaceX activities at VSFB, this species is not carried forward in this BA.

2 Project Description

2.1 Project Location

VSFB occupies approximately 99,100 acres (ac.) (400 square kilometers [km^2]) of central Santa Barbara County, California, and is approximately halfway between San Diego and San Francisco (Figure 2.1-1). VSFB occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species. The Santa Ynez River and State Highway 246 divide VSFB into two distinct parts: North Base and South Base. SLC-4 is located on South Base, approximately 4.0 miles [mi] [6.4 km] south of the Santa Ynez River and 0.9 mi (1.4 km) east of the Pacific Ocean. SLC-4E is the existing launch facility for the Falcon 9 program and SLC-4W is the existing landing facility for the Falcon 9 program.

Biological surveys of the area surrounding SLC-4 were performed as part of the 2017 biological assessment (ManTech SRS Technologies, Inc [MSRS] 2017). There was no need to perform additional field surveys for this BA because the Proposed Action does not require any construction-related ground disturbance, the maximum number of first stage landings (12) at SLC-4W would not change from what was described in the 2017 BO (USFWS 2017a), and recent survey data are available for all relevant species in the areas potentially impacted.

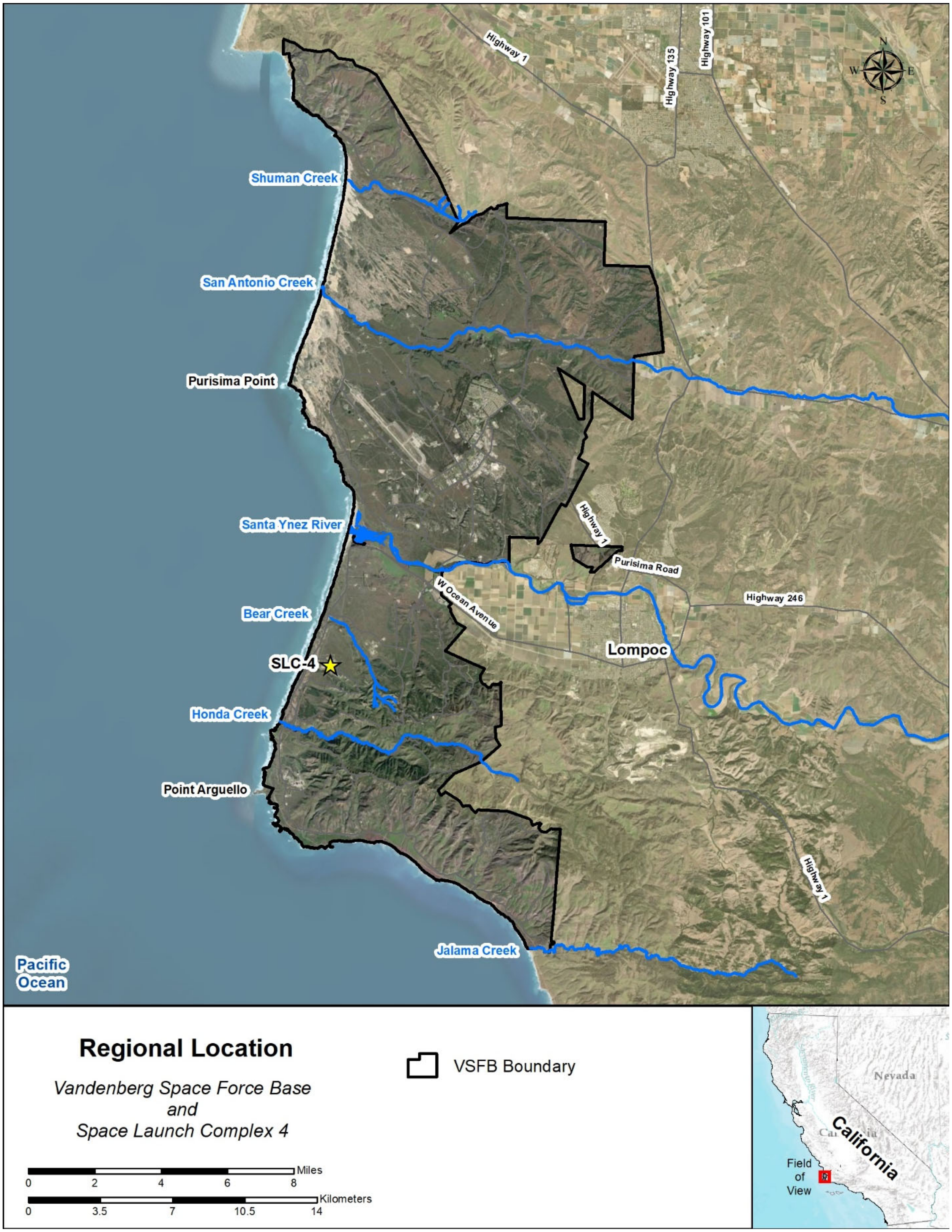

Figure 2.1-1. Regional location of SLC-4.

2.2 Proposed Action

The Proposed Action is to increase the Falcon 9 annual first stage launch and recovery cadence from 12 to 36 at SLC-4 on VSFB and include additional downrange offshore landing locations in the Pacific Ocean. Following each launch, SpaceX would perform a boost-back and landing of the first stage, either downrange on a droneship in the Pacific Ocean or at SLC-4W at VSFB. No more than 12 first stage landings would occur at SLC-4W per year.

2.2.1 Launch Operations

SpaceX would launch Falcon 9 from SLC-4E up to 36 times per calendar year in a manner similar to what was described in the 2017 BO (USFWS 2017a). Each takeoff may be preceded by a static fire test of the engines, which lasts a few seconds. The need to conduct a static fire test is mission dependent, but there would be no more than 36 static fire events per year. Launch operations would occur day or night, at any time during the year. In addition to the previously flown missions with launch azimuths between 140 and 210 degrees, the Proposed Action includes adding a northerly mission profile with a launch azimuth between 305 and 325 degrees (**Error! Reference source not found.**).

SpaceX would utilize a water-filled flame duct to reduce vibration impacts from noise on payloads. Since implementation, SpaceX has reduced the amount of water needed in the flame duct per launch from 200,000 gallons to 70,000 gallons. Up to 2.52 million gallons of water per year would be used in the flame duct to reduce vibration impacts. Until November 2022, SpaceX used a deluge water system on the pad during each launch operation that used up to 330,000 gallons of water per static fire and launch. However, this system has been replaced by a closed-loop system for cooling water that eliminates the need to utilize launch pad water for cooling. As a result, water is no longer used for deluge. In addition to water used for support of launch activities, approximately 2.1 million gallons per year are used to support general non-launch activities at SLC-4. This general use would increase by approximately 1,277,336 gallons per year under the Proposed Action.

As was described in the 2017 BO, flame duct water may be ejected during launches. Based on prior Falcon 9 missions, approximately half of the volume of water remains in the flame duct and half is expelled as water and water vapor. Approximately one quarter of the water ejected is expelled as steam, with the remaining quarter expelled as liquid water into facility stormwater swales which discharge into Spring Canyon. Water discharged as part of this action would meet the thresholds identified by the Regional Water Quality Control Board in the statewide low threat discharge to surface waters permit. The maximum temperature of the water and water vapor is expected to be up to 130 degrees Fahrenheit (^{o}F) by the point at which it would reach Spring Canyon. To avoid and minimize impacts on nesting migratory birds, SpaceX maintains all vegetation to just above ground level within a 3.3-acre (ac.) (1.3-hectare [ha]) area of Spring Canyon adjacent to SLC-4 (hereafter referred to as the vegetation management area) that is impacted by the ejection of water and steam.

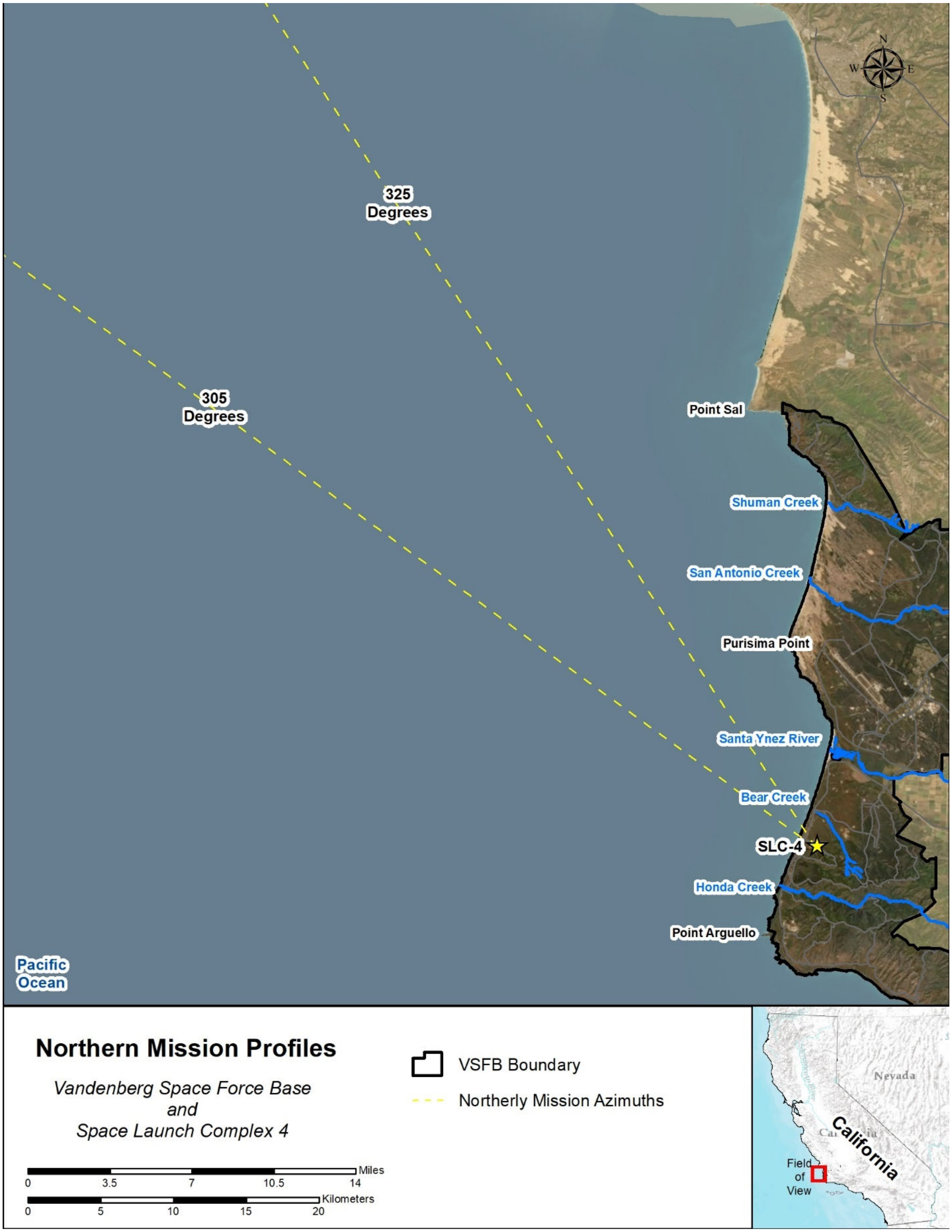

Figure 2.2-1. Northern mission azimuths.

2.2.2 First Stage Recovery Operations

The Proposed Action includes conducting first stage recovery through the boost-back and landing of the Falcon 9 first stage booster in the same manner as described in the 2017 BO (USFWS 2017a). Landing locations would be specific to each mission. Following each launch, SpaceX would perform a boost-back and landing of the first stage up to 36 times, either downrange on a droneship in the Pacific Ocean or at SLC-4W at VSFB. As analyzed in the 2017 BO (USFWS 2017a), no more than 12 first stage landings would occur at SLC-4W per year. Landing operations at SLC-4W would continue to utilize approximately 40,000 gallons per landing or up to 480,000 gallons per year. The Proposed Action includes expanding the potential landing area in the Pacific Ocean to the Proposed Landing Area, shown in Figure 2.2-2, to accommodate new trajectories.

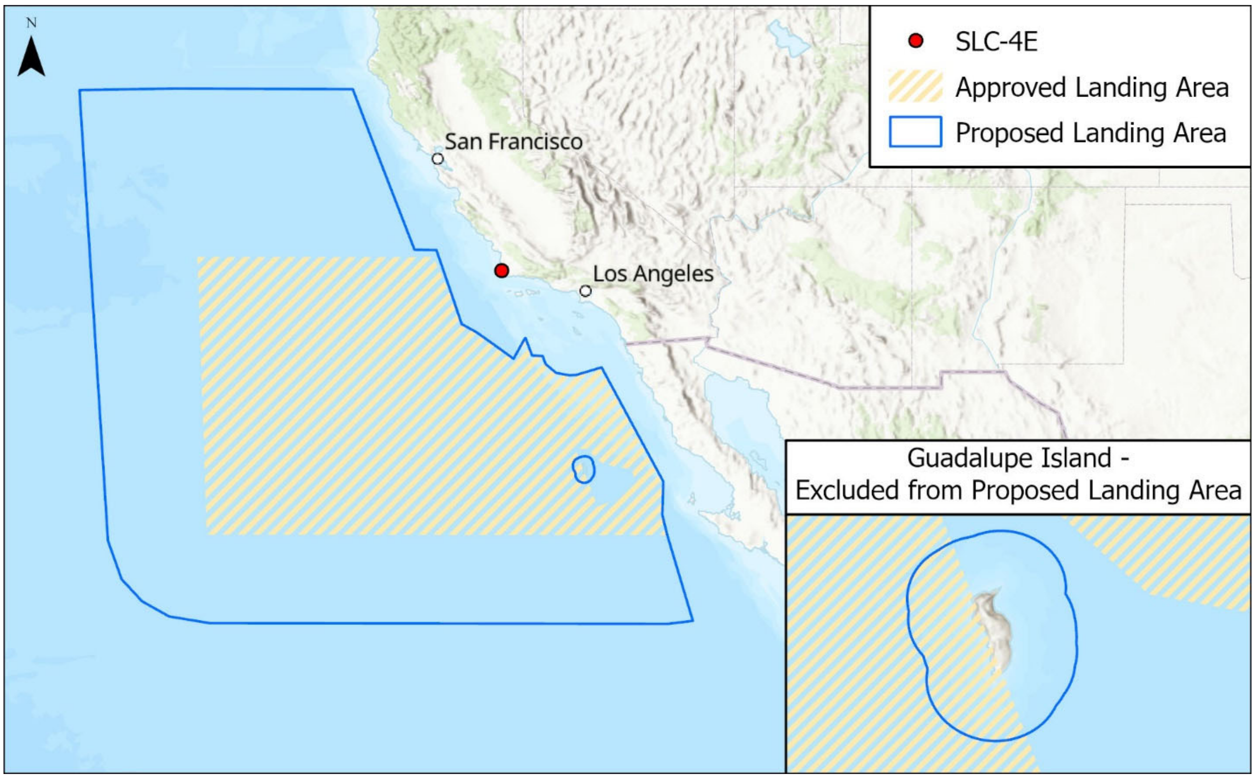

Figure 2.2-2. Proposed droneship landing areas.

SpaceX transports first stages from the Port of Long Beach to the VSFB Harbor via a "roll-on-roll-off" (RORO) barge. The first stage would be transferred from the droneship to SpaceX's Self-Propelled Modular Transport that is positioned on a small, low draft barge. The barge would be pulled by a tug from the Port of Long Beach into the VSFB Harbor. A support tug would assist the barge and primary tug in maneuvering into and out of the VSFB Harbor. The first stage would then be driven off the barge and travel from VSFB Harbor to the hangar at SLC-4E, where it would be unloaded. The Proposed Action would include up to 36 events per year utilizing the RORO barge and tugs at the VSFB Harbor.

2.2.3 Launch and Landing Noise

Rocket Engine Noise

Engine noise was modeled using RUMBLE v. 2.0, a publicly available software tool developed by Blue Ridge Research and Consulting, LLC to model rocket engine noise. This sophisticated model incorporates numerous components, including the acoustic power of the rocket engine source, forward flight effects, the angle from the source to the receiver (directivity), Doppler effect, propagation between the source and receiver (ray path), atmospheric absorption, and ground interference to estimate received noise levels (Bradley et al. 2018). RUMBLE assumes the surface of the earth is flat and therefore does not account for attenuation due to landforms. Therefore, the estimates of engine noise levels below are conservative for areas shielded by hills, bluffs, or other features, such as buildings or dense vegetation.

Engine noise produced during launches would be audible across most of VSFB and the immediate surrounding area (Figure 2.2-3). Landing noise would impact a substantially smaller area along the coast between Bear Creek and Honda Creek (Figure 2.2-4). Landing noise follows launch and associated launch engine noise by approximately 5 to 7 minutes and typically occurs slightly before the sonic boom impacts land. Static fire engine tests, which typically occur 1 to 3 days prior to launch and last up to 7 seconds per event, would generate noise across south VSFB and portions of north Base (Figure 2.2-5).

Sonic Boom

During ascent, a sonic boom (overpressure of impulsive sound) with a peak of approximately 3.0 to 5.0 pounds per square foot (psf) would be generated. Depending on the launch trajectory, the sonic boom may or may not impact the surface of the earth. Since 2017, approximately 24 percent (7 out of 29) Falcon 9 launches from SLC-4 have not produced sonic booms that impact the surface of the earth because the ascent of the rocket was too steep. When the sonic booms do impact the earth's surface, they primarily impact the Pacific Ocean, but may overlap the Northern Channel Islands (NCI; see example shown in Figure 2.2-6). Since 2017, 7 out of the 22 launches that produced sonic booms that impacted the surface of the earth impacted the NCI. As mentioned above, SpaceX proposes to add a northerly mission profile with launch azimuths between 305 and 325 degrees (Figure 2.2-1). Sonic boom modeling determined that launches with these northerly mission profiles will only impact the ocean's surface with no impacts to land.

During descent, a sonic boom would also be generated. Prior modeling estimated that sonic booms produced during landing at SLC-4W may reach up to 8.5 psf at the immediate landing location (MSRS 2017). However, the six Falcon 9 missions conducted with first stage landing at SLC-4W have had a maximum modeled sonic boom of between 2 and 5 psf (see example in Figure 2.2-7). Although unlikely, sonic booms up to 3.1 psf may also impact the NCI during landing events at SLC-4 or on droneships in offshore areas near VSFB. However, during the majority of downrange droneship landings in the proposed landing areas, sonic booms would be directed entirely at the ocean surface without impacting any land (see examples shown in Figures 2.2-8 and 2.2-9).

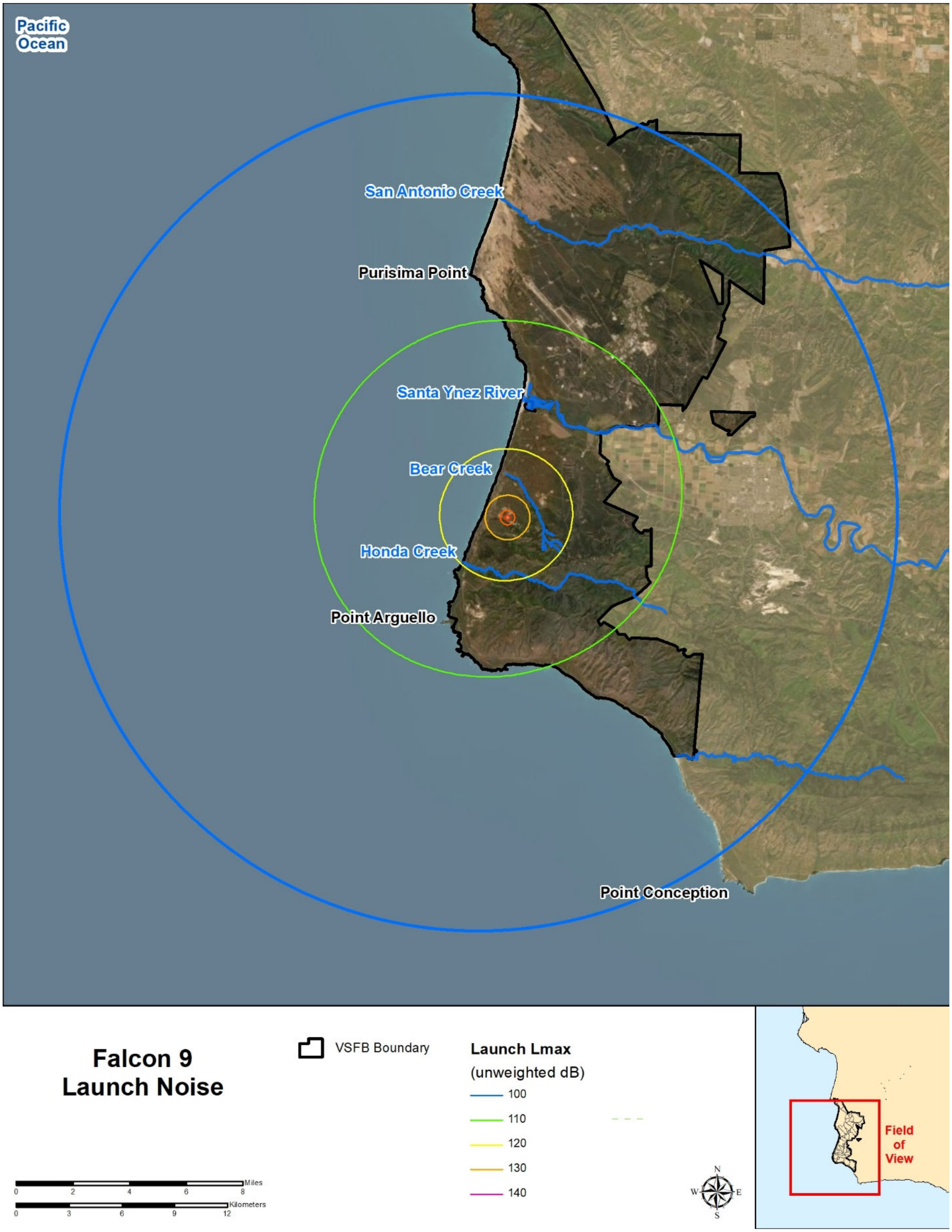

Figure 2.2-3. Maximum unweighted engine noise during Falcon 9 launch from SLC-4E.

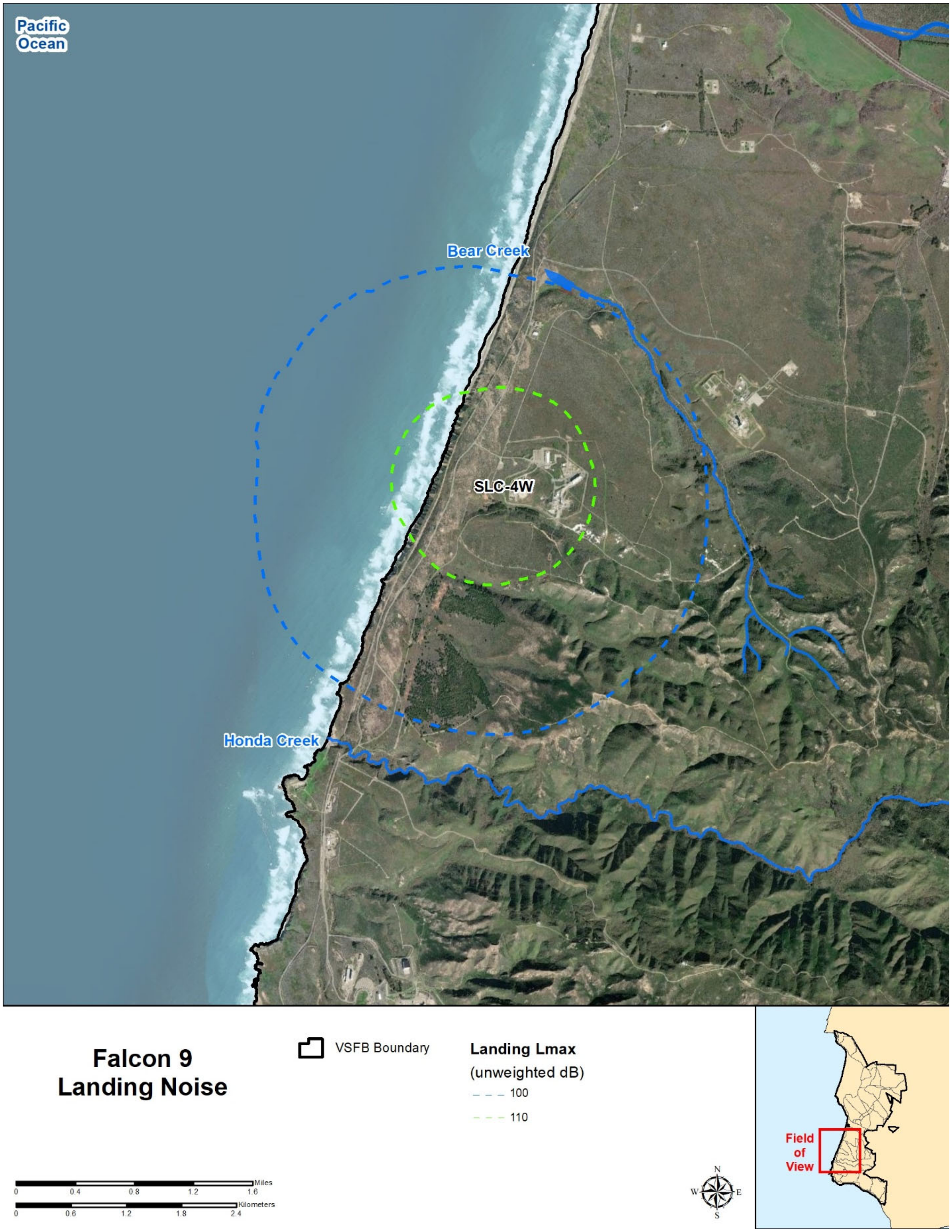

Figure 2.2-4. Maximum unweighted engine noise during Falcon 9 first stage landing at SLC-4W.

Figure 2.2-5. Maximum unweighted engine noise during Falcon 9 static fire at SLC-4W.

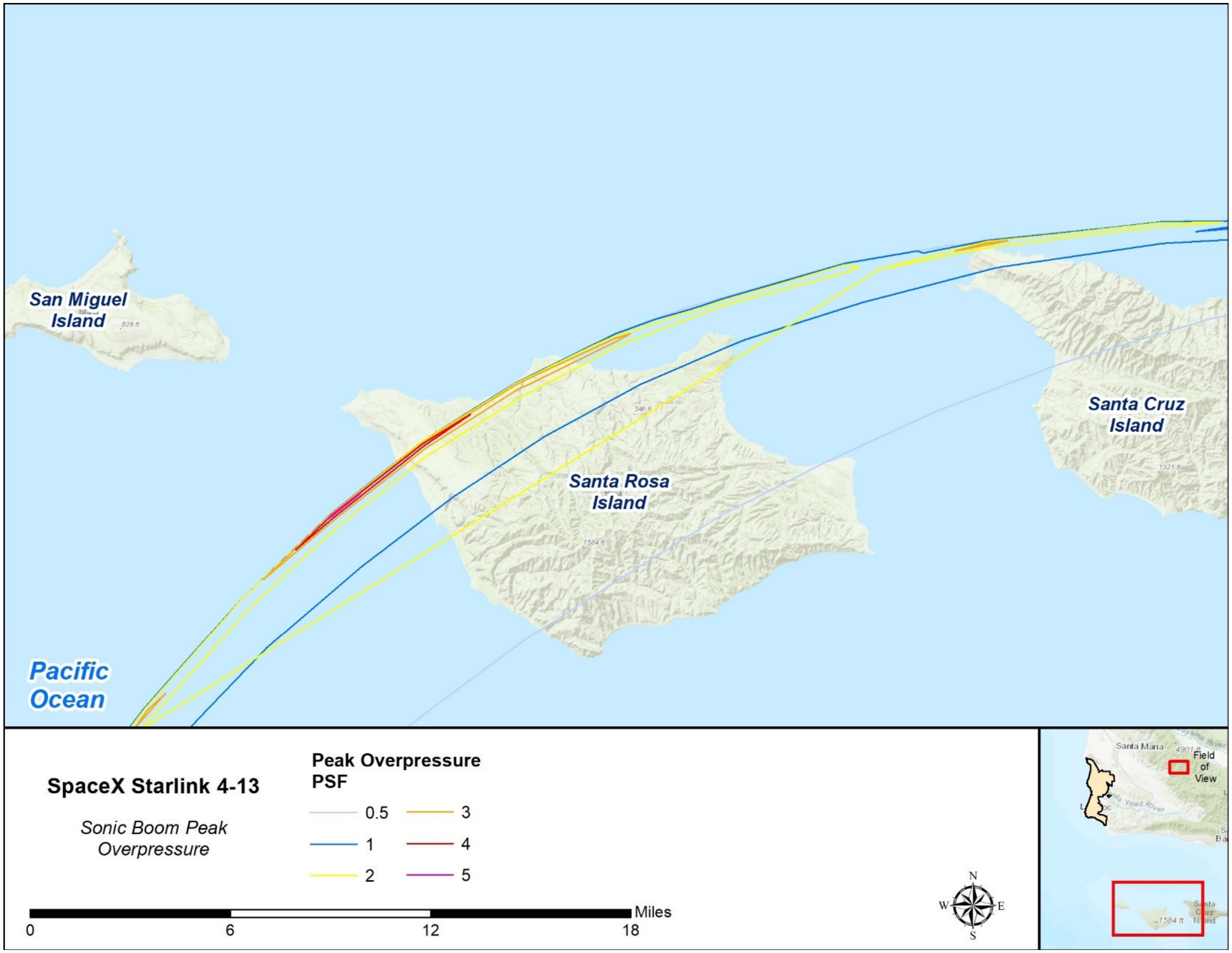

Figure 2.2-6. Sample sonic boom profile generated during launch of Falcon 9 from SLC-4E.

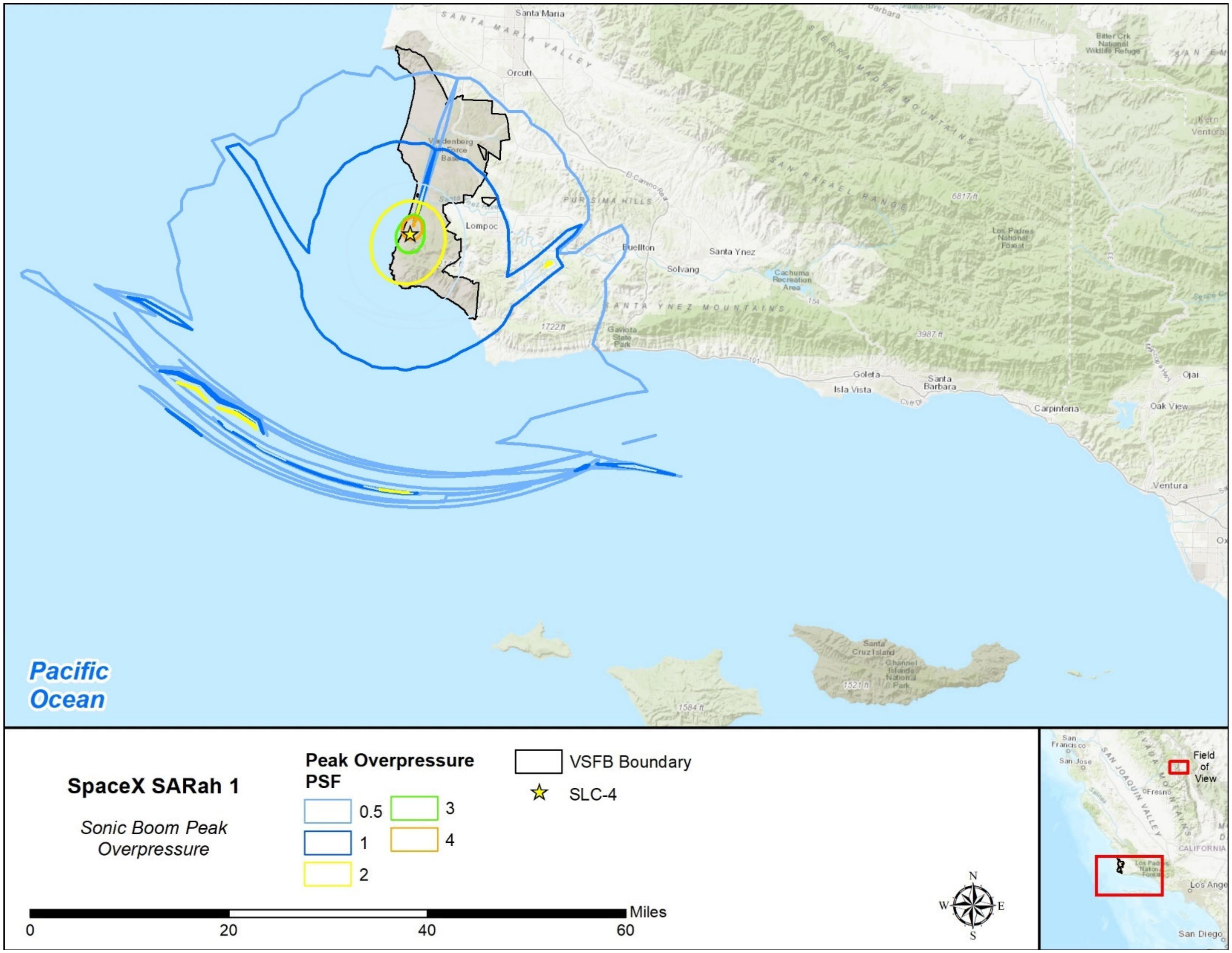

Figure 2.2-7. Example of a typical sonic boom profile for Falcon 9 first stage landing at SLC-4W.

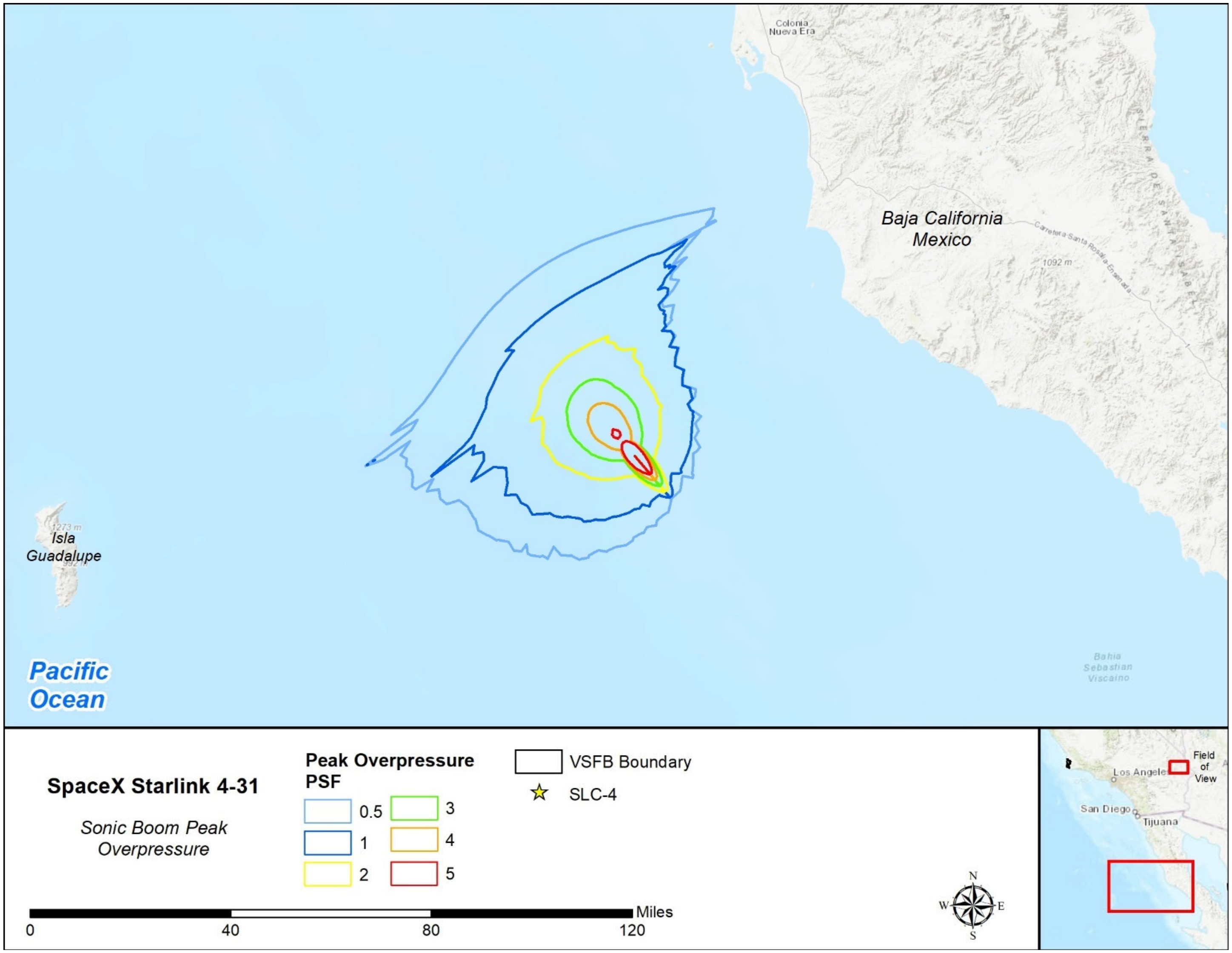

Figure 2.2-8. Example of a typical sonic boom profile for Falcon 9 first stage landing on a droneship in the proposed landing areas with a southerly mission profile.

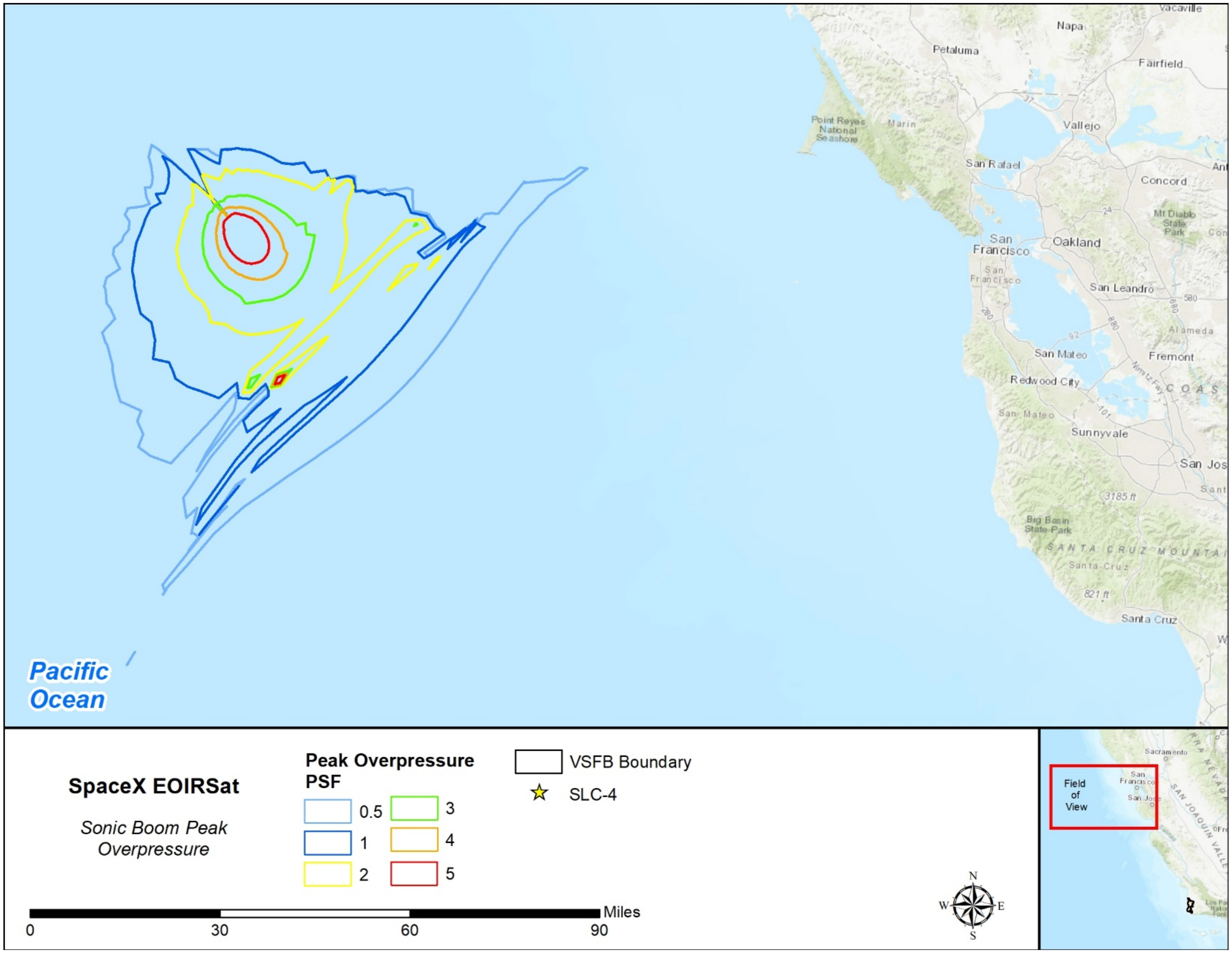

Figure 2.2-9. Example of a typical sonic boom profile for Falcon 9 first stage landing on a droneship in the proposed landing areas with a northerly mission profile.

2.3 Avoidance, Minimization, Monitoring, and Mitigation Measures

The minimization and monitoring measures listed below would be implemented to avoid, minimize, or characterize the effects of the Falcon 9 launch vehicle, on the CRLF, SNPL, LETE, and California condor. There are no minimization or monitoring measures proposed for TWG, UTS, MAMU, or southern sea otter. There are no feasible methods to minimize the intensity of the sonic boom or engine noise; however, as discussed in Section 2.2.3, the estimates of noise levels are conservatively high, since the modeling does not consider attenuation due to landforms. Monitoring measures are set forth for listed species likely to be affected by noise.

Avoidance and minimization measures included in this BA require various levels of biological competency from personnel completing specific tasks, as defined below:

- Permitted Biologist: Biologist with a valid and current USFWS section 10(a)(1)(A) Recovery Permit or specifically named as an approved biologist in a project-specific Biological Opinion (BO). The USSF will coordinate with the USFWS prior to assigning permitted biologists to this project.
- USFWS Approved Biologist: Biologist with the expertise to identify listed species and species with similar appearance. The USSF will review and approve the resumes from each individual, and then submit them to the USFWS for review and approval no less than 15 days prior to the start of the Proposed Action. Each resume will list their experience and qualifications to conduct specific actions that could potentially affect listed species and their habitats. A USFWS approved biologist could train other biologists and personnel during surveys and project work; in some cases, a USFWS approved biologist could also provide on-site supervision of other biologists.
- Qualified Biologist: Biologist trained to accurately identify specific federally listed species and their habitats by either a permitted or USFWS approved biologist. This person could perform basic project monitoring but would need to have oversight from a permitted or USFWS approved biologist. Oversight will require a permitted or USFWS approved biologist to be available for phone/email consultation during the surveys and to have the ability to visit during monitoring/survey activities if needed.

2.3.1 General Environmental Protection Measures

The following protection and monitoring measures would apply to all aspects of the Proposed Action to protect and minimize effects on biological resources:

2.3.2 California Red-legged Frog

- Vegetation Management Area
  - One day prior to vegetation removal from Spring Canyon, a qualified biologist will conduct surveys for CRLF within the area to be mowed. A USFWS Approved or Permitted biologist will capture any CRLF present if possible and released at the nearest suitable habitat within Spring Canyon outside of the vegetation management area, as determined by the biologist. The biologist will also be present during vegetation removal to capture and relocate CRLF to the extent that safety precautions allow. This biologist will also search for injured or dead CRLF after vegetation removal to document take.

- A qualified biologist will perform one CRLF survey annually during peak breeding season in Spring Canyon when individuals are most likely to be present and detectable. If CRLF are not encountered at the time of this survey, no subsequent pre/post launch surveys would occur. If CRLF is found to be present during the annual survey, pre- and post-launch surveys and relocation of any CRLF encountered would occur for each subsequent launch event.

- CRLF Baseline and Launch Monitoring:
  - Quarterly night surveys for CRLF and spring tadpole surveys of lower Honda Creek will be conducted to compare baseline CRLF occupancy data collected over the past 10 years and assess if there are any changes in CRLF habitat occupancy, breeding behavior (calling), and breeding success (egg mass and tadpole densities). The following will be recorded and measured during the surveys:
    - CRLF detection density (number of frogs per survey hour), following the same survey methods conducted previously at these sites and throughout VSFB
    - CRLF locations and breeding evidence (e.g., calling, egg masses)
    - Environmental data during surveys (temperature, wind speed, humidity, and dewpoint) to determine if environmental factors are affecting CRLF detection or calling rates
    - Annual habitat assessments to measure flow rates, stream morphology, depths, and sediment to determine if any changes in CRLF metrics are associated with other environmental factors, such as drought
    - Locations and densities of co-occurring anurans, including bullfrogs (*Lithobates catesbeianus*) and Baja California tree frogs (*Pseudacris hypochondriaca*)
  - Bioacoustic monitoring will be conducted annually during CRLF breeding season (typically November through April, depending on rainfall) to characterize the noise environment and determine if there are changes in calling behaviors as SpaceX's Proposed Action commences and continues. Passive noise recorders and environmental data loggers (temperature, relative humidity, dew point) would be placed at two suitable breeding locations on lower Honda Creek. The bioacoustic monitoring would allow impacts of launch, static fire, and SLC-4W landing events on calling behavior during the breeding season to be characterized and analyzed to assess whether CRLF calling frequency is affected by Falcon 9 noise events.
  - If CRLF occupancy, calling frequency, or tadpole densities decline from baseline by 15 percent or more, the 15 percent decline from baseline is maintained for two consecutive years, and the decline cannot be attributed to changes in environmental factors or other impacts unrelated to SpaceX, VSFB would mitigate for the loss of suitable habitat, as discussed below.
- CRLF Mitigation
  - The USSF will create new CRLF breeding habitat at a 2:1 ratio (habitat enhanced: habitat affected) for adverse effects to occupied CRLF habitat, as determined above. Restoration would occur at the San Antonio Creek Oxbow Restoration Area, an established wetland mitigation site that is located outside of areas

impacted by launch noise on VSFB (Figure 2.3-1). This abandoned tract of agricultural land (Figure 2.3-2) was historically occupied by riparian vegetation and is a suitable location to improve San Antonio Creek and provide breeding habitat for CRLF.

- Restoration, which has already been conducted at this site for other projects, will be conducted in the "expansion area" adjacent to the restoration area (Figure 2.3-3), involve digging a channel that reaches ground water, and use the spoils to create a berm that will be planted with willows (Figure 2.3-4). This method is already being used at the site and has proven successful at creating deep water aquatic habitat, suitable for CRLF breeding, and riparian woodland that simulate naturally occurring high-flow channels.
- Actions taken within this area will include site preparation via herbicide application, plowing, container plant installation, seeding, willow pole planting (via water jet, hand-held power auger, or manually driving a steel rod into the ground), and watering via water truck. The mitigation actions for CRLF are included under an existing USFWS BO (2016-F-0103; USFWS 2018) and all applicable avoidance, minimization, and monitoring measures required under BO 2016-F-0103 would be implemented.

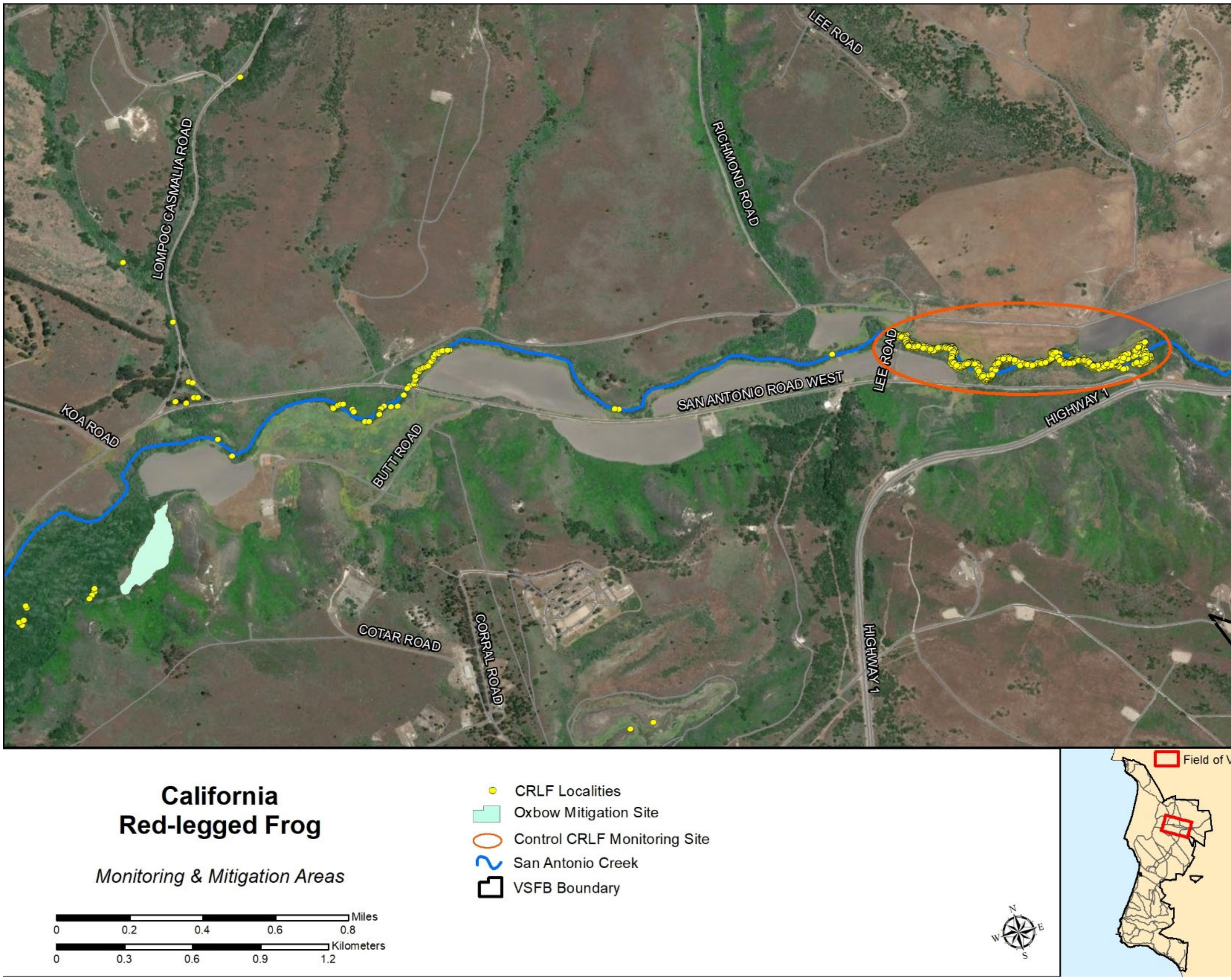

Figure 2.3-1. California red-legged frog Oxbow mitigation site and control monitoring location. (Note: the depicted distribution of CRLF localities is a factor of where prior survey efforts were performed, not actual occurrence.)

Figure 2.3-2. Aerial view of San Antonio Creek "Oxbow" restoration site prior to restoration efforts that are currently being conducted.

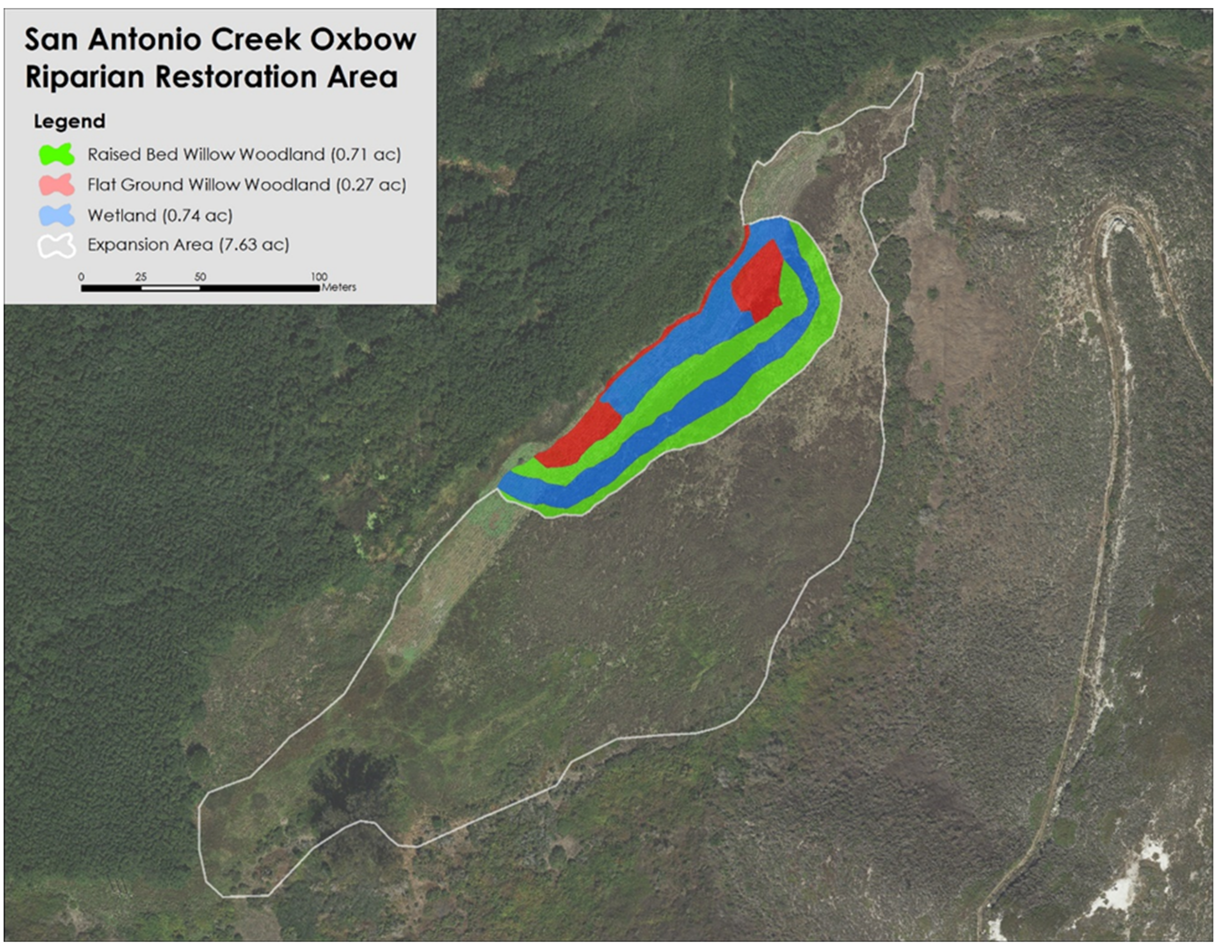

Figure 2.3-3. Current restoration efforts (blue, red, and green) and existing expansion area that would be restored at a 2:1 mitigation ratio.

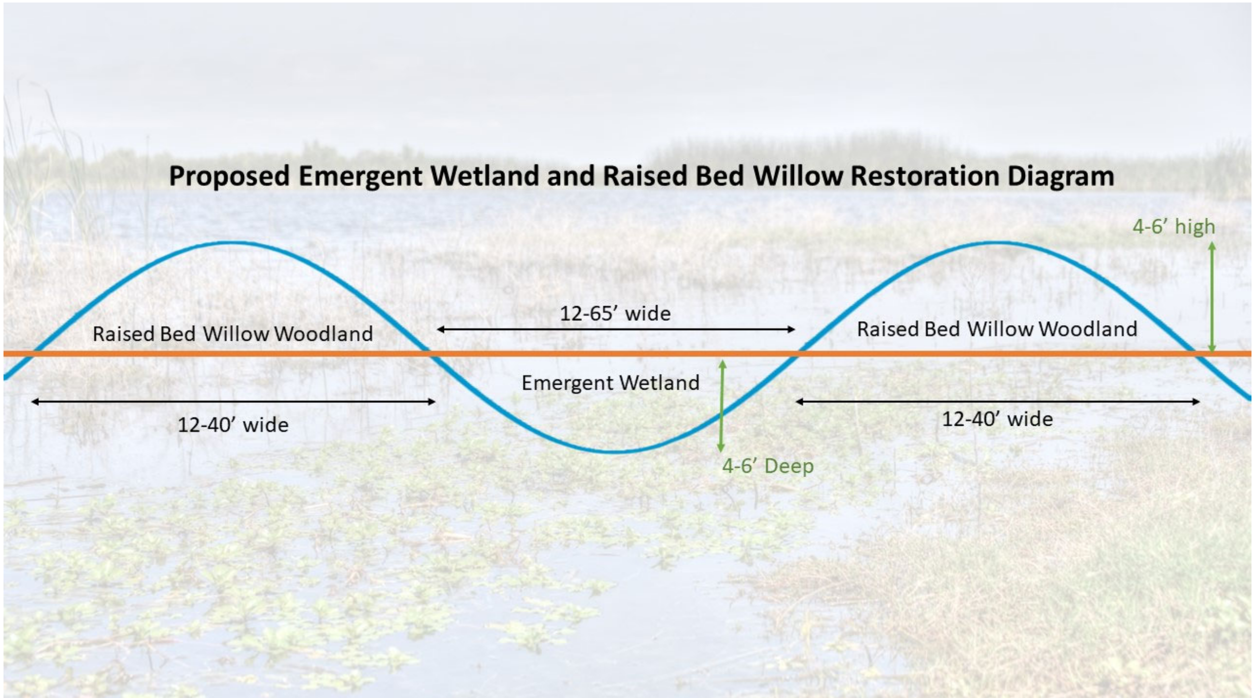

Figure 2.3-4. Contouring plan as currently being conducted to successfully create wetland.

2.3.3 Western Snowy Plover

- Due to the proposed frequency of noise events motion triggered video cameras would be used during the breeding season to determine nest fates and potential impacts to nests due to launches and landings to reduce disturbance associated with human activity within breeding habitat.
  - At least 10 percent of active nests at South Surf Beach will be monitored with motion triggered video cameras during the breeding season.
  - Cameras will be placed in a manner to minimize disturbance to nesting plovers; this will be determined in the field based on the best judgement of a permitted biologist.
- Acoustic monitoring will be conducted throughout the SNPL breeding season by placing sound level meters immediately inland of South Surf Beach during the breeding season to characterize the noise environment and any related launch and landing associated disturbance.
- The current SNPL monitoring program on VSFB will be augmented by performing geospatial analysis of nesting activity on South Surf Beach to assess potential adverse effects from Falcon 9 noise events.
  - The current Base-wide SNPL monitoring program estimates breeding effort, nest fates, and fledging success while recording patterns of habitat use through the season. Geospatial analysis will be performed annually to identify declines in population, nesting activity, and reproductive success that may result from cumulative effects of multiple launches and landings from SLC-4.

- If geospatial analysis shows that a statistically significant decline (defined as a decline greater than the baseline annual variation in these variables over the past 10 years at South Surf Beach) in population or reproductive success that continues over two consecutive years within the areas impacted by noise from the Falcon 9 and that is not attributable to other factors (e.g., increased predation, coastal flooding, or other factors), the USSF will mitigate for this impact (see below).

- SNPL Mitigation
  - The USSF will increase predator removal efforts to include the non-breeding season, particularly focusing on raven removal at and adjacent to VSFB beaches.
  - Given that VSFB has already or will soon (under current planning) restore all available SNPL nesting habitat on Base, the biggest factor limiting recovery is predation, including significant impacts from ravens. The raven population, which has historically been absent to rare in the region, is now common, and has increased substantially over the past two decades due to human-related factors that have allowed their numbers to increase and range to expand. As documented, the raven population continues to increase each year. Conducting predator removal efforts during the non-breading season will help increase adult survival and reduce predator populations on Base prior to the breeding season which should further increase reproductive success.
  - SNPL predator control actions will include trapping, shooting, and tracking individuals on VSFB property. The mitigation actions for SNPL are permitted under an existing USFWS BO (8-8-12-F-11R; USFWS 2015a) and all applicable avoidance, minimization, and monitoring measures required under BO 8-8-12-F-11R will be implemented. VSFB also maintains a USFWS depredation permit.

2.3.4 California Least Tern

- Due to the proposed frequency of noise events motion triggered video cameras would be used during the breeding season to determine nest fates and potential impacts to nests due to launches and landings to reduce disturbance associated with human activity within breeding habitat.
  - At least 10 percent of active nests at South Surf Beach will be monitored with motion triggered video cameras during the breeding season.
  - Cameras will be placed in a manner to minimize disturbance to nesting terns; this will be determined in the field based on the best judgement of a permitted biologist.
- Acoustic monitoring will be conducted throughout the LETE breeding season by placing sound level meters immediately inland of the LETE colony during the breeding season to characterize the noise environment and any related launch and landing associated disturbance.
  - If annual monitoring shows that a statistically significant decline (defined as a decline greater than the baseline annual variation in these variables over the past 10 years) in breeding effort or nest success that continues over two consecutive years within the areas impacted by noise from the Falcon 9 and that is not

attributable to other factors (e.g., increased predation or other factors), the USSF would mitigate for this impact (see below).

- LETE Mitigation
    - The USSF will increase predator removal efforts to include the non-breeding season, particularly focusing on raven removal at and adjacent to VSFB beaches.
    - The biggest factor limiting recovery is predation. Off-season depredation will help reduce the predator population on Base prior to the breeding season which should increase adult survival and reproductive success.
    - Predator control actions will include trapping, shooting, and tracking LETE predators from VSFB beaches and surrounding areas on Base. The mitigation actions for LETE are permitted under an existing USFWS BO (8-8-12-F-11R; USFWS 2015a) and all applicable avoidance, minimization, and monitoring measures required under BO 8-8-12-F-11R will be implemented. VSFB also maintains a USFWS depredation permit.

2.3.5 California Condor

- Movements of California condor would be monitored in the vicinity of VSFB, if present, via satellite telemetry during launch and landing events to determine whether launch and boostback had an effect on movement patterns within the action area. Determination of presence would be coordinated with Ventana Wilderness Society and Service Condor Recovery Coordinator beginning two weeks in advance of each launch event at SLC-4.

2.3.6 Southern Sea Otter

- A USFWS-approved biologist would monitor southern sea otters for landing events at SLC-4W whenever a sonic boom of 2 psf or greater is predicted to be generated by the boost-back that would impact southern sea otter habitat. The monitoring location would be selected based on where pressure waves greater than 2 psf are predicted to impact and the relation of these locations to occupied sea otter habitat, which is commonly Sudden Flats on south VAFB. However, no monitors are allowed within the "Impact Limit Line" during launch or boostback. If otter counts by the United States Geological Survey, or other non-related survey efforts, show the establishment of new populations within the action area, new survey locations would be considered for boost-back and landing events;
    - A USFWS-approved biologist would conduct daily counts of sea otters at the selected monitoring location beginning 3 days before and continuing 3 days after the boost-back and landing. The monitor would note any mortality, injury, or abnormal behavior observed during these counts. Weather permitting; the counts would be conducted between 09:00 AM and 12:00 PM when otters are most likely to be rafting to help maintain daily consistency in detectability. Monitors would use both binoculars (10X) and a high-resolution 50—80X telescope to conduct counts; and
- Acoustic recording equipment would be deployed at or near the monitoring location to document and quantify sonic boom levels.

2.3.7 Annual Report

- A written report will be submitted by 1 March for each calendar year that activities are conducted. The annual report will include documentation of the analysis of impacts of the proposed activities on federally listed species; monitoring results; documentation of the number of individuals of federally listed species harassed (e.g., flushed or relocated from an area), captured, or injured or killed; the date, time, and location of any form of take; approximate size and age of those individuals taken; a description of relocation sites for captured individuals; the acreages of habitat for the federally listed species that were restored/enhanced; and requests for modifying or discontinuing any of the monitoring or mitigation measures.

3 Methods and Action Area

The USFWS's regulations define the "Action Area" as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 Code of Federal Regulations [C.F.R.] section 402.02). Impacts on listed species were considered for all areas potentially impacted by the potential disturbances caused by launch activities, including visual impacts, engine noise, sonic booms, and water use from launches and increased number of personnel to support launch activities. The current water source for VSFB is four water wells located within the San Antonio Creek Basin. There is an existing connection between State water and the VSFB water supply system; however, due to ongoing drought conditions and significant reductions in State water allocations, VSFB will remain on well water from the San Antonio Creek Basin for the foreseeable future. Listed species known to occur within San Antonio Creek were also considered due to water extraction requirements to support SLC-4 operations. The Action Areas for each species was determined by considering each species sensitivity to all facets of the Proposed Action, and existing data and studies on effects of noise impacts on species.

The primary stressor inherent in the Proposed Action is noise. Noise impacts may induce startle and alert responses in individuals. Responses to noise vary, based largely upon individual circumstances and psychological factors unrelated to the intensity of the sound. It is, therefore, difficult to generalize the anticipated behavioral reactions to various noise levels across species. Available studies and data as well as personal observations by qualified biologists in the field were used as the basis for determining what noise levels were likely to produce a significant behavioral response or damage to hearing sensitivity. In most cases, however, no directly applicable studies exist. Therefore, reasonable conclusions were deduced from similar species as proxy to the extent possible and by examining evidence of impacts from other types of noise (e.g., aircraft noise, space vehicle launch noise).

Existing special status species monitoring data, survey reports, and California Natural Diversity Database records were reviewed to assess the potential occurrence, distribution, and habitat use of federally listed species within the broader Action Area.

4 Status of the Species

4.1 Tidewater Goby (Federally Listed Endangered Species)

4.1.1 Status

The TWG was listed as endangered on 7 March 1994 (59 Federal Register [FR] 5494). On 24 June 1999, the USFWS proposed to remove the populations occurring north of Orange County, California, from the endangered species list (64 FR 33816). In November 2002, the USFWS withdrew this proposed delisting rule and retained the TWG's listing as endangered throughout its range (67 FR 67803). The USFWS published a Recovery Plan for the TWG in 2005 (USFWS 2005). In January 2014, USFWS proposed to reclassify the TWG from endangered to threatened (79 FR 14340-14362). In addition, the USFWS is considering a proposed taxonomic split between northern and southern populations of this species, with an expectation to delist the northern population (including all individuals at VSFB). A decision on this proposal has not been made.

4.1.2 Life History

The TWG is a small, bottom-dwelling fish found in California's coastal estuaries, wetlands, lagoons, and lower reaches of coastal streams and rivers. It is an annual species, with individuals typically not living for more than a year. TWG population size is heavily influenced by environmental conditions. In years experiencing high rains, when lagoons are breached, TWG numbers fall as fish are washed out to sea. Individuals able to access refugia, such as that provided by vegetation in littoral marshes, are able to survive flood events. These surviving individuals breed after the lagoons close, allowing populations to rebound the following summer (Swift et al. 1989). Breeding may occur year-round (Swenson 1999), with peak spawning activity usually occurring during the spring and a second peak during the late summer (Swift et al. 1989).

The key threat to TWG is the degradation of coastal lagoons as a result of diversion of water (dewatering streams affects marsh habitat extent, and alters temperature and salinity within the marshes), pollution from agricultural and sewage effluents, siltation (often through sediment generated during cattle overgrazing and feral pig activity), and coastal development. In addition, introduced predatory fish (especially centrarchids and channel catfish [*Ictalurus punctatus*], crayfish [*Procambarus clarkii*], and mosquito fish [*Gambusia affinis*]) pose a direct threat to TWG populations through predation of eggs, larvae, and adults.

4.1.3 Occurrence within the Action Area

TWG have been reported in all the major drainages on VSFB, including Shuman Creek, San Antonio Creek, Santa Ynez River, Honda Creek, and Jalama Creek (Swift et al. 1997). TWG typically favor areas within the fresh-saltwater interface with salinities of less than 12 parts per thousand (Swift et al. 1989). However, this species will range into fresh water and has been recorded up to 7.5 mi (12 km) upstream from the ocean in the Santa Ynez River (Swift et al. 1997).

Potential habitat for TWG within the Action Area includes Honda Creek, the Santa Ynez River, and San Antonio Creek. TWG were first found in the Honda estuary lagoon in 1995 (Lafferty et al. 1999). The species was again documented in 2001; however, seine net surveys conducted in Honda Creek in 2008 indicated that TWG were no longer present (MSRS 2009a). Seine net surveys were again conducted in Honda Creek in 2015 and 2016 with no TWG present (MSRS

2016, 2018a). Despite being easily detectable in shallow water with a flashlight during night frog surveys, no TWG were observed during night CRLF surveys of the Honda Creek estuary for SpaceX launch monitoring activities in January 2022 (J. LaBonte, pers. obs.).

In 2013, the Honda Creek estuary lagoon dried and stayed dry through 2016 before rehydrating in the winter of 2016–2017 (MSRS 2018a). Since 2017, the lagoon has been subject to drying during late summer months, making any longer than short-term occupancy by fish dependent on being able to establish in areas east of Coast Road, but the narrowness and shallowness of the creek in this area makes this unlikely. Occurrence within Honda Creek would be dependent on TWG recolonizing the lagoon if it fills and breaches in response to winter rains. Unless environmental conditions return to a consistently wetter regime conducive to perennial water in the Honda lagoon, any TWG occupancy is likely to be of short duration.

TWG currently occur in the Santa Ynez River from the estuary to 13th Street Bridge and San Antonio Creek, being mostly concentrated in the San Antonio Creek lagoon as compared to its channel (Swift 1997, 1999; MSRS 2018b).

4.1.4 Critical Habitat

The USFWS issued a final rule for designation of Critical Habitat for the TWG on 6 February 2013 (78 FR 8745-8819). VSFB was exempted from critical habitat designation under Section 4(a)(3) of the ESA. USFWS has adopted VSFB's Integrated Natural Resources Management Plan (INRMP; U.S. Air Force 2021), prepared under section 101 of the Sikes Act (16 U.S.C. 670a).

4.2 Unarmored Threespine Stickleback (Federally Listed Endangered Species)

4.2.1 Status

The UTS was listed as endangered in 1970 (35 FR 16047-16048). A Recovery Plan was issued in 1985 (USFWS 1985a).

4.2.2 Life History

UTS are small fish (approximately 6 centimeters) that are short-lived (i.e., rarely surviving 2–3 years; USFWS 1985a). UTS reproduce throughout the year with highest recruitment noted from May to September (USFWS 1985a). These fish are opportunistic feeders and primarily feed on invertebrates and aquatic insects (USFWS 1985a). In San Antonio Creek, UTS coexist with other native and introduced species, many of which likely prey on UTS.

4.2.3 Occurrence in the Action Area

UTS were abundant throughout the Los Angeles basin, but was reported to be extirpated by 1942. As of 1985, UTS was generally restricted to the Santa Clara River drainage in Los Angeles County and the San Antonio Creek drainage in Santa Barbara County (USFWS 1985a). On VSFB, UTS have been found in San Antonio Creek from Barka Slough to the lagoon and mostly in the creek channel rather than the lagoon (ManTech 2009a, Swift 1999). UTSs were previously documented as being most concentrated near the El Rancho Road bridge (Swift 1999).

UTS were introduced into Honda Creek, south of SLC-5, in 1984 (MSRS 2009a). Extensive aquatic surveys conducted in 2008, 2016, and 2017 did not detect any fish in the creek (MSRS 2009a, 2016, 2018a). Between 2008 and 2022, Honda Creek has gone through multiple cycles of drying and rehydration, which would preclude occupancy by and persistence of fish.

4.2.4 Critical Habitat

Critical Habitat for the UTS was proposed in 1980 (45 FR 76012-76015) but has not been finalized.

4.3 California Red-Legged Frog (Federally Listed Threatened Species)

4.3.1 Status

The UFSWS listed the CRLF as threatened on 23 May 1996 (61 FR 25813-25833). In 2002, USFWS issued a Recovery Plan to stabilize and restore CRLF populations (USFWS 2002).

4.3.2 Life History

The CRLF is a member of the family Ranidae and is California's largest native frog. In order to breed, CRLF require water bodies with sufficient hydroperiods and compatible salinity levels to accommodate larval and egg development. Breeding typically takes place from November through April with most egg deposition occurring in March. Eggs require 7 to 28 days, depending on water temperature, to develop into tadpoles. Tadpoles typically require 11 to 20 weeks to develop into terrestrial frogs (USFWS 2002), although some individuals may overwinter in the tadpole stage (Fellers et al. 2001; A. Abela, pers. obs.).

Adult CRLF have been documented traveling distances of over 1.0 mi (1.6 km) during the wet season and spending considerable time in terrestrial riparian vegetation (Tatarian 2008). Christopher (2018) found that 90 percent of the CRLF observations at VSFB within the dry season occurred within 197 ft (60 meters [m]) of riparian or other aquatic habitats. It is thought that riparian vegetation provides good foraging habitat, as well as good dispersal corridors, due to canopy cover and presence of adequate moisture (USFWS 2002).

Habitat loss and degradation, combined with over-exploitation and introduction of exotic predators, were important factors in the decline of CRLF in the early to mid-1900s. Continuing threats to CRLF include direct habitat loss due to stream alteration and loss of aquatic habitat and drought, and indirect effects of expanding urbanization, competition, or predation from non-native species including the bullfrog, catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquitofish, and crayfish. Chytrid fungus (*Batrachochytrium dendrobatidis*) is a waterborne fungus that can decimate amphibian populations and is considered a threat to CRLF populations.

4.3.3 Occurrence within the Action Area

CRLF have been documented in nearly all permanent streams and ponds on VSFB as well as most seasonally inundated wetland and riparian sites (Figures 4.3-1 and 4.3-2; Christopher 2002). CRLF have been consistently documented in Honda Creek (Christopher 2002; MSRS 2009a, 2016, 2018a, 2021a) and during SpaceX launch monitoring activities in January 2022 (MSRS 2022). The Santa Ynez River and Bear Creek, to the north of SLC-4, have CRLF populations and suitable breeding habitat (Christopher 2002; MSRS 2009b, 2014a).

Spring Canyon is an ephemeral drainage located approximately 200 ft south of SLC-4. Spring Canyon has no definable channel through the majority of the drainage and minimal evidence of potential pooling or flow of surface water (MSRS 2014b). Depending on annual rainfall levels, several small areas of Spring Canyon may constitute suitable habitat for CRLF during wet periods when adequate surface water is present; however, in July 2017, after an above-average rain year, a USFWS-permitted biologist reassessed the drainage in support of this 2017 Falcon 9 BA (MSRS 2017) and found no significant changes from the habitat assessment conducted in 2013, including no suitable breeding habitat within the vegetation removal area or downstream. Since 2017, across 11 survey efforts to perform minimization measures associated with the 2017 BO, no suitable habitat has been found, likely a result of the protracted drought conditions in Santa Barbara County. It is therefore unlikely that CRLF occupy this area on a regular basis, other than transitory habitat.

Approximately 2 mi. (3.2 km) south of SLC-4, suitable CRLF breeding habitat is found in Honda Creek, along with scattered CRLF localities in minor wetlands and drainages, across south VSFB, including Bear Creek located 1.0 mi (1.6 km) northeast of SLC-4 (Christopher 2002; MSRS 2009b, 2014a). Suitable upland dispersal habitat exists throughout VSFB between the various riparian zones and ponds on Base but, as noted above, dispersal into these upland habitats is not likely to be as extensive as has been observed in more mesic parts of the range of this species. CRLF also occur throughout San Antonio Creek on VSFB from Barka Slough to the estuary (MSRS 2009a, 2009b, 2016).

4.3.4 Critical Habitat

The USFWS issued a final rule revising the CRLF's Critical Habitat on 16 March 2010 (75 FR 12816–12959). The USFWS excluded VSFB from CRLF Critical Habitat designation pursuant to Section 4(b)(2) of the ESA. However, USFWS designated Critical Habitat for the species along the southeastern (Unit STB-4) and northeastern (Unit STB-2) perimeters of VSFB (Figure 4.3-1).

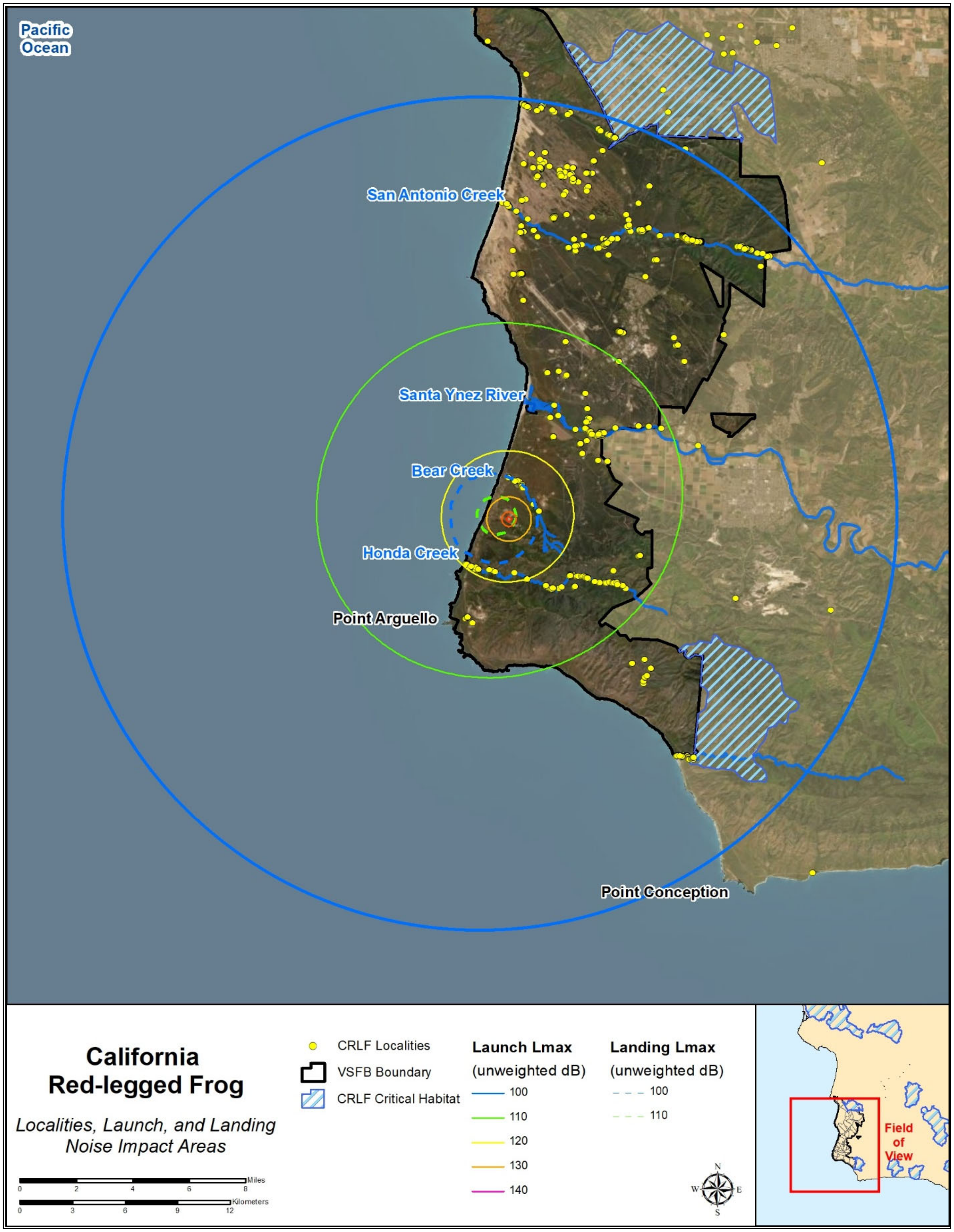

Figure 4.3-1. California red-legged frog localities, Critical Habitat, and rocket engine noise impact areas.

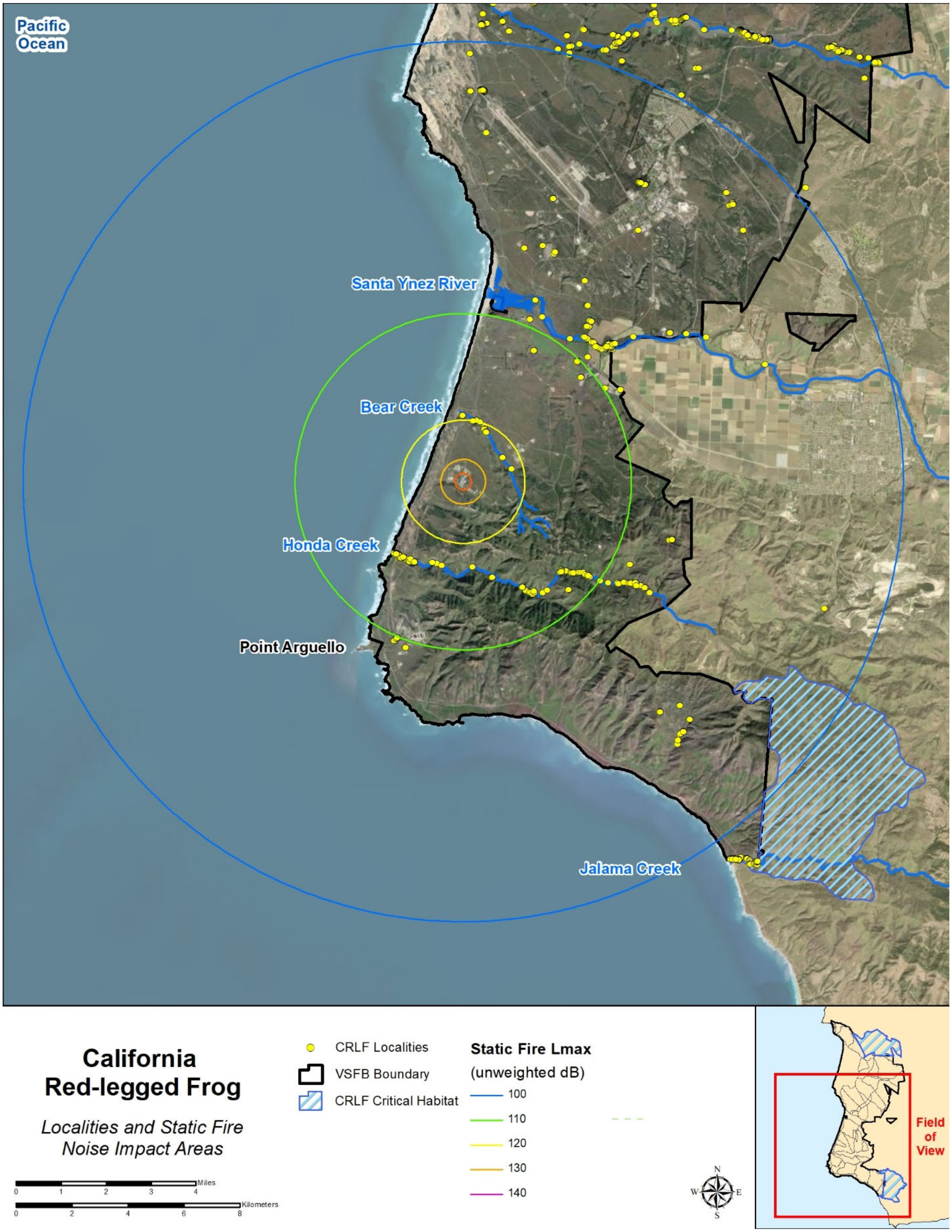

Figure 4.3-2. California red-legged frog localities, Critical Habitat, and static fire noise impact areas.

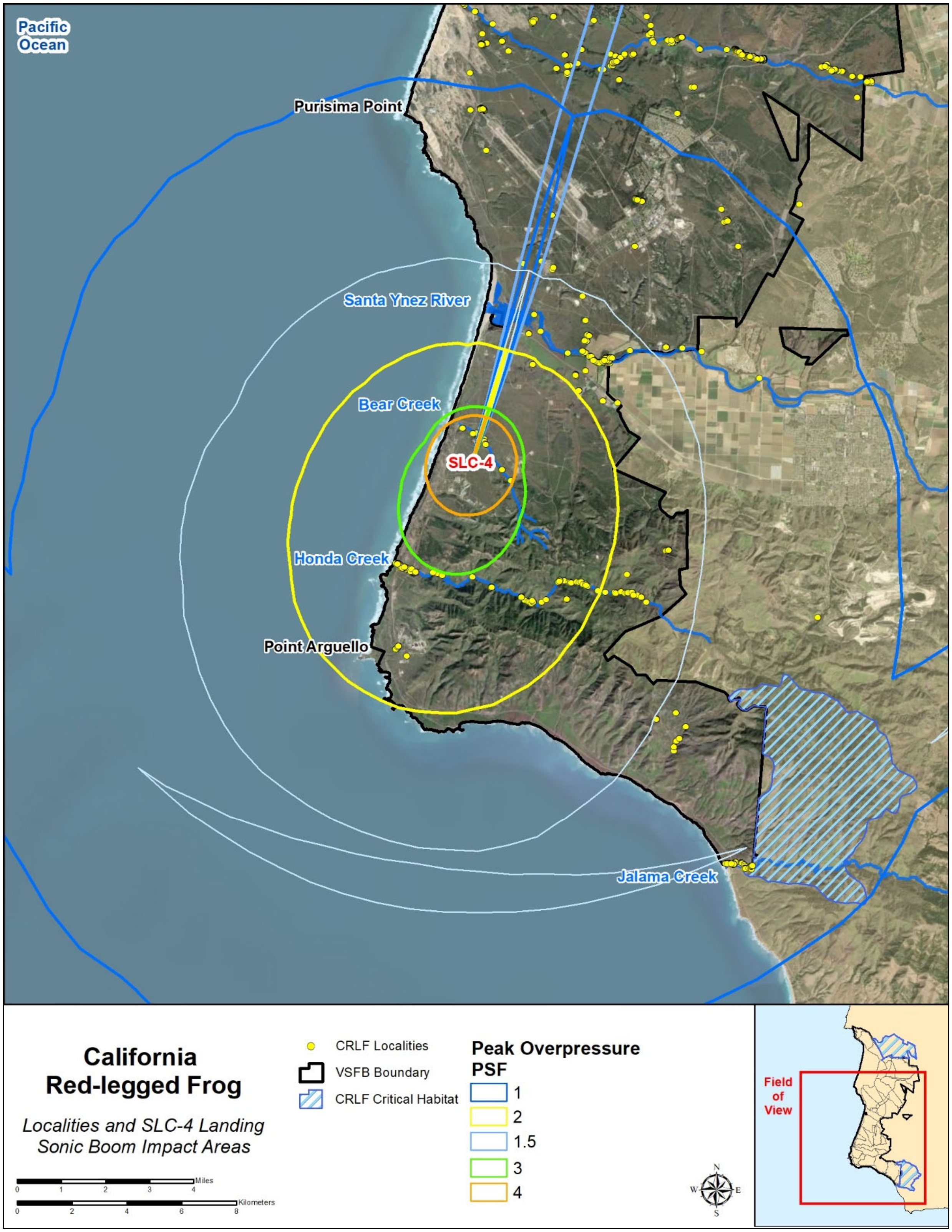

Figure 4.3-3. California red-legged frog localities, Critical Habitat (inset), and sonic boom impact areas.

4.4 Marbled Murrelet (Federally Listed Threatened Species)

4.4.1 Status

The USFWS listed the MAMU as threatened on 1 October 1992 (57 FR 45328) and published a Recovery Plan for the species in 1997 (USFWS 1997). The USFWS completed a 5-year review of the species in 2009 (USFWS 2009).

4.4.2 Life History

The MAMU is a small seabird that breeds along the Pacific coast. It forages in nearshore marine waters on small fish and invertebrates, and flies inland to breed. The species requires abundant prey within foraging habitat. Among alcids, the species is unique because it uses old-growth coniferous forests and mature trees for nesting (USFWS 1997). MAMU are wing-pursuit divers. Although little was historically known about the MAMU movement and home range, more information is becoming available. The first MAMU nest was not documented until 1974. Since then, the MAMU's home range has been determined to be 253 square miles (mi^2) (655 km^2) for non-nesters and 93 mi^2 (240 km^2) for nesters within California. In addition, at-sea resting areas have also been observed an average of 3.2 mi (5.1 km) from the mouths of drainages. MAMU spend nighttime hours resting in the ocean in these at-sea resting areas and commute to foraging areas during the day. Nests have been observed from sea level to 5,020 ft (1,530 m) (USFWS 2009).

MAMU range from Alaska to California and may occur as far south as Baja California. The species is considered rare to very rare much of the year in Santa Barbara County. However, the species may be somewhat regular north of VSFB in the late summer and would be considered casual in the spring (Lehman 2020; eBird 2022). There is no known or suitable breeding habitat for MAMU on VSFB. As such, the non-breeding individuals occur within portions of the Action Area subject to noise impacts (Figure 4.4-1).

4.4.3 Occurrence Within the Action Area

MAMU have been observed semi-regularly off the coast in nearshore waters between the Santa Maria River and offshore of VSFB from on-land observation sites (Figures 4.4-1 through 4.4-3; eBird 2022). Specifically, one individual was observed at an unreported distance offshore from an observation site located approximately 0.5 mi (0.8 km) west of SLC-4 in 2011 (Figures 4.4-1 through 4.4-3; eBird 2021). Two separate sightings were also documented in 1995 offshore of Purisima Point (Figures 4-4.1 through 4.4-3; eBird 2022). MAMU has never been documented breeding on VSFB, nor is any old-growth coniferous forest present on VSFB or in the Action Area.

4.4.4 Critical Habitat

The USFWS designated Critical Habitat for the MAMU on 24 May 1996 (61 FR 26257) and revised this designation on 4 August 2016 (81 FR 51348–51370). There is no designated Critical Habitat for this species within or adjacent to the Action Area. The nearest Critical Habitat is over 160 mi (97 km) to the north near Santa Cruz, California.

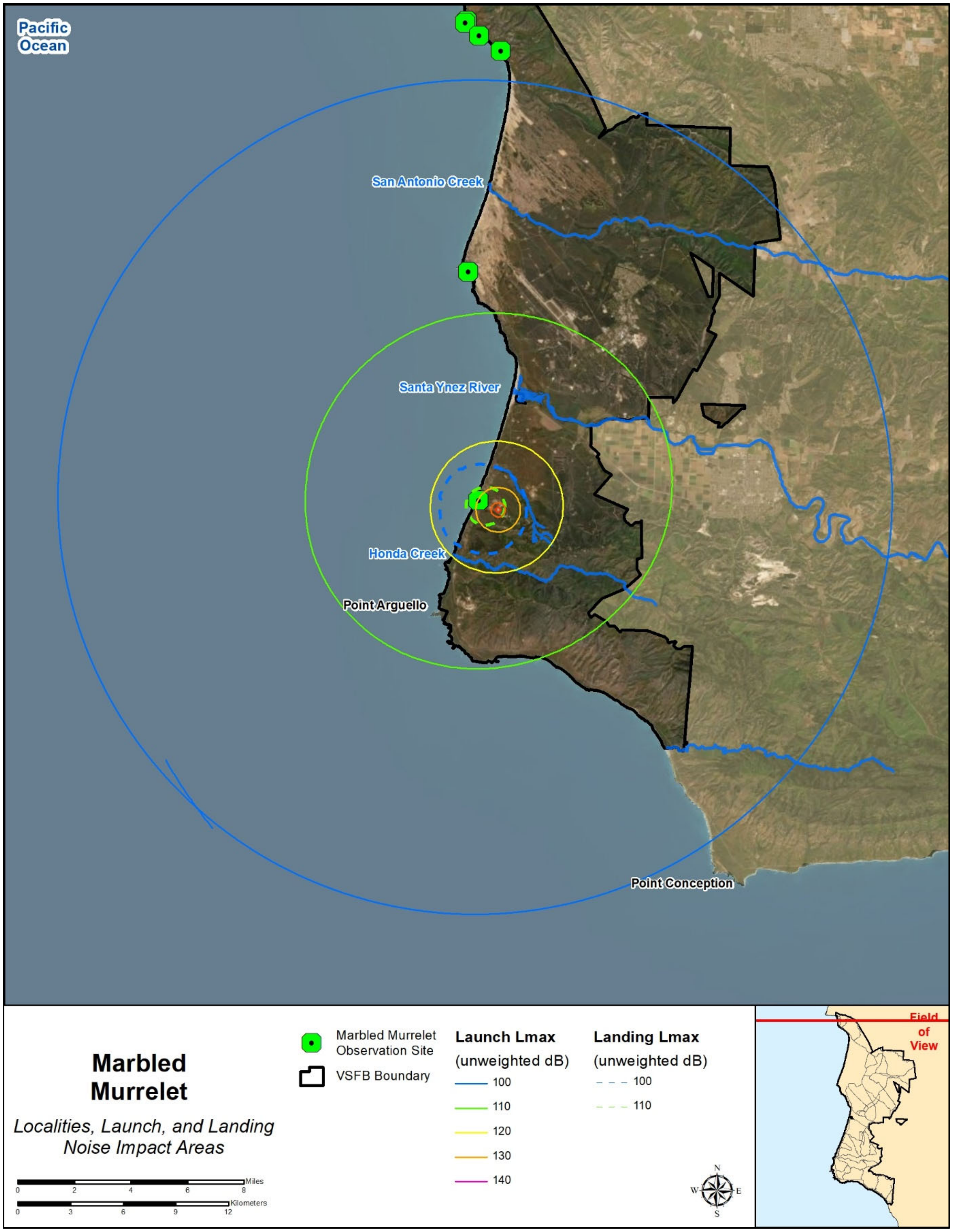

Figure 4.4-1. Marbled murrelet observation sites and launch and landing noise impact areas. (Source: eBird 2022; Note: birds were observed at an unrecorded distance offshore of these observation sites).

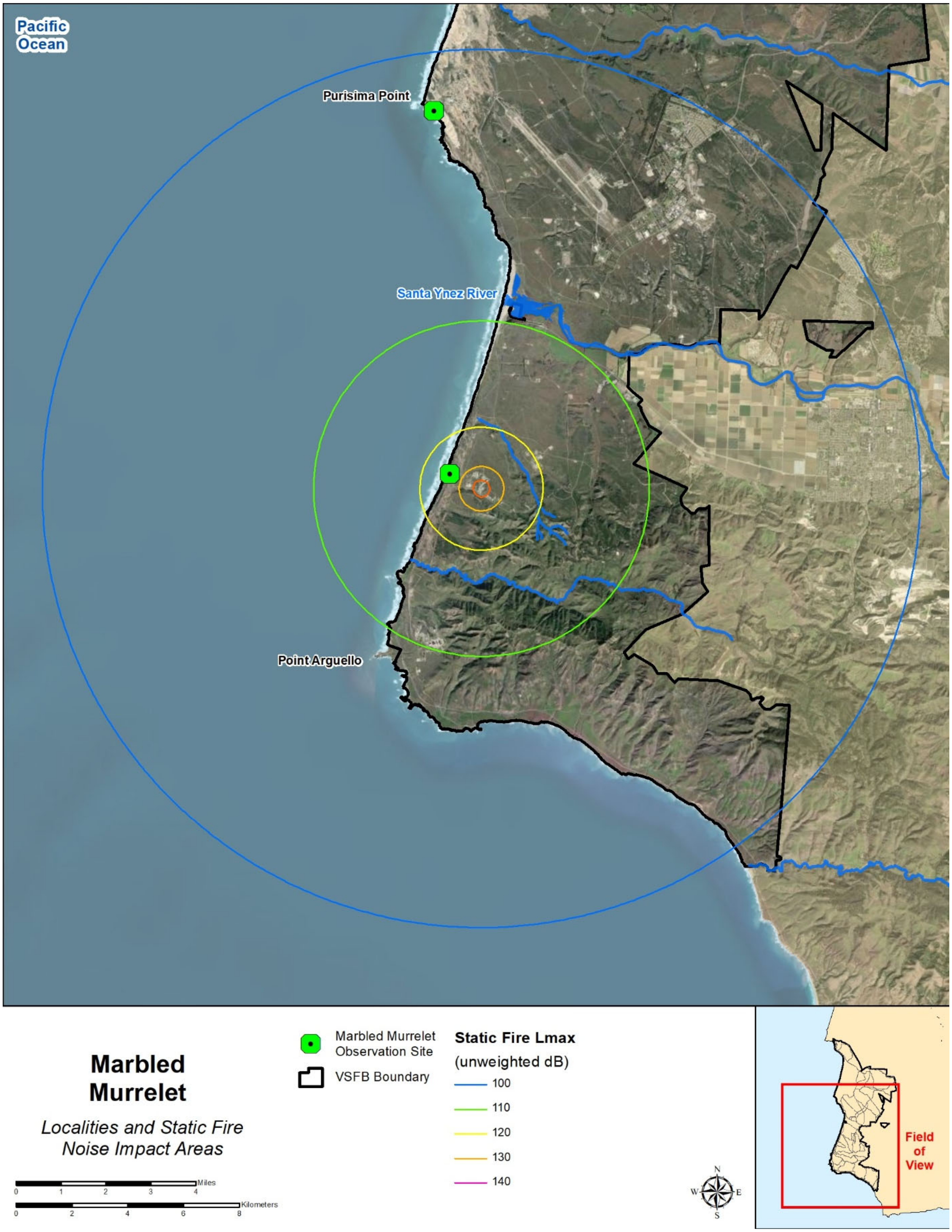

Figure 4.4-2. Marbled murrelet observation sites and static fire noise impact areas. (Source: eBird 2022; Note: birds were observed at an unrecorded distance offshore of these observation sites).

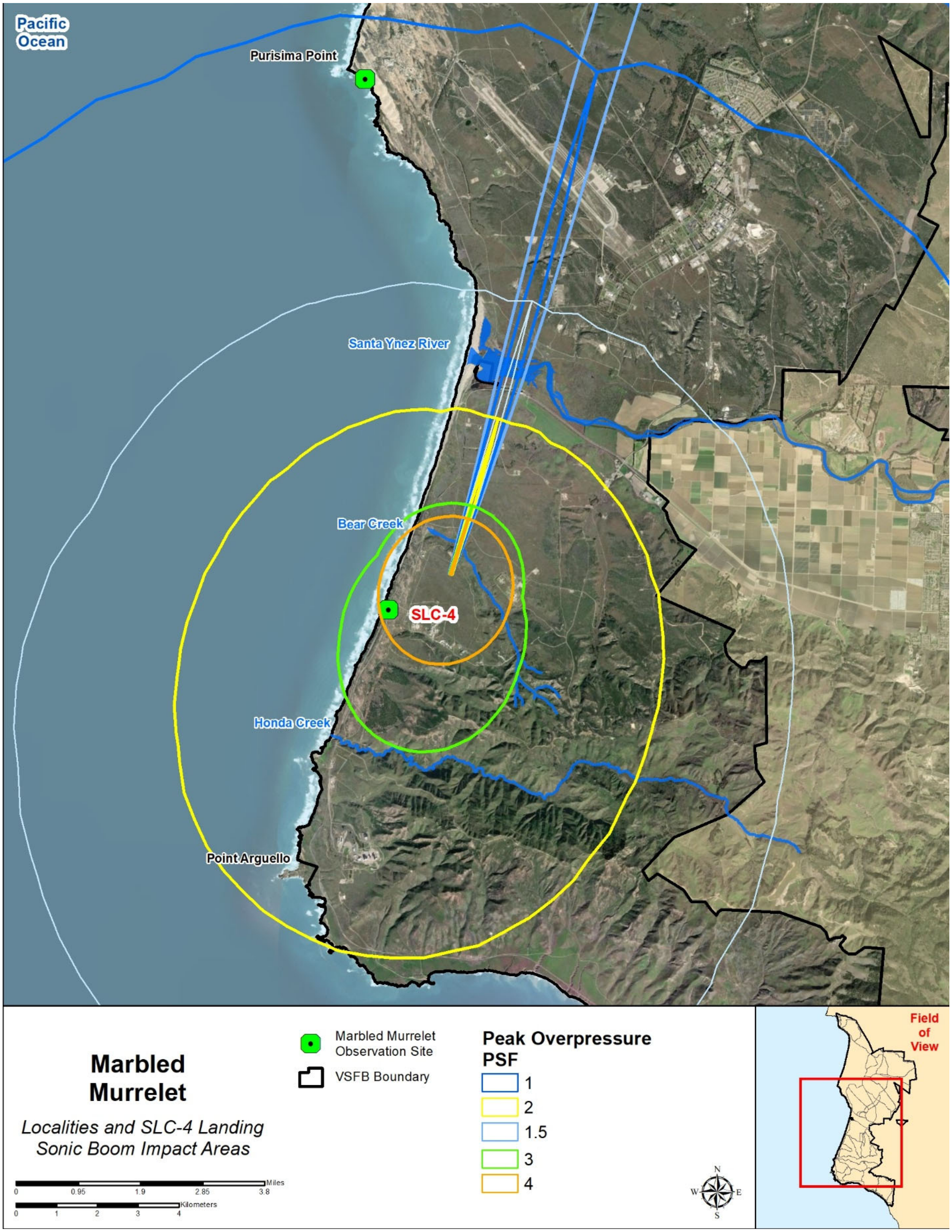

Figure 4.4-3. Marbled murrelet nesting records and sample sonic boom model results for SLC-4W landing events.

4.5 Western Snowy Plover (Federally Listed Threatened Species)

4.5.1 Status

The USFWS listed the Pacific coast population of the SNPL as federally threatened in March of 1993 (58 FR 12864–12874) and published a recovery plan for the Pacific coast population in 2007 (USFWS 2007).

4.5.2 Life History

The SNPL is a small shorebird with a pale tan back, white underparts, and dark patches on the sides of the neck reaching around to the top of the chest. The Pacific coast population of snowy plovers is limited to individuals that nest adjacent to tidal waters. The population's range extends from Southern Washington to Baja California, Mexico.

4.5.3 Occurrence within the Action Area

VSFB provides important breeding and wintering habitat for SNPL, which includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north VSFB (approximately 7.7 mi [12.4 km]). Also included are all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach south to the rock cliffs at the south end of Surf Beach on South VSFB (approximately 4.8 mi [7.7 km]).

VSFB has consistently supported one of the largest populations of breeding SNPL along the west coast of the United States (Robinette et al. 2016). VSFB has performed annual monitoring of SNPL since 1993 (Robinette et al. 2021). In 2014, VSFB supported an estimated 11 percent of California's breeding population (USFWS 2014c). The breeding population of SNPL on VSFB has been highly variable but relatively stable since 2007, with 235 adults and 472 nests initiated in 2021 (Robinette et al. 2021). The nearest SNPL nesting area to SLC-4 is on South Surf Beach, approximately 0.7 mi (1.1 km) northwest of SLC-4 (**Error! Reference source not found.**s 4.5-1 through 4.5-3).

The SNPL is considered a permanent resident of Santa Rosa Island. On San Miguel Island, a high count of 61 SNPL was documented during the 2016–2017 winter window survey; however, counts at San Miguel Island typically document very few to no individuals (USFWS 2017c).

4.5.4 Critical Habitat

The USFWS designated Critical Habitat for the SNPL in 1999 and revised this designation on 29 September 2005 (70 FR 56969–57119) and on 19 June 2012 (77 FR 36727). VSFB was exempted from Critical Habitat designation under section 4(a)(3) of the ESA. The nearest Critical Habitat is approximately 8 mi (13 km) to the south on Santa Rosa Island.

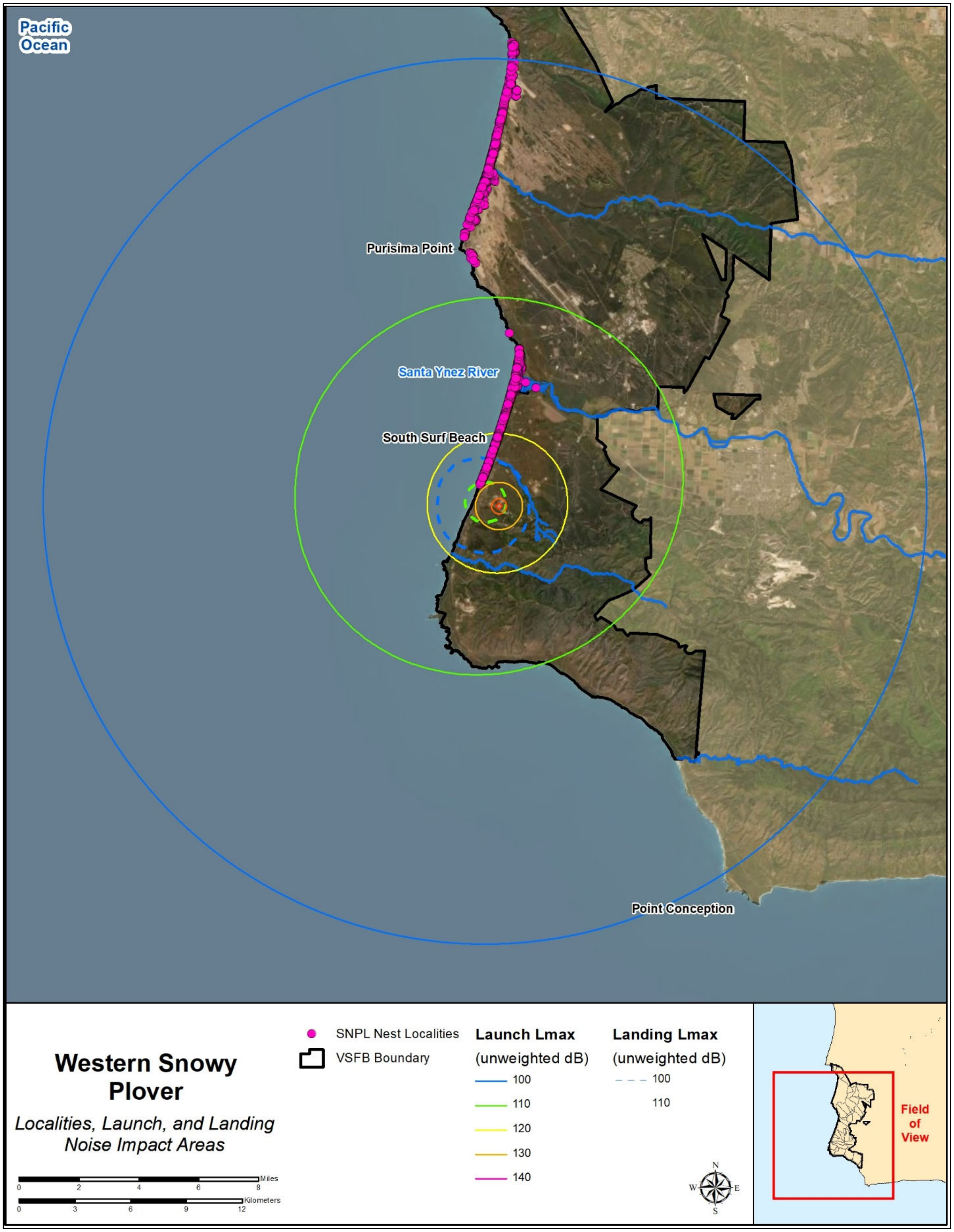

Figure 4.5-1. Western snowy plover nesting records and launch and landing noise impact areas.

Figure 4.5-2. Western snowy plover nesting records and static fire noise impact areas.

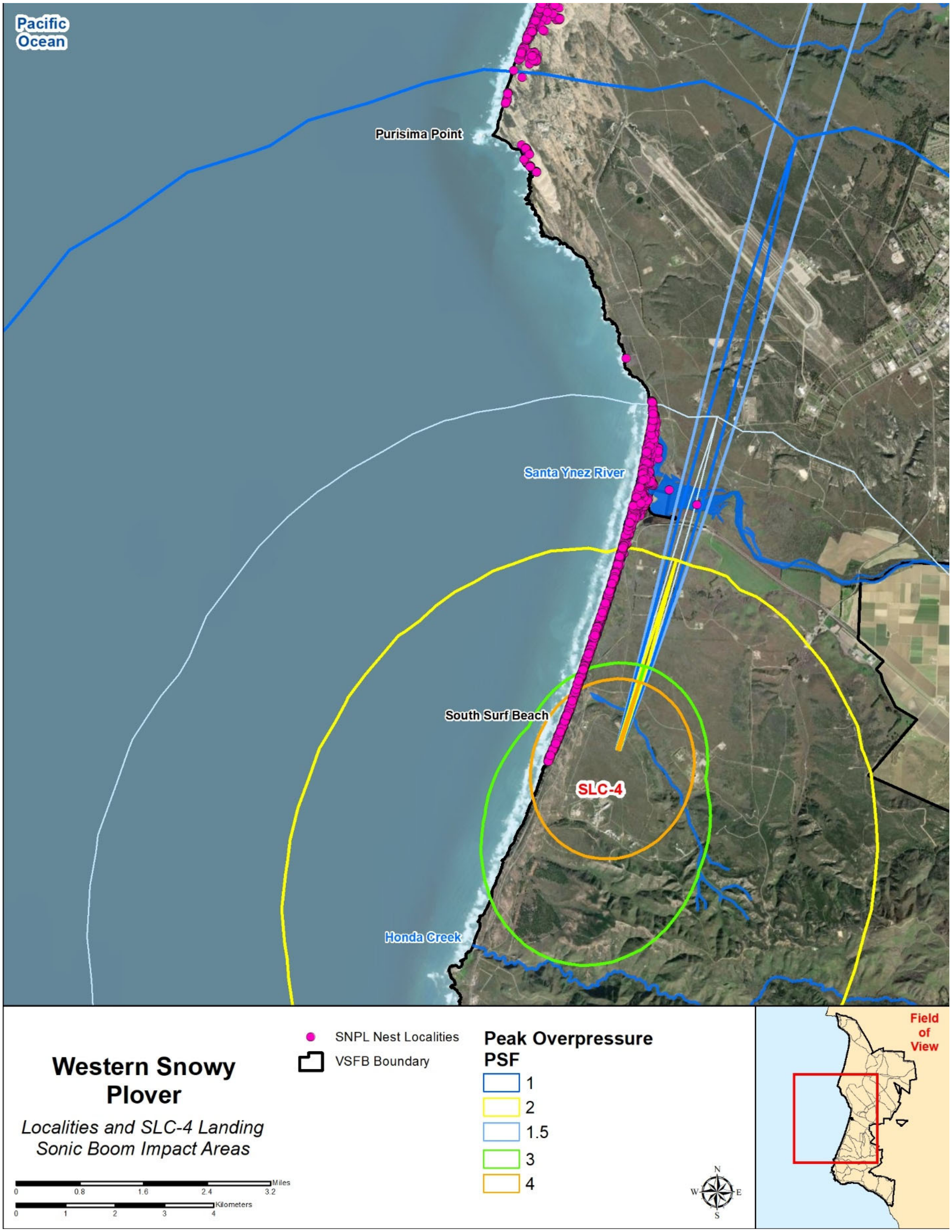

Figure 4.5-3. Western snowy plover nesting records and sample sonic boom model results for SLC-4W landing events.

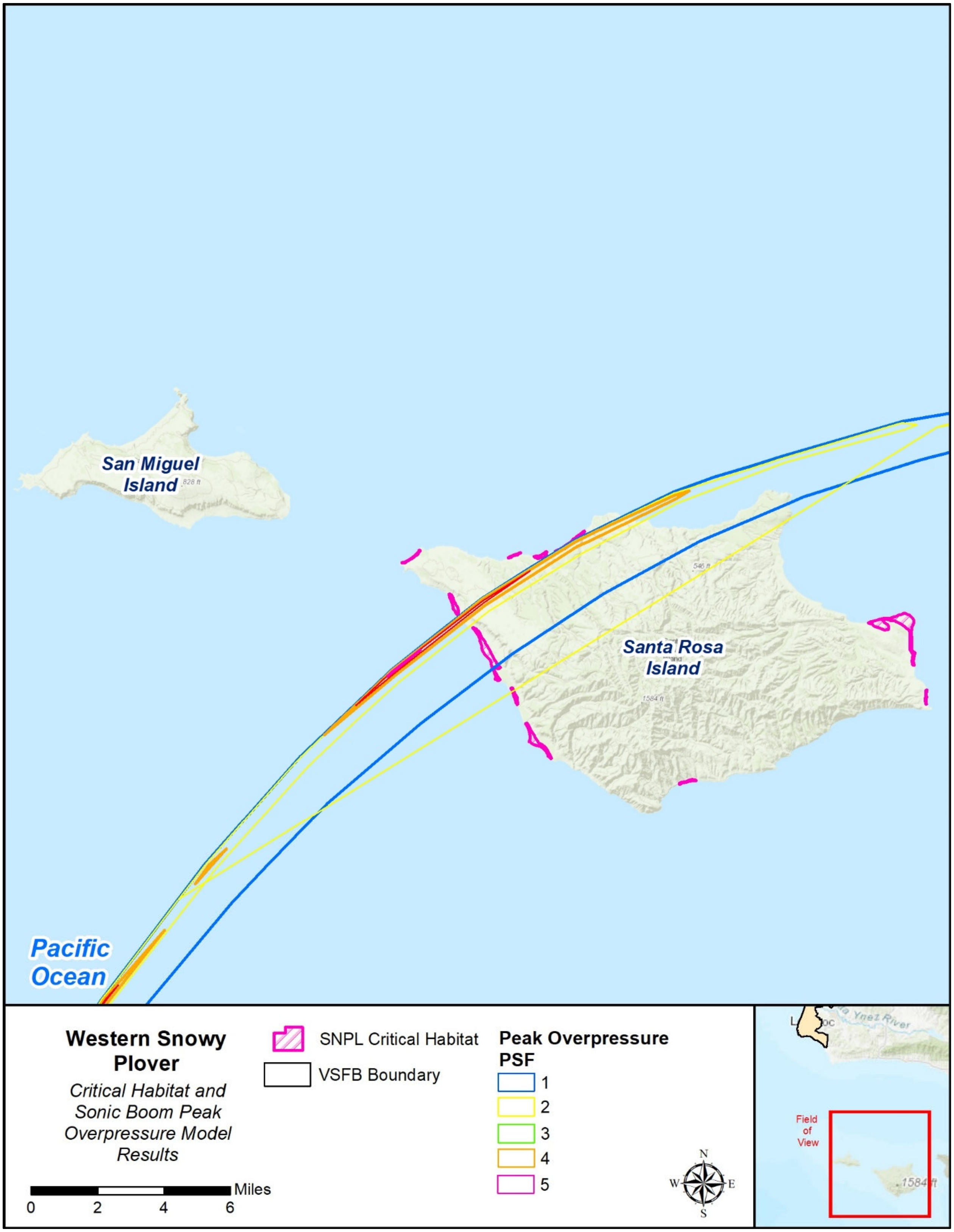

Figure 4.5-4. Designated Critical Habitat for the western snowy plover and sample sonic boom model results.

4.6 California Least Tern (Federally Listed Endangered Species)

4.6.1 Status

The USFWS listed the LETE as federally endangered on 13 October 1970 (35 FR 16047–16048) and published a recovery plan for the species in 1985 (USFWS 1985b).

4.6.2 Life History

The LETE is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. The upperparts are gray and the underparts are white. The California populations are localized and increasingly fragmented due to coastal development resulting in habitat loss. LETE are migratory and winter along the Pacific coast of Southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. This species nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal or wind action.

4.6.3 Occurrence in the Action Area

Historically, LETE nested in colonies in several locations along the coastal strand of the north VSFB coastline. Since 1998, except for two nests established south of San Antonio Creek in 2002, LETE have nested only at the primary colony site, in relatively undisturbed blufftop open dune habitat at Purisima Point. The population of LETE at VSFB represents a small percentage of all known breeding colonies. Robinette et al. (2016) estimated that VSFB supports a breeding population of 25 pairs of LETE. Although this population is small, VSFB is one of only three breeding colonies that nest between Monterey and Point Conception; therefore, the Purisima Point breeding colony is considered important. This colony is approximately 8 mi. (12.9 km) north of SLC-4 (Figure 4.6-1). Adult LETE forage in the Santa Ynez River lagoon and estuary, approximately 3.7 mi. (6.0 km) north of SLC-4. After young LETE have fledged in late summer, they will disperse to this location to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (Robinette & Howar 2010).

4.6.4 Critical Habitat

The USFWS has not designated critical habitat for the LETE.

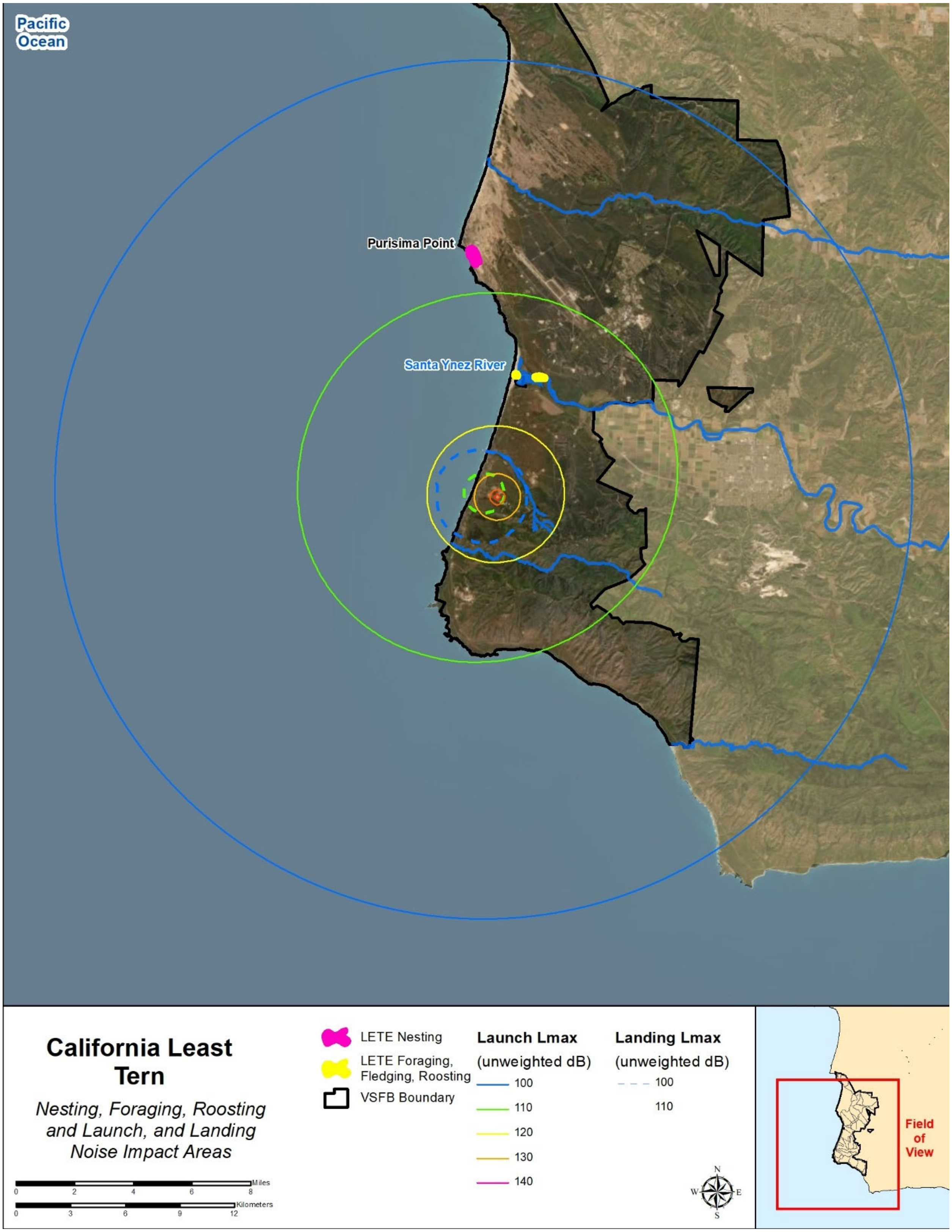

Figure 4.6-1. California least tern foraging, roosting, and nesting areas and launch and landing noise impact areas.

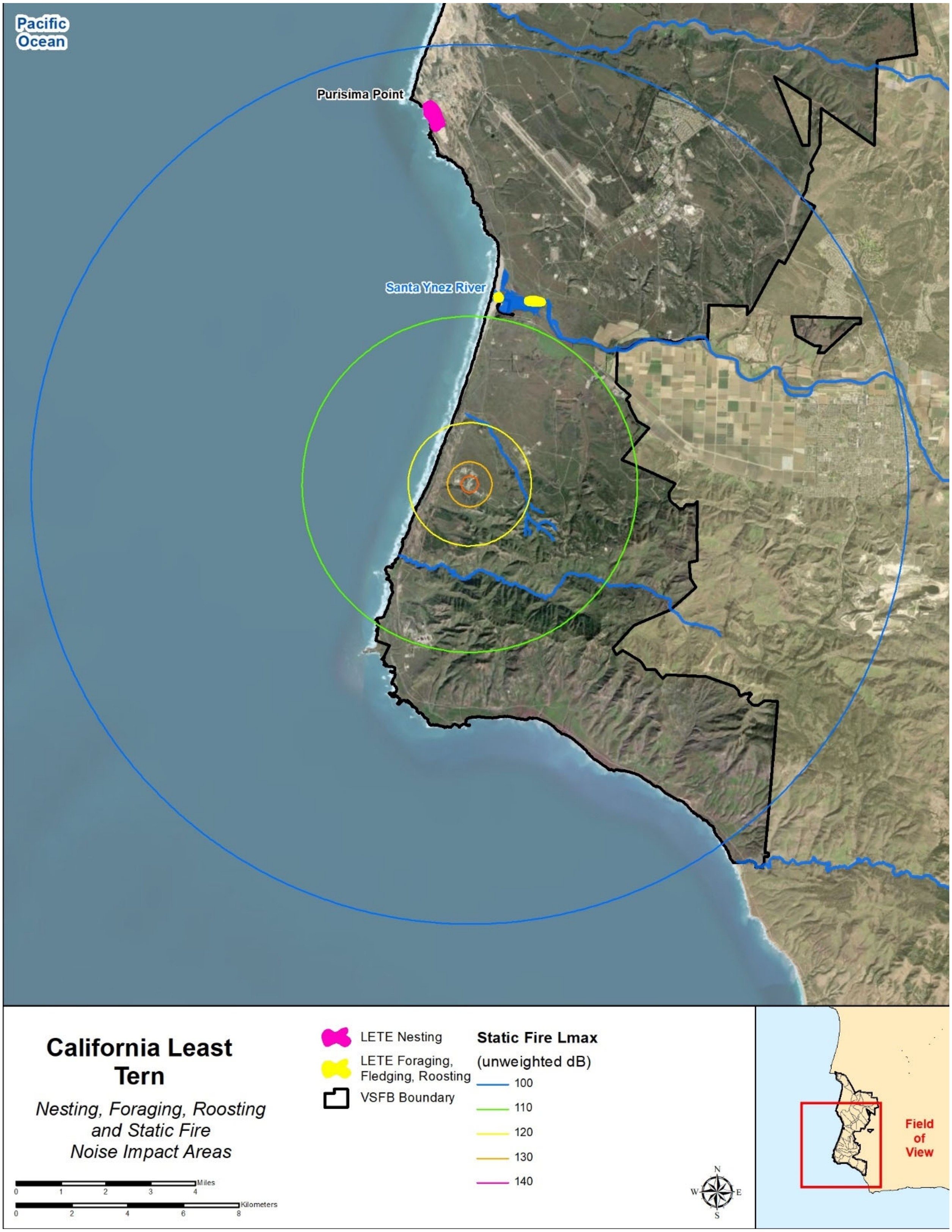

Figure 4.6-2. California least tern foraging, roosting, and nesting areas, and static fire noise impact areas.

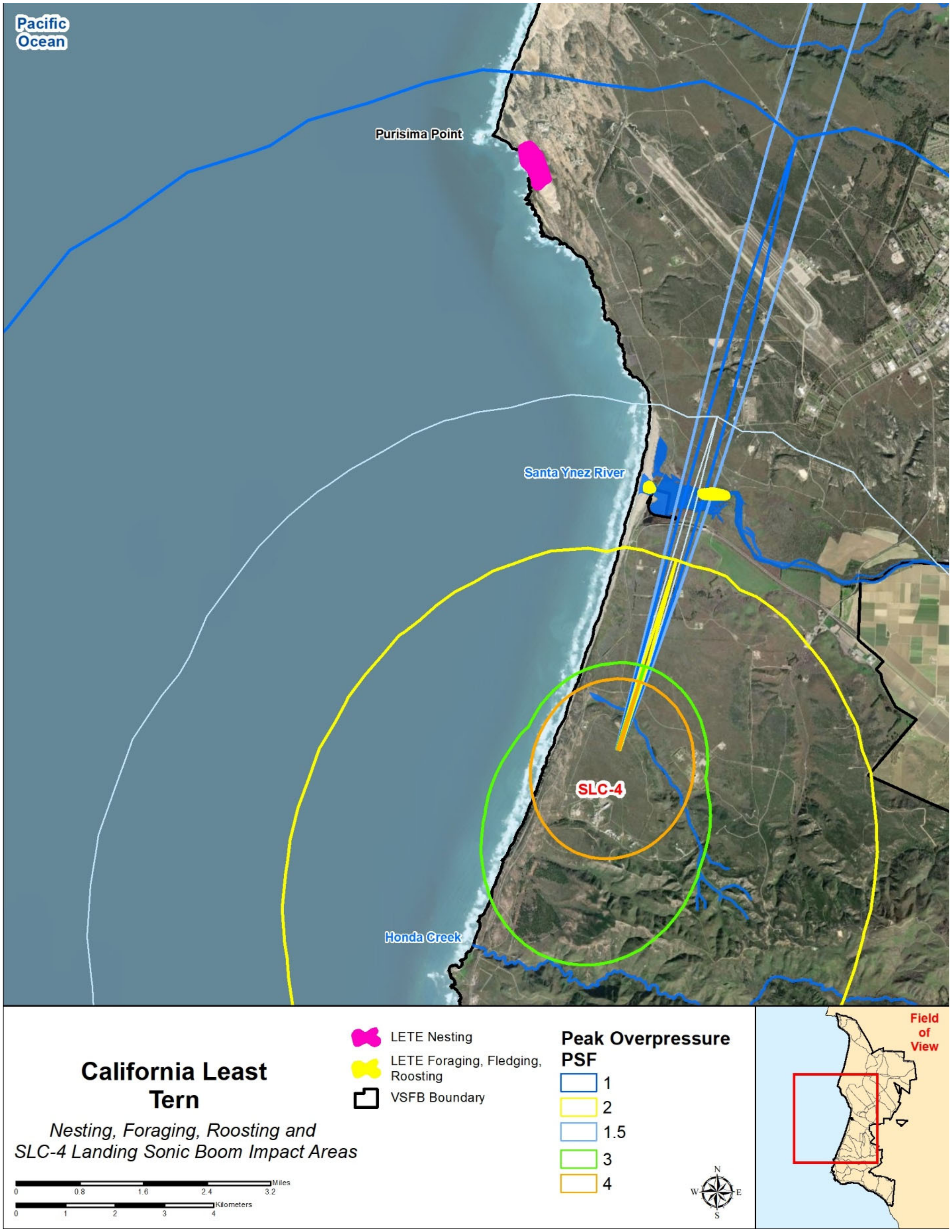

Figure 4.6-3. California least tern nesting, foraging, and roosting areas, and sample sonic boom model results for SLC-4W landing events.

4.7 California Condor (Federally Listed Endangered Species)

4.7.1 Status

The USFWS listed the California condor as endangered on 11 March 1967 (32 FR 4001) and completed a Recovery Plan for the species on 25 April 1996 (USFWS 1996). In 1982, there were only 23 California condors in existence. To prevent the condor from going extinct, all remaining condors were placed into a captive breeding program in 1987. The USFWS and its partners began releasing condors back into the wild in 1992. The nearest release site to the Action Area is Bitter Creek National Wildlife Refuge (USFWS 2017b). Other release sites include the Ventana Wilderness and Pinnacles National Park. Almost all condors released into Santa Barbara County have either died or were brought back into captivity, with the last nesting attempt occurring in 2001 (Lehman 2020).

4.7.2 Life History

Condors nest in rock formations (e.g., ledges and crevices) and less frequently in giant sequoia trees (*Sequoiadendron giganteum*). They normally lay a single egg between late January and early April. Both parents incubate the egg and share responsibilities for feeding the nestling after hatching. Condors require large remote areas and can range up to 150 mi (241 km) a day in search of food. Chicks usually take their first flight around 6 to 7 months from hatching. The cause of the California condor's decline is inconclusive, but experts believe that lead poisoning and hunting greatly contributed to their decline (USFWS 1996).

4.7.3 Occurrence within the Action Area

The California condor's current range is not within the Action Area. However, in March 2017, the USSF learned that telemetry data from USFWS showed there was a California condor ranging within VSFB. This condor was SB 760 ("VooDoo"), an immature, non-reproductive female (USFWS, personal communication, 27 March 2017). SB 760 hatched in captivity on 22 May 2014. She was released at the Ventana Wilderness on 9 November 2016 (Ventana Wildlife Society 2017). SB 760 departed the VSFB area on or about 22 April 2017 and, several months later, was found deceased, in northern San Luis Obispo County. VSFB natural resource managers maintain routine communications with the USFWS and Ventana Wildlife Society for SpaceX launch monitoring requirements and condors have not been present since. However, given the wide-ranging nature of this species, individuals may occur on Base in the future.

4.7.4 Critical Habitat

The USFWS designated Critical Habitat for the California condor in 1976 and revised it in 1977 (42 FR 47840). The nearest designated Critical Habitat for the California condor is near San Luis Obispo, approximately 44 mi (70 km) from the Action Area. There is no Critical Habitat within or adjacent to the Action Area.

4.8 Southern Sea Otter (Federally Listed Threatened Species)

4.8.1 Status

The USFWS listed the southern sea otter as federally threatened on 14 January 1977 (42 FR 2965) and published a Recovery Plan in 2003 (USFWS 2003). The USWFS completed a 5-year review of the species in 2015 (USFWS 2015b).

4.8.2 Life History

The southern sea otter is the smallest species of marine mammal in North America. It inhabits the nearshore marine environments of California from San Mateo County to Santa Barbara County with a small geographically isolated population around San Nicolas Island. On occasion, southern sea otters have been observed beyond these limits and have been documented as far south as Baja, Mexico (USFWS 2015b).

This species breeds and gives birth year-round and pups are dependent for 120 to 280 days (average 166 days; Riedman & Estes 1990). Sea otters are opportunistic foragers known to eat mostly abalones, sea urchins, crabs, and clams. They play a key ecological role in kelp bed communities by controlling sea urchin grazing.

4.8.3 Occurrence within the Action Area

Southern sea otters occur regularly off the coast of VSFB, with animals typically concentrated in the kelp beds between the Boat House and Jalama Creek on south VSFB (Figures 4.6-1 through 4.6-3). Annual surveys performed by United States Geological Survey (USGS) document persistent populations in nearshore waters in this area (USGS Western Ecological Resource Center 2017, 2018, 2020). As many as 55 adult otters have been documented in the Sudden Flats area at one time (SRS Technologies, Inc. 2006a). More recently, a high of 44 adults and two pups were observed in November 2020 in the Sudden Flats area during monitoring for a Falcon 9 launch (MSRS 2021c).

Historically, the Purisima Point area also supported a persistent otter population with as many as 18 adult otters documented in the area at one time (SRS Technologies, Inc. 2002). During the last three annual spring census counts that were performed (2017, 2018, and 2019), however, there is a running average of only one otter within the Purisima Point area (USGS Western Ecological Resource Center 2017, 2018, 2020). Transitory otters also occasionally traverse the coast between Purisima Point and Point Arguello.

4.8.4 Critical Habitat

The USFWS has not designated Critical Habitat for this species.

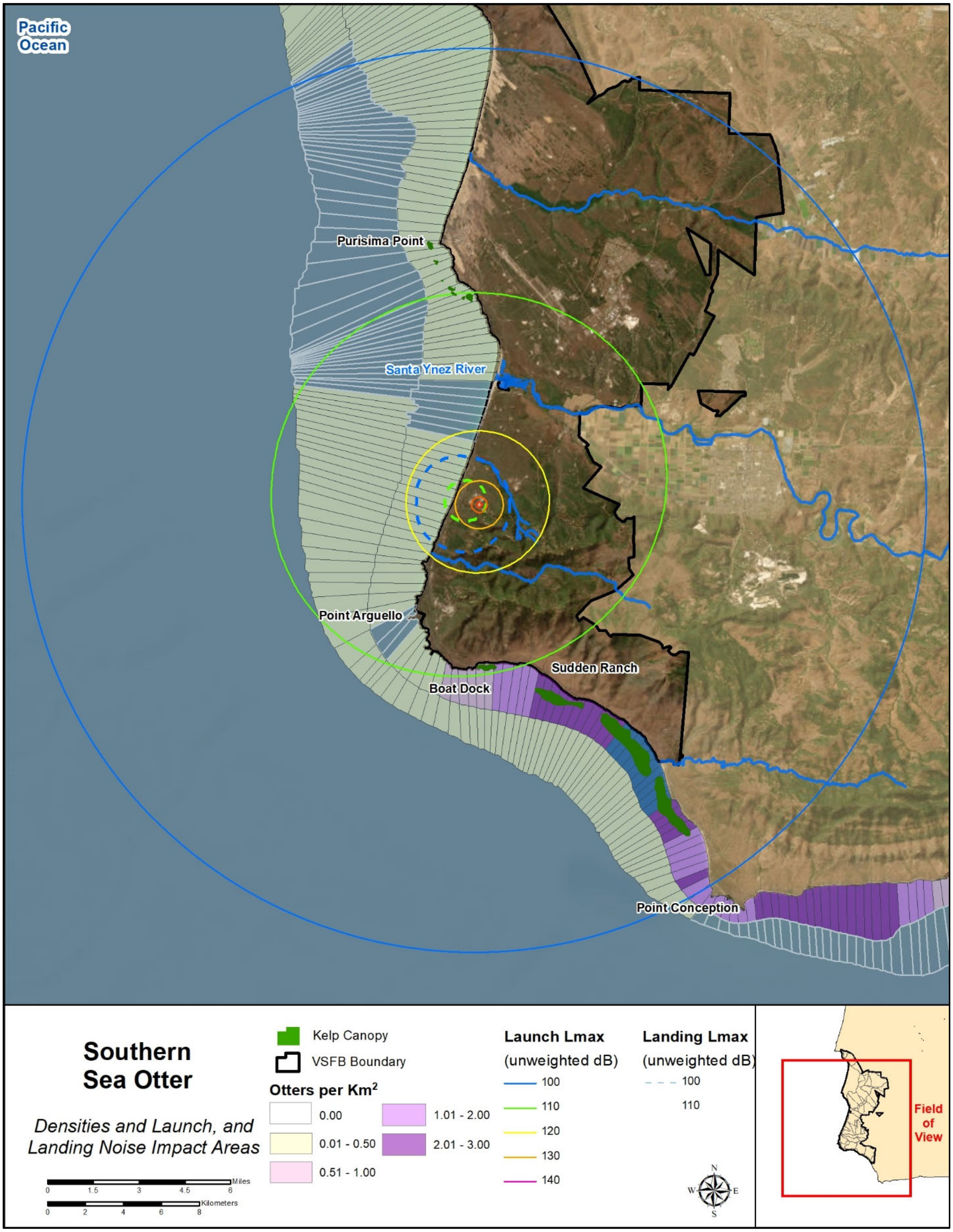

Figure 4.8-1. 2019 southern sea otter densities and launch and landing noise impact areas (USGS 2020).

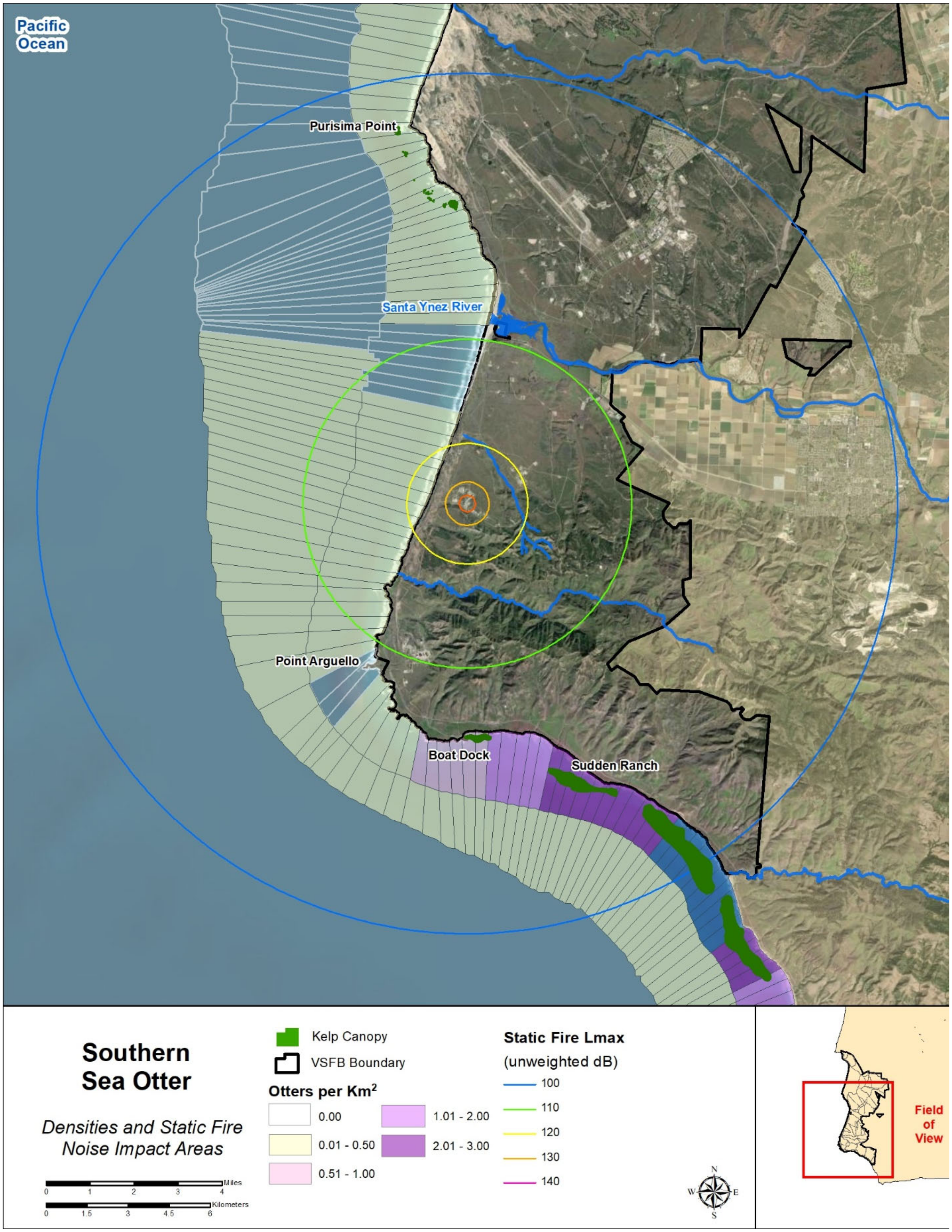

Figure 4.8-2. 2019 southern sea otter densities and static fire noise impact areas (USGS 2020).

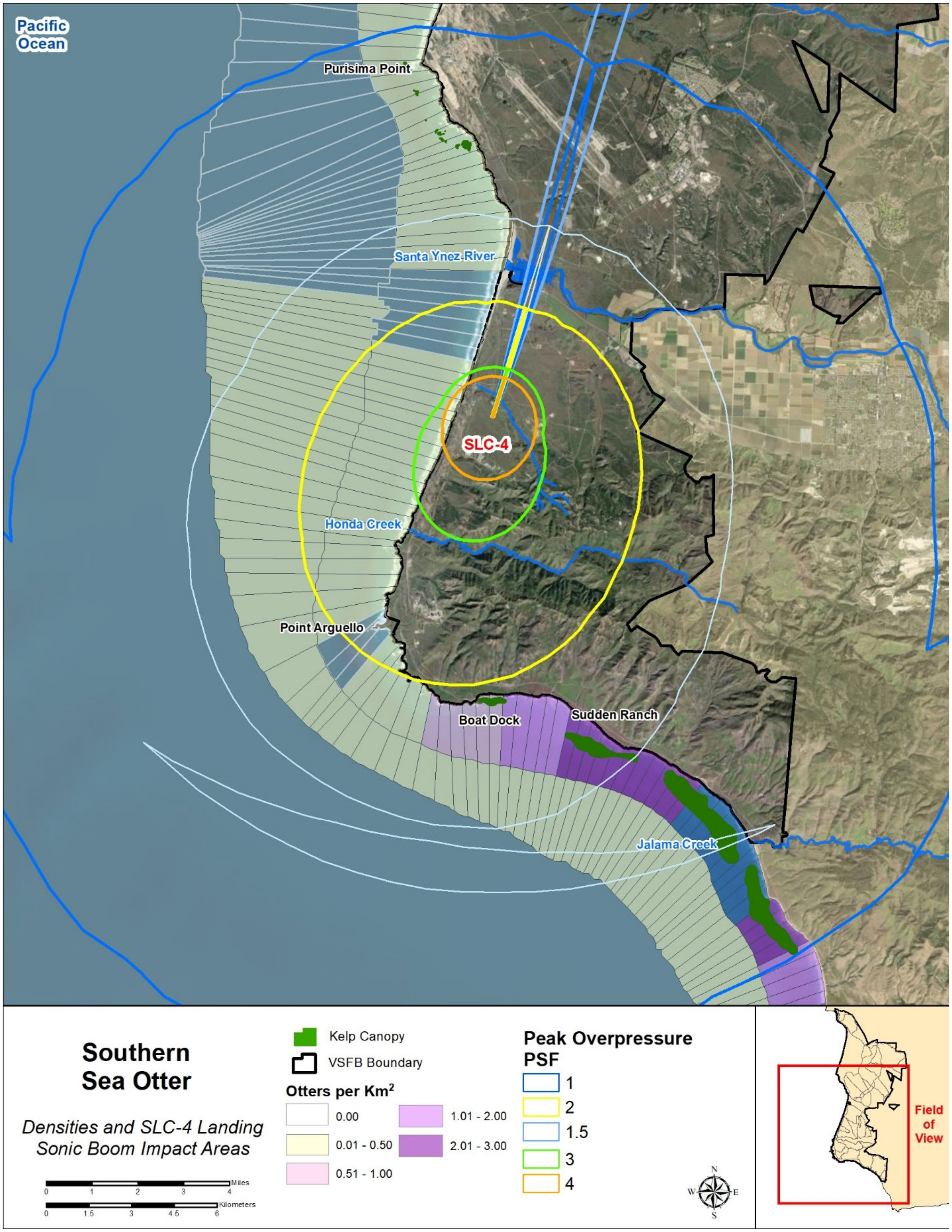

Figure 4.8-3. 2019 southern sea otter densities and sample sonic boom model results for SLC-4W landing events (USGS 2020).

5 Analysis of Effects of the Proposed Action

5.1 Direct and Indirect Effects on Species

Effects of an action include direct and indirect effects. Direct effects are those effects that would be caused by or result from the proposed action and occur contemporaneously with the proposed action (USFWS and National Marine Fisheries Service 1998). USFWS regulations define indirect effects as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur" (50 C.F.R. section 402.02). The direct impacts potentially resulting from the Proposed Action vary by species, but include loss or degradation of habitat, physical impacts because of water release during launch, noise, vibration, and visual disturbance. Potential indirect impacts could result from water use, which is currently extracted from the San Antonio Creek Basin. Indirect impacts that may affect some species include potential long-term effects of increasing the launch frequency on VSFB over the next five years, to include up to 36 launches and 36 static fire events per year under the Proposed Action.

In addition to direct and indirect effects, the USSF analyzed the collective effects of launch-related noise impacts on ESA-listed species on VSFB (Section 5.3) per prior USFWS requests. For each species, the USSF considered the potential effect of overlapping noise impacts from multiple launch programs.

Determining how much noise energy overlaps the hearing sensitivity of an animal that may be affected by the exposure is critical to evaluating the potential effect the noise will have (Halfwerk et al. 2011; Francis & Barber 2013). Therefore, for those species that would potentially be adversely affected by noise impacts because of the Proposed Action, a species-specific frequency-weighting filters following methods in Southall et al. (2019) was developed. Best available hearing data from closely related taxa was used to estimate audiograms (a graph of audible thresholds for standardized frequencies) in combination with other audiometric data (i.e., equal loudness, equal latency, and temporary threshold shift measurements, and/or vocal range) to derive auditory weighting functions for each species. Weighting functions have been primarily developed and evaluated systematically in humans (A-weighted decibels [dBA]), with very limited efforts to develop them for non-human animals. These functions are like "band-pass" filters—they include a central region corresponding to greatest sensitivity and susceptibility to noise, along with lower- and higher-frequency regions where the relative sensitivity is lower (reflected as negative values on these curves).

Weighting functions provide a means of calculating how a noise exposure would be perceived by a specific species or group with similar hearing capabilities and how it may potentially affect the hearing of an animal given the extent to which the frequency spectra match frequency-specific hearing sensitivity. The effect of noise exposure on an animal is determined by first weighting (filtering) the noise exposure using the weighting function—analogous to adding the weighting function amplitude (in dB) to the noise spectral amplitude (in dB) at each frequency. Next, the weighted noise spectra is integrated across frequency to obtain a species- or group-specific weighted noise exposure level, which describes exposure for the entire frequency range with a single metric. The weighting function generally appears as the inverse of the audiogram, with less weighting being applied near the center of the audiogram. For each species where relatively frequent launch-related noise exposure is analyzed below, a discussion of how species-specific weighting functions were developed is presented.

5.1.1 Tidewater Goby

Physical Impacts

No aspects of the Proposed Action would have potential physical impacts on TWG.

Noise Impacts

During up to 36 launch events per year, engine noise produced during Falcon 9 launches would reach approximately 123 dB L_{max} at potential TWG habitat in Honda Creek (Figure 4.2-1). During up to 12 SLC-4W landing events per year, noise would be less than 100 dB Lmax at Honda Creek (Figure 4.2-2). Static fire events produce approximately 115 dB L_{max} at Honda Creek (Figure 4.2-3).

Exceptionally little sound is transmitted between the air-water interface (Godin 2008). Therefore, in-air sound during launches, landings, and static fire events is not expected to cause more than a temporary behavioral disruption to fish, if present, in Honda Creek. Since TWG have not been detected during regular survey efforts dating back to 2008 (MSRS 2009a, 2016, 2018a), they are unlikely to be present during the proposed launch and static fire activities; however, TWG could potentially recolonize Honda Creek in the future.

Water Use

At 36 launches, 36 static fire tests, and 12 SLC-4W landings per year, the annual usage in the flame duct would be up to 3.0 million gallons (9.2 ac-ft). In addition, a maximum of 1.28 million gallons (3.92 ac-ft) per year would be required to support the personnel and operational activities at SLC-4. Therefore, at maximum cadence, the Proposed Action would use up to 4.28 million gallons (13.1 ac-ft) of water per year. The current water source for VSFB, including SLC-4, is the San Antonio Creek Basin via four water wells. There is an existing connection between State water and the VSFB water supply system; however, due to ongoing drought conditions and significant reductions in State water allocations, VSFB would remain on well water from the San Antonio Creek Basin for the foreseeable future.

TWG in San Antonio Creek would be negatively impacted if the water used for the Proposed Action reduced flow rates, hydration periods, or water levels in San Antonio Creek. Annual VSFB water use over the past three years (2019 through 2021) has averaged 910,500,000 gallons (2,794 ac-ft) per year. SpaceX's proposed use of up to 13.1 ac-ft per year would represent approximately 0.47 percent of the total annual water usage on VSFB. The Proposed Action's water usage would therefore be discountable and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek.

Conclusion

Because of the low likelihood of TWG presence in Honda Creek and the minimal transfer of in-air noise into underwater noise, and the discountable increase in water extraction from the San Antonio Creek Basin, the anticipated level of disturbance from the Proposed Action would be discountable. Therefore, VSFB has determined that the Proposed Action may affect but is not likely to adversely affect the TWG.

5.1.2 Unarmored Threespine Stickleback

Physical Impacts

No aspects of the Proposed Action would have potential physical impacts on UTS.

Noise Impacts

As discussed in Section 4.1, the UTS was introduced into Honda Creek, south of SLC-5, in 1984 (MSRS 2009a). Extensive surveys conducted in 2008, 2016, and 2017 did not detect any fish in the creek (MSRS 2009a, 2016, 2018a). Between 2008 and 2022, Honda Creek has gone through multiple cycles of drying and rehydration, which would preclude occupancy by and persistence of fish. UTS in San Antonio Creek would be outside areas where launch noise would occur. Therefore, the Proposed Action would not have any noise impacts on UTS.

Water Use

At 36 launches, 36 static fire tests, and 12 SLC-4 landings per year, the annual usage in the flame duct would be up to 3.0 million gallons (9.2 ac-ft). In addition, a maximum of 1.28 million gallons (3.92 ac-ft) per year would be required to support the personnel and operational activities at SLC-4. Therefore, at maximum cadence, the Proposed Action would use up to 4.28 million gallons (13.1 ac-ft) of water per year. The current water source for VSFB, including SLC-4, is the San Antonio Creek Basin via four water wells. There is an existing connection between State water and the VSFB water supply system; however, due to ongoing drought conditions and significant reductions in State water allocations, VSFB will remain on well water from the San Antonio Creek Basin for the foreseeable future.

UTS in San Antonio Creek would be negatively impacted if the water used for the Proposed Action reduced flow rates, hydration periods, or water levels in San Antonio Creek. Annual VSFB water use over the past three years (2019 through 2021) has averaged 910,500,000 gallons (2,794 ac-ft) per year. SpaceX's proposed use of up to 13.1 ac-ft per year would represent approximately 0.47 percent of the total annual water usage on VSFB. The Proposed Action's water usage would therefore be discountable and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek.

Conclusion

The increase in water extraction from the San Antonio Creek Basin under the Proposed Action would be discountable. Therefore, VSFB has determined that the Proposed Action may affect but is not likely to adversely affect the UTS.

5.1.3 California Red-Legged Frog

Physical Impacts

Direct impacts on post-metamorphic CRLF within the 3.3-ac (1.3-ha) vegetation management area may include injury or mortality from inadvertent crushing by workers as they walk and operate mechanical equipment while mowing vegetation. During launch, CRLF may be injured or killed as a result of the release of hot water and vapor into Spring Canyon from the flame bucket. An assessment of Spring Canyon in 2013 (MSRS 2014) and in July 2017 (MSRS 2017) found no suitable aquatic habitat within Spring Canyon within or downstream of the vegetation management area. In addition, since 2017, across 11 survey efforts to perform minimization measures associated with the 2017 BO, no suitable habitat has been found in this area, likely because of the protracted drought conditions in the region. Routinely mowing the vegetation in the area impacted by water and vapor also reduces the suitability and attractiveness of the site for CLRF occupancy. It is therefore unlikely that CRLF occupy this area on a regular basis and no direct impacts during vegetation management activities or water release are anticipated.

The risk of impacts on CRLF during vegetation management would be reduced because USFWS approved or permitted biologists would capture and relocate all individuals detected within the vegetation management area to nearby suitable habitat prior to the onset of vegetation clearing activities. A qualified biologist would be present to monitor vegetation-clearing activities and a USFWS approved or permitted biologist would move any CRLF encountered out of harm's way.

Noise Impacts

During up to 36 launch events of the Falcon 9 per year, engine noise would reach approximately 128 dB L_{max} at Bear Creek, 123 dB L_{max} at Honda Creek, and 118 dB L_{max} at the Santa Ynez River (Figure 4.3-1). Up to 36 static fire tests per year would produce noise of approximately 125 dB L_{max} at Bear Creek, approximately 118 dB L_{max} at Honda Creek, and 110 dB L_{max} at the Santa Ynez River (Figure 4.3-3). During up to 12 SLC-4W first stage landing events per year, landing engine noise in these locations would be approximately 100 dB L_{max} at Bear Creek, less than 100 dB L_{max} at Honda Creek, and less than 85 dB L_{max} at the Santa Ynez River (Figure 4.3-1). Up to 12 SLC-4 landing events per year would also produce sonic booms that would impact the Santa Ynez River (estimated between 1.5 and 2.0 psf), Honda Creek (estimated between 2.0 and 3.0 psf), and Bear Creek (estimated between 4.0 and 5.0 psf; Figure 4.3-3). As noted in Section 2.2.3, landing noise follows launch by approximately 5 to 7 minutes and typically occurs slightly before (seconds) the sonic boom impacts land.

The received maximum noise levels estimates are conservative since the modeling assumes a flat landscape and does not account for features like hills, bluffs, or dense vegetation that would attenuate sound during noise events. Engine noise would reach as high as 150 dB L_{max} with sonic booms up to 8.5 psf in upland CRLF dispersal habitat on SLC-4. However, vegetation management within and around SLC-4 would make CRLF presence above ground in these areas unlikely during typical dry conditions.

There are no studies on the effects of noise on CRLF. Simmons et al. (2014) found that consistent morphological damage of hair cells in the hearing structures of American bullfrogs (*Lithobates catesbeianus*), which are within the same Family as the CRLF (Ranidae), were observed with exposure to sound levels greater than 150 dB L_{max} (approximately equivalent to 13 psf). Even after such hearing damage, bullfrogs showed full functional recovery within 3 to 4 days; thus, the hearing damage was temporary (Simmons et al. 2014). CRLF in terrestrial environments may be exposed to engine noise levels of 150 dB L_{max} and sonic booms up to 8.5 psf; therefore, even temporary hearing damage would be unlikely for CRLF that may be present. Additionally, due to vegetation management around the proposed launch vehicle sites, the likelihood of CRLF being present in terrestrial environments exposed to these noise levels would be very low and few individuals would be impacted.

As discussed at the beginning of Section 5.0, determining the amount of noise energy that would be perceived by CRLF is important to analyzing the potential effects that launch noise disturbances would have on this species. There are no CRLF-specific hearing curves (i.e., audiograms) or other data on this species' hearing sensitivity. However, there are published hearing curves for several species in the same family that are similar in size and have similar call frequency spectra. Fay (1988) presents hearing curves for the pool frog (*Pelophylax lessonae*, Family Ranidae), the marsh frog (*P. ridibunda*, Family Ranidae), and the edible frog (*P. esculentus*, Family Ranidae). These data were used to create a mean "Ranidae" hearing curve (Figure 5.1-1), and the mean curve processed following methods established in Southall et al. (2019) to produce a weighting function that would be appropriate for CRLF hearing sensitivity (Figure 5.1-2). Slopes beyond the lower and upper frequency cutoffs surrounding the range of best hearing (in dB/decade) were measured to estimate the amount of weighting to be applied at each frequency (Figure 5.1.2).

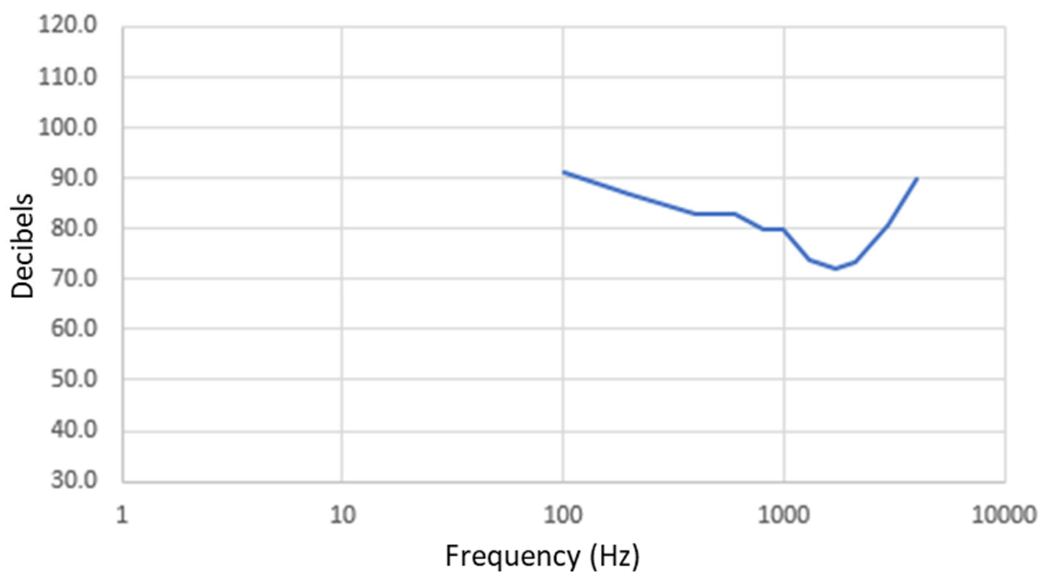

Figure 5.1-1. Mean Ranidae hearing sensitivity curve.

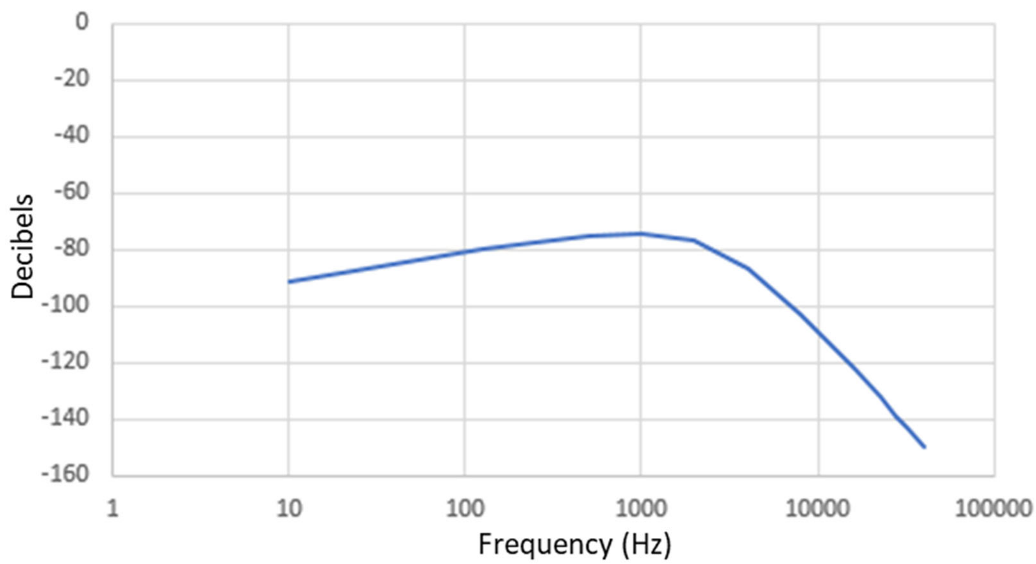

Figure 5.1-2. Ranidae weighting function.

This weighting function was applied to the time waveform recording of a June 2022 launch at VSFB (Falcon 9 SARah-1). The unfiltered time waveform had frequency spectra with an unweighted peak level of approximately 110 dB Lmax (Figure 5.1-3). After applying the Ranidae weighting function, the peak level is approximately 22 dB Lmax (Figure 5.1-3). In humans, 20 dBA is equivalent to whispering. Given the high falloff rates outside the range of best hearing, as well as a much higher hearing threshold, the perceived rocket engine noise in CRLF is very likely to be negligible.

Figure 5.1-3. Launch peak noise level comparison of unweighted (green) versus Ranidae-weighted (brown) decibels (note: time waveform recording from the June 2022 Falcon 9 SARah-1 launch).

It is assumed that the sonic boom would likely trigger a startle response in CRLF, causing them to flee to water or attempt to hide in place. This would result in a temporary disruption of behaviors including foraging, calling, and mating. However, there are no data on what level of sonic boom would cause this reaction. To date, one SpaceX landing event at SLC-4W has occurred during CRLF breeding season, the NROL-87 on 2 February 2022. MSRS performed bioacoustic monitoring (MSRS 2022) at two locations within the predicted boom impact area, following the monitoring requirements of the 2017 BO (USFWS 2017a). Though the landing occurred during daylight hours, CRLF were detected calling at both monitoring locations, a drainage near the VSFB Recreation Center and lower Honda Creek. The sonic boom did not cause a measurable reduction in CRLF calling frequency at either of the two locations where the received overpressures were between 1 (VSFB Recreation Center) and 2.4 psf (lower Honda Creek). At both sites, CRLF calls were detected within 20 to 30 minutes after the sonic boom was received and the average number of calls per hour during the two nights following the sonic boom were greater than the night prior to the boom, suggesting that the noise disturbance did not prompt reduced calling behavior (MSRS 2022). At the Fitness Center Drainage, three CRLF calls were detected during the hour prior to the sonic boom (1100–1200), and three were detected the hour period when the sonic boom occurred (1200–1300). One of the three calls detected during the period when the boom was received was 30 minutes prior to the boom and again 23 and 24 minutes after the boom. At lower Honda Creek, no CRLF calls were detected during the hour period prior to the sonic boom (1100–1200), and four calls were detected during the hour when the boom occurred (1200–1300). Of the four calls that occurred during the hour period when the boom was received, all four were detected after the boom, at 32, 37, 47, and 48 minutes following the sonic boom (MSRS 2022).

Lewis and Narins (1985) determined that white-lipped frogs (*Leptodactylus albilabris*) can detect seismic signals and use them in communication. This species is not closely related to CRLF; however, it may be reasonable to assume that the strongest reaction to engine noise and sonic booms would be the result of physical vibrations of water or the ground caused by the low frequency portion of the noise energy in combination with visual disturbance, rather than the noises themselves.

As stated above, CRLF would likely exhibit a startle response to noise, vibrations, and visual disturbance during launch, landing, and static fire, causing them to flee to water or attempt to hide in place. Because landing engine noise occurs approximately 5 to 7 minutes after launch noise and is typically slightly (seconds) before the sonic boom is received, individuals that flee into water because of launch disturbance would have a reduced likelihood of being exposed to the landing engine noise and sonic boom due to the attenuation of sound in water (Godin 2008). It is likely that any reaction would be dependent on the sensitivity of the individual, the behavior in which it is engaged when it experiences the noise, and past exposure to similar noise. Regardless, the reaction is expected to be the same—the frog's behavior would likely be disrupted, and it may flee to cover in a similar reaction to that of a frog reacting to a predator. As a result, there could be a temporary disruption of CRLF behaviors including foraging, calling, and mating (during the breeding season). However, frogs tend to return to normal behavior quickly after being disturbed.

Rodrıguez-Prieto and Fernandez-Juricic (2005) examined the responses in the Iberian frog (*Rana iberica*) to repeated human disturbance and found that the resumption of normal behavior after three repeated human approaches occurred after less than four minutes. Sun and Narins (2005) examined the effects of airplane and motorcycle noise on anuran calling in a mixed-species assemblage, including the sapgreen stream frog (*Rana nigrovittata*). Sun and Narins found that frogs reduced calling rate during the stimulus but increased calling rate immediately after cessation of the stimuli, likely in response to the subsequent lull in ambient sound levels. Similarly, Kruger and Du Preez (2016) found that male Pickersgill's reed frog (*Hyperolius pickersgilli*) exposed to routine airplane overflights increased call rates immediately after the noise but resumed their normal call-rest patterns within a few minutes of absence of plane noise. USFWS permitted biologists working on VSFB and elsewhere in CRLF occupied habitat have also routinely observed a similar response in this species after disrupting individuals while conducting frog surveys (A. Abela, M. Ball, and J. LaBonte, pers. obs.). CRLF would, therefore, be expected to resume normal activities quickly once the disturbance from the noise event has ended and any behavioral response to individual noise events would be short term.

Whether a result of physical vibrations caused by noise or overlap of some noise stimuli with various species hearing sensitivity range, there is a growing body of literature on the effects of anthropogenic noise disturbance on anurans. These studies have typically examined the impact of sustained vehicle noise associated with roads near breeding ponds and have generally shown negative effects on individual frog behavior and physiology which potentially have consequences for populations (see examples in Parris et al. 2009 and Tennessen et al. 2014). For instance, a variety of anurans have been shown to alter call signal structure in response to chronic exposure to traffic noise (Bee & Swanson 2007; Lengagne 2008; Cunnington & Fahrig 2010; Kaiser et al. 2011; Hanna et al. 2014) and airplane noise (Sun & Narins 2005, Kruger & Du Preez 2016). Researchers studying chronic exposure to sustained anthropogenic noise in anurans have also found higher levels of stress hormones, lowered immunity, and impacts to reproductive physiology and behavior, all of which may have negative consequences for populations. Tennessen et al. (2014) showed that prolonged exposure to traffic noise increased corticosterone and impaired mate attraction in wood frogs (*Lithobates sylvaticus*). Tennesen et al. (2014) also showed that populations of wood frogs in high traffic noise locations have undergone evolutionary adaptation to avoid physiological costs of the noise to fitness, suggesting that at least some species may be able to adapt to sustained noise. In an experiment where European tree frogs (*Hyla arborea*) were exposed to four hours of continuous recorded traffic noise nightly, Troïanowski et al. (2017) found increased stress hormone level that induced an immunosuppressive effect in the subjects. Similarly, White's treefrogs (*Litoria caerulea*) exposed to continuous, sustained noise (one week of recorded traffic noise) had higher levels of corticosterone and decreased sperm count and sperm viability (Kaiser et al. 2015). In chronic high-noise habitats adjacent to a busy highway (average 30,000 vehicles per day), the time and distance over which male Pacific chorus frogs (*Psuedacris regilla*) calls could be perceived for was significantly reduced, potentially having implications for the reproductive success of this species (Nelson et al. 2017). Japanese tree frogs (*Dryophytes japonicus*) exposed to persistent, low frequency noise caused by wind turbines had faster call rates, increased salivary concentrations of corticosterone, and lower innate immunity (Park & Do 2022). Eastern sedge frogs (*Litoria* *fallax*) tended to choose less attractive male calls significantly more often when experimentally exposed to background traffic noise, potentially having evolutionary and population level implications over the long term (Schou et al. 2021).

None of the preceding studies are directly comparable to the noise impacts of the Proposed Action, which is likely to be minimally perceptible in the hearing range of CRLF but presumed to cause vibrations that would be sensed, non-sustained, and infrequent compared to the available literature, which examines sustained traffic noise and multiple daily airplane flights. Additionally, there are no thresholds in the literature that quantify what level of noise or frequency of disturbance would elicit stress hormone responses, impacts to breeding and reproduction, or negative population level effects. While these studies show effects on behavior and physiology that could have impacts on fitness and populations, none of them present direct evidence of population impacts so the long-term effects of chronic exposure to anthropogenic noise on populations is unknown for these species.

The USSF will implement a monitoring program (see Section 2.3.2) to track CRLF habitat occupancy, breeding behaviors, and tadpole densities in Lower Honda Creek (the area to receive the highest noise levels) as the frequency of launch and static fire under the Proposed Action. As full tempo under the Proposed Action is reached, the USSF will be able to assess incremental changes in the acoustic environment at Lower Honda Creek through the use of passive bioacoustic recorders and analyze these data to assess any associated impacts on the CRLF population. If CRLF occupancy, calling frequency, or tadpole densities decline from baseline by 15 percent or more, the 15 percent decline from baseline is maintained for two consecutive years, and the decline is not attributable to other non-launch-related factors, VSFB would mitigate for these impacts by creating new CRLF breeding habitat at the San Antonio Creek Oxbow Restoration Area, an established wetland mitigation site that is located outside of areas currently impacted by launch noise on VSFB. Historically occupied by riparian vegetation, restoration efforts would focus on enhancing this abandoned tract of agricultural land to improve San Antonio Creek and provide breeding habitat for CRLF, thus offsetting population level impacts at Honda Creek within an area that is not impacted by launch noise.

Water Use

At 36 launches, 36 static fire tests, and 12 SLC-4 landings per year, the annual usage in the flame duct would be up to 3.0 million gallons (9.2 ac-ft). In addition, a maximum of 1.28 million gallons (3.92 ac-ft) per year would be required to support the personnel and operational activities at SLC-4. Therefore, at maximum cadence, the Proposed Action would use up to 4.28 million gallons (13.1 ac-ft) of water per year. The current water source for VSFB, including SLC-4, is the San Antonio Creek Basin via four water wells. There is an existing connection between State water and the VSFB water supply system; however, due to ongoing drought conditions and significant reductions in State water allocations, VSFB will remain on well water from the San Antonio Creek Basin for the foreseeable future.

CRLF in San Antonio Creek would be negatively impacted if the water used for the Proposed Action reduced flow rates, hydration periods, or water levels in San Antonio Creek. Annual VSFB water use over the past three years (2019 through 2021) has averaged 910,500,000 gallons (2,794 ac-ft) per year. SpaceX's proposed use of up to 13.1 ac-ft per year would represent approximately 0.47 percent of the total annual water usage on VSFB. The Proposed Action's water usage would therefore be discountable and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek.

Conclusion

VSFB has determined that potential physical impacts because of water release and vegetation clearing in Spring Canyon, rocket engine noise, and sonic booms resulting from the Proposed Action may affect, and is likely to adversely affect, the CRLF. Launch noise and sonic booms may induce behavioral responses in CRLF ranging from momentary startling or freezing by individual frogs to population-level emigration away from impacted areas. To comply with the USSF's sections 7(a)(1) and 7(a)(2) obligations under the ESA, as well as the prospective USFWS Mitigation Policy, post-project restoration activities will be implemented. Restoration activities will align with the objectives of the CRLF Conservation Strategy (USFWS, in prep.) with the goal of achieving no net loss to the species.

5.1.4 Marbled Murrelet

Physical Impacts

No ground disturbing activities would occur within or near MAMU habitat; therefore, the Proposed Action would have no direct physical impacts on MAMU or MAMU habitat.

Noise and Visual Disturbance

MAMU do not nest on VSFB so exposure to noise impacts would be limited to foraging adults that have occasionally been observed between the late summer through winter foraging off the coast of south VSFB (eBird 2022). Although unlikely, if MAMU were present immediately off the coast they would experience engine noise of less than 130 dB L_{max} during launch (Figure 4.4-1), less than 115 dB L_{max} during SLC-4 landing (Figure 4.4-1), approximately 125 dB L_{max} during static fire events (Figure 4.4-2), and sonic booms up to 4 psf during SLC-4 landings (Figure 4.4-3). Additionally, the majority of MAMU are found in a band about 984 to 6,561 ft (300 to 2,000 m) from shore (Strachan et al. 1995) where noise levels would be much lower.

Very little data are available regarding MAMU's response to noise and visual disturbances; however, Bellefleur et al. (2009) examined the response of MAMU to boat traffic. MAMU response was found to depend on the age of the birds, the distance and speed of the boats encountered, and the season. MAMU either showed no reaction, flew, or dove in response. Late in the season (July through August), some MAMU were found to fly completely out of feeding areas when approached by boats traveling in excess of 17.9 mi per hour (28.8 km per hour). The dominant response of MAMU to approach by boats was, however, for birds to dive and resurface a short distance away. MAMU are, therefore, expected to exhibit a startle response that would cause birds to dive and resurface, but they are expected to return to normal behavior soon after each launch or static fire event has been completed.

Conclusion

Because MAMU would be unlikely to be present during a launch, landing, or static fire event, and the expected impact would be a temporary behavioral reaction in response to noise, the

Proposed Action would have a discountable effect on MAMU. Therefore, VSFB has determined that the Proposed Action may affect, but is not likely to adversely affect, the MAMU.

5.1.5 Western Snowy Plover

Physical Impacts

No ground disturbing activities would occur within or near SNPL habitat; therefore, the Proposed Action would have no direct physical impacts on SNPL or SNPL habitat.

Noise and Visual Disturbance

SNPL on VSFB beaches would be exposed to levels between 100 and 130 dB L_{max} during launches (Figure 4.5-1), between approximately 100 and 110 dB L_{max} during SLC-4 landing (Figure 4.5-1), and between 100 and 125 dB L_{max} during static fire events (Figure 4.5-2), and sonic booms between 1.5 and 5.0 psf during SLC-4 landing (Figure 4.5-3). Launch noise events would last less than one minute and static fire noise would last less than 7 seconds.

As discussed at the outset of Section 5.0, determining the amount of noise energy that overlaps with the hearing sensitivity of SNPL is critical to understanding the potential effects that the noise disturbances would have. With the lack of SNPL-specific audiograms or other data on this species' hearing sensitivity, a weighted noise function for SNPL was deduced based on call frequency. There is a strong correlation between the range of hearing in birds and the frequency spectrum of bird vocalizations (Dooling & Popper 2007). That is, except for some nocturnal predators, birds hear best in the spectral region of their species-specific vocalizations. Typical frequency components of SNPL call and song were identified using field recordings from California. As presented in Figure 5.1-5, the highest energy in a plover call falls between 1.2 and 4 kilohertz (kHz), equating to a best hearing range between 1.2 and 4 kHz. This range was used to review several avian hearing curves (i.e., audiograms) to identify an approximate match for the SNPL that could be used in developing a weighting filter.

Figure 5.1-4. Western snowy plover call frequency.

The hearing curve of an analogous species (mallard duck; *Anas platyrhynchos*) that possessed a best hearing range similar to the frequency range of the SNPL (Figure 5.1-6) was selected. This audiogram was then processed following methods established in Southall et al. (2019), deriving an auditory weighting function serving as a frequency-specific filter to quantify how noise would be perceived by SNPL (Figure 5.1-6), and how that would relate to the spectral characteristics of a SNPL's potential susceptibility to noise. Weighting functions are used to de-emphasize noise at frequencies where susceptibility is lower and emphasize noise at frequencies where sensitivity is greater. The high and low frequency cutoffs of the audiogram were noted as were the "fall-offs" outside of the range of best hearing. The slopes of the lower and upper frequency cutoffs were measured (dB/decade) and used to estimate the amount of weighting to be applied at each frequency (Figure 5.1-7).

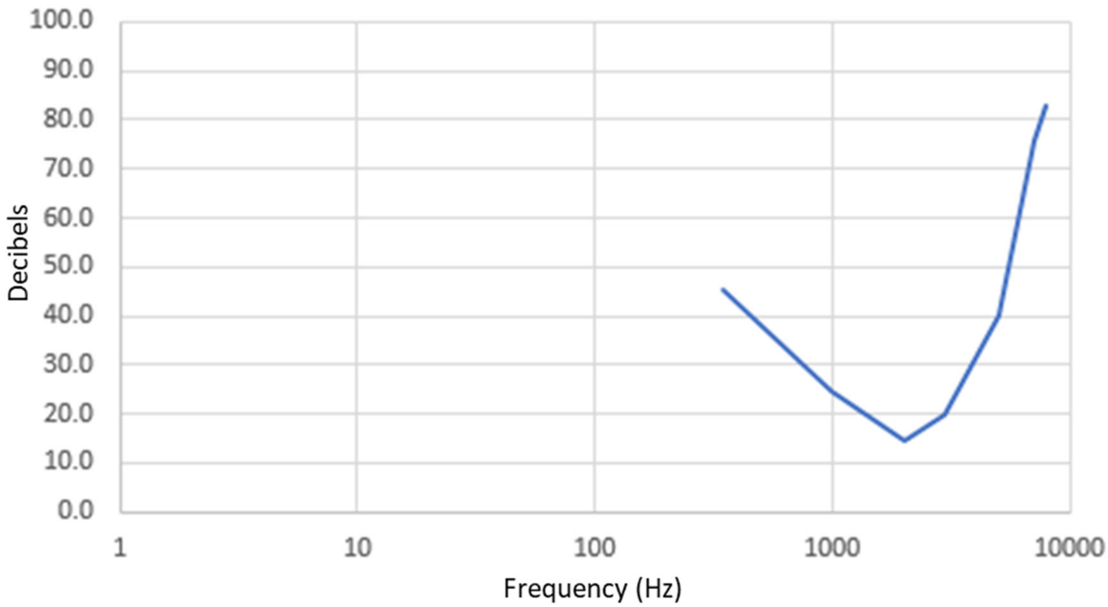

Figure 5.1-5. Mallard duck hearing sensitivity curve.

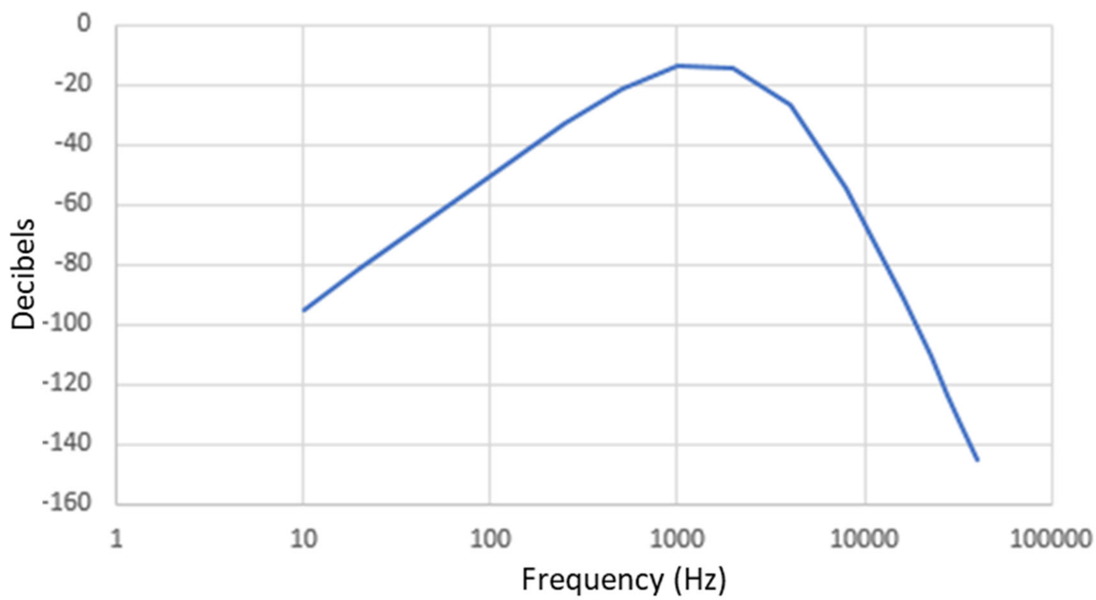

Figure 5.1-6. Mallard duck weighting function.

Finally, this weighting function was applied to the timewave form recording of the June 2022 Falcon 9 SARah-1 launch. The unfiltered time waveform had a frequency spectra with an unweighted peak level of approximately 110 dB Lmax (Figure 5.1-8). Given the high falloff rates outside the range of best hearing, both the low- and high-frequency component of the rocket launch noise were notably reduced. After applying the SNPL weighting function, the peak level was approximately 60 dB Lmax (Figure 5.1-8). In comparison to human hearing sensitivity, 60 dBA is equivalent to the noise level of typical conversation. The very low incidence of behavioral responses to launch noise and lack of evidence of changes in SNPL abundance, nesting behavior, and distribution on VSFB beaches in response to launches, discussed below, is likely because very little of the noise produced by rocket engine noise is perceived by SNPL.

Figure 5.1-7. Launch peak noise level comparison of unweighted (green) versus SNPL-weighted (orange) decibels (note: time waveform recording from the June 2022 Falcon 9 SARah-1 launch).

SNPL monitoring for impacts from launch-related engine noise and visual disturbance has been conducted during numerous launches on VSFB over the past two decades during the breeding and non-breeding seasons. The monitoring has routinely demonstrated that SNPL behavior is not adversely affected by launch noise or vibrations, and no incidents of injury or mortality to adults, young, or eggs attributable to launch noise have been documented (SRS Technologies, Inc. 2001, 2006a, 2006b, 2006c, 2006f, 2006g, 2006h, 2006i, 2006j, 2006k; MSRS 2007a, 2008a, 2008b, 2008c, 2009c, 2010a, 2010b, 2013; Robinette & Ball 2013; Robinette & Miller 2017a, 2017b; Robinette & Rice 2019; Robinette & Rice 2022a). SNPL monitoring during prior Falcon 9 launches and landing events has not conclusively shown evidence of injury, mortality, or abnormal behavior.

The 25 June 2017 SpaceX Falcon 9 launch did not cause any detectable impacts on SNPL abundance and distribution on South Surf Beach and there were no nest or brood losses within the defined impact area (approximately 110 dBA L_{max}) at the time of the launch (Robinette & Miller 2017a). Although there were no active nests present during the 24 August 2017 SpaceX Falcon 9 launch, there were no detectable impacts on SNPL abundance and distribution on South Surf Beach and there were no brood losses within the area impacted by noise (approximately 110 dBA L_{max}) at the time of the launch (Robinette & Miller 2017b).

Direct observations of wintering birds were made during a Titan IV and Falcon 9 launch from SLC-4E (SRS Technologies, Inc. 2006b; Robinette and Ball 2013). The Titan IV launches resulted in sound levels of 130 dBA L_{max}. SNPL did not exhibit any adverse reactions to these launches (SRS Technologies, Inc. 2006b; Robinette and Ball 2013), except for one observation.

To date, monitoring has been performed for three Falcon 9 first stages have landed at SLC-4W and created sonic booms on South Surf Beach during plover breeding season. On 12 June 2019, SNPL response was documented during a SpaceX Falcon 9 launch with boost-back and first stage recovery at SLC-4 (Robinette & Rice 2019). The return flight of the first stage to SLC-4 produced a 3.36 psf sonic boom and landing engine noise of 138 dB L_{max}, as measured on South Surf Beach. SNPL responses to the noise impacts were documented via pre- and post-launch monitoring and video recording during the launch event. Incubating SNPLs captured on video did not react to the landing engine noise but were observed to startle and either jump or hunker down in response to the sonic boom. One SNPL egg showed signs of potential damage. This egg was part of a three-egg clutch in which the other two eggs successfully hatched. It is common for one or more eggs from a successful nest to not hatch. Failure of the egg to hatch was not conclusively tied to the launch event (Robinette and Rice 2019).

SNPL were monitored for the 17 April 2022 SpaceX Falcon 9 NROL-85 launch with boost-back and first stage recovery at SLC-4 (Robinette & Rice 2022a). In addition to launch and landing engine noise, which were separated by approximately 7 minutes and reached over 110 dB L_{max} for each, SNPL at South Surf Beach also received a 1.95 psf sonic boom immediately after the landing engine noise. Monitors found no differences in overall plover abundance or nest attendance before and after the launch and boost-back and determined the launch did not negatively impact nesting snowy plovers at VSFB. Of the 11 nests that were active within the South Surf Beach nesting area at the time of the launch, 5 successfully hatched all eggs, 4 were depredated after the launch event (i.e., not related to launch), 1 was lost to a high tide event after the launch event (i.e., not related to launch), and 1 was not fertile. No damaged eggs were identified from any of the 11 nests that were active during the launch. Overall, hatching rates for snowy plover nests that were active during the 17 April 2022 launch were similar to hatching rates from previous years during periods when no launch occurred, despite successive noise disturbances (launch engine noise, landing engine noise, and sonic booms).

More recently, SNPL were monitored for the 18 June 2022 Falcon 9 SARah-1 mission with boost-back and first stage recovery at SLC-4 (Robinette & Rice 2022b). There were no differences in overall bird abundance or nest attendance before and after the launch and landing. Video footage showed that the incubating adults reacted to both the launch and the sonic boom produced by the return flight of the first stage with more intense reactions to the sonic boom. There was one snowy plover egg at north Wall Beach (outside of the monitoring area) that had a long crack. The damaged egg had an approximately three-week-old embryo that may have stopped developing around the time of the launch. However, it is not uncommon for one or more eggs from a successful nest to not hatch and we do not have data on how often eggs are damaged under normal (i.e., non-launch) circumstances. The nest with the damaged egg did not have a camera set on it, so it could not be determined what caused the damage.

Observations have been made of SNPL responding to impulsive noise during a firework display in Goleta, California. BioResource Consultants Inc. (2018) observed SNPL startle, flush nests, flee chicks, and exhibit stress behaviors in response to successive firework discharges approximately

1.5 mi (2.4 km) away that varied in length from a few seconds to several successive discharges lasting approximately 10 to 15 seconds. However, all birds being monitored returned to normal behaviors within a brief period of time and there was no evidence of abandonment of eggs or chicks (BioResource Consultants Inc. 2018). Sonic booms are similar to firework blasts as both are impulsive noises. For animal noise disturbance, the onset of the noise, or rate at which pressure rises to its maximum level, is important since the faster the noise level rises, the more likely that individuals will be startled (Francis & Barber 2013). Rocket engine noise rises in intensity gradually and is therefore less likely to result in a startle response than impulsive noise, such as sonic booms. However, firework displays are characterized by multiple blasts over a relatively long period of time and are thus not directly comparable to a single sonic boom. Overall, prior monitoring shows that SNPL's reaction to launch engine noise varies from no response to a mild startle response and has not affected nesting behavior, nesting success, abundance, or distribution on South Surf Beach.

The scientific literature shows that the effects of frequent noise disturbance on bird species varies greatly. Reviewed in Francis and Barber (2013), response to noise disturbances in wildlife depends on how frequent and predictable the noise is, acuteness, overlap with biologically relevant sounds, and overlap with animals hearing sensitivity range. Chronic (i.e., sustained) noise generally causes acoustic que masking, which can impact a variety of behaviors important to reproduction and fitness (Francis & Barber 2013). On the opposite side of the spectrum, infrequent, acute noise tends to cause startle responses (Francis & Barber 2013). In birds, sustained, chronic noise, such as that produced by traffic, wind turbines, and gas/oil fields, has been shown to correlate to a variety of negative effects, including changes in levels of stress hormones and stress physiology (Kleist et al. 2018; Zollinger et al 2019), acoustic que masking (Francis et al. 2011a; Francis & Barber 2013), changes in breeding behavior (Goudie & Jones 2004; Swaddle & Page 2007; Alquezar et al. 2020), changes in territorial behavior and aggression (Goudie & Jones 2004; Mockford & Marshall 2009; Wolfenden et al. 2019; Passos et al. 2020), impacts on reproduction and nest success (Halfwerk et al. 2011; Kleist et al. 2018; Zollinger et al. 2019), and declines in bird abundance (Francis et al. 2011b; McClure et al. 2013; Mejia et al. 2019; Rosa & Koper 2022), all of which have implications for survival and fitness (Francis & Barber 2013).

In many species, however, research has shown a lack of effect of chronic noise and evidence of habituation. It should, therefore, not be assumed that chronic noise exposure in birds is necessarily associated with the negative impacts listed above or that closely related species, or even individuals, will respond similarly. Yorzinski and Hermann (2016) found that peafowl (*Pavo cristatus*) exposed to continuous white noise showed no preference for roosting near or away from the noise source. Walthers and Barber (2020) found that traffic noise was not associated with stress indicators in nestling European starlings (*Sturnus vulgaris*). Similarly, stress physiology and immune function in nestling tree swallows (*Tachycineta bicolor*) was not altered when exposed to continuous white noise. Although Meillere et al. (2015) found differences in predator vigilance in house sparrows (*Passer domesticus*) exposed to traffic noise, they found no effect of the chronic exposure on reproductive performance. In response to loud, frequent, but non-sustained aircraft noise, a study of domestic turkeys (*Meleagris gallopavo domesticus*) showed they quickly acclimated to the noise (Bradley et al. 1990). Conomy et al. (1998) found that black duck (*Anas rubripes*) reactions to jet noise declined with exposure, but wood duck (*Aix sponsa*) reactions did not change. Aircraft noise was also shown not to have a significant effect on physiological stress in nestling tree sparrows (*Passer montanus*; Redondo et al. 2021).

The effect of increasing noise disturbances on SNPL is uncertain based on the scientific literature. However, none of the scientific literature studies are directly comparable to the noise impacts of the Proposed Action. Launch engine noise and sonic booms are acute, non-sustained, and unpredictable. It is most similar to aircraft noise disturbance yet would be relatively much less frequent. Beyond the launch monitoring efforts discussed above, there are no relevant studies on the effects of rocket launch on birds.

VSFB would augment the existing SNPL monitoring program on Base, which records habitat use, nesting efforts, nest fates, fledgling survival, and population size through each breeding season, with geospatial analysis of SNPL nesting and the noise environment, as presented in Section 2.3.3. SLMs would be deployed immediately inland of South Surf Beach to characterize the noise environment during the breeding season within Falcon 9's 100 dB L_{max} footprint. Geospatial analysis would be performed annually to assess whether patterns of nesting activity, nest fates, or fledgling success are negatively impacted by noise from the Proposed Action or other launch programs on VSFB. If geospatial analysis shows that a statistically significant decline in breeding effort or nest success over two consecutive years is not attributable to other factors, VSFB would offset this impact by increasing predator removal efforts on Base to include the non-breeding season, particularly focusing on raven removal at and adjacent to VSFB beaches.

On the NCI, impacts on SNPL would be substantially less (Figure 4.5-4). Over the past 29 Falcon 9 launches, only seven have impacted the NCI, and only four have impacted Santa Rosa Island where SNPL is considered a permanent resident. Sonic booms impacting Santa Rosa Island as a result of the Proposed Action during the SNPL breeding season would therefore be infrequent. As established through monitoring on VSFB (discussed above) SNPL would be expected to have a startle reaction to a sonic boom on Santa Rosa Island. However, there would not be any exposure to launch or landing noise or any associated visual stimuli. Since the sonic boom would be disassociated from these other stimuli, SNPL on Santa Rosa Island would likely have less intensity than on VSFB, but would still be expected to have a brief startle reaction. Reactions would likely be short term, infrequent, and be unlikely to cause any long-term consequences for individuals or populations. Because of the infrequent, short-term, and transient nature of the sonic booms and the relatively few numbers of individuals occurring on the NCI, the impacts would be insignificant and discountable to SNPL on the NCI.

Conclusion

VSFB has determined that the Proposed Action may affect, and is likely to adversely affect, the SNPL on VSFB. Individuals nesting, roosting, and foraging in the action area on VSFB are likely to be distressed by visual disturbance, noise, and overpressures from launch and landing activities. These disturbances may startle SNPL or disrupt foraging or breeding activities. If launch and landing occur during the breeding season (approximately March through September), brooding birds may startle and flush which could potentially damage eggs and leave eggs or chicks unattended. Unattended eggs and chicks may become vulnerable to exposure or predation.

Frequent exposure to sound and overpressure may cause effects that are not immediately evident and may cause reduced numbers of nesting adults or reduced productivity in the action area over time.

VSFB would perform geospatial analysis to monitor the impacts of noise from the Proposed Action and other launch programs on Base to assess any potential adverse impacts on the species at VSFB as the launch frequency gradually increases and reaches full tempo (Section 2.3.3). If adverse effects are found, VSFB would mitigate those effects by increasing predator management efforts on VSFB (Section 2.3.3) to comply with the USSF's sections 7(a)(1) and 7(a)(2) obligations under the ESA. Mitigation activities would align with the SNPL Recovery Plan (USFWS 2007) and 5-year review (USFWS 2019) with the goal of achieving no net loss to the species.

5.1.6 California Least Tern

Physical Impacts

No ground disturbing activities would occur within or near LETE habitat; therefore, the Proposed Action would have no direct physical impacts on LETE or LETE habitat.

Noise and Visual Disturbance

If missions are performed when LETE are present (approximately 15 April through 15 August), LETE at the Purisima colony would receive launch engine noise of approximately 108 dB L_{max} (Figure 4.6-1). The Purisima colony and Santa Ynez River mouth would receive landing engine noise less than 80 dB L_{max} (Figure 4.6-1). During static fire, which typically occur 1 to 3 days prior to launch, noise levels at the Purisima colony would be approximately 102 dB Lmax (Figure 4.6-1). During landing events, overpressures would be between 1 and 3 psf from a sonic boom (Figure 4.6-3). If LETE are present at the Santa Ynez River mouth, they may experience 115 dB L_{max} during launches and less than 80 dB L_{max} engine noise and a 1.5 to 4.0 psf sonic boom during SLC-4 landing events (Figure 4.6-3). Static fire tests would produce approximately 110 dB L_{max} at the Santa Ynez River mouth (Figure 4.6-2). Due to time requirements for refurbishing vehicle components, payload preparation, and site preparation, only approximately one third of the proposed 36 annual launches would overlap the time period when LETE are typically present at VSFB (15 April and 15 August).

At VSFB, LETE monitoring has been conducted for five Delta II launches from SLC-2 on north VSFB. SLC-2 is 0.4 mi. (0.6 km) from the Purisima Point nesting colony. LETE responses to launch noise have varied. Pre- and post-launch monitoring of non-breeding LETE for the 7 June 2007 Delta II COSMO-1 launch and monitoring of nesting LETE during the 20 June 2008 Delta II OSTM and 10 June 2011 Delta II AQUARIUS launches did not document any mortality of adults, young, or eggs, or any abnormal behavior resulting from launches (MSRS 2007a, 2008b, 2011). In addition, Delta II launches from SLC-2 in 2002 and 2005, when terns were arriving at the colony, may have caused temporary or permanent emigration from the colony because there was decreased attendance following the launches (Robinette et al. 2003; Robinette & Rogan 2005). These data imply that LETE response to noise relates to timing with the nesting cycle. For instance, at the beginning of the nesting season when LETE are arriving at the breeding colony, the adults seem to be more disturbed, but once courtship and nest-tending begins, the adults are more tenacious.

On 12 June 2019, LETE response was documented during a SpaceX Falcon 9 launch with first stage landing at SLC-4 on VSFB. The landing produced a 2.7 psf sonic boom, as measured at the Purisima LETE colony. LETE response to the launch and boost-back landing was documented via pre- and post-launch monitoring and video recording during the launch event. LETE response during the launch was difficult to determine since birds flushed before sonic boom impact. All LETE returned to their nests minutes after the launch event. One LETE egg was found to be damaged. The damaged LETE egg was from a one egg clutch and was inspected when it was a week past hatch date. The cause of the damage to the egg was inconclusive (Robinette & Rice 2019).

Monitoring of the LETE colony was also performed for the 12 June 2022 SpaceX Falcon 9 launch with first stage landing at SLC-4W. A 1.1 psf sonic boom was recorded at the colony. There were no differences in overall bird abundance or nest attendance before and after the launch and landing. Video monitoring showed the reaction of incubating LETE ranged from alert and minor looking around to a startle effect (i.e., calm before the boom, with a jolt and quick head movements looking around when the boom hit; Robinette & Rice 2022b).

Based on the existing monitoring observations, the audible and visual components of the Proposed Action (i.e., launch, landing, sonic boom, and vehicle lift off) could cause LETE to respond behaviorally. This stimulus could trigger a startle response that alerts predators to nest locations and causes temporary (minutes) abandonment of nests. The proposed environmental protection measures (Section 2.3.4) would be employed to characterize impacts on LETE as a result of launch-related noise events.

The scientific literature shows that the effects of frequent noise disturbance on bird species vary greatly. Reviewed in Francis and Barber (2013), response to noise disturbances in wildlife depends on how frequent and predictable the noise is, acuteness, overlap with biologically relevant sounds, and overlap with animals hearing sensitivity range. Chronic (i.e., sustained) noise generally causes acoustic que masking, which can impact a variety of behaviors important to reproduction and fitness (Francis & Barber 2013). On the opposite side of the spectrum, infrequent, acute noise tends to cause startle responses (Francis & Barber 2013). In birds, sustained, chronic noise, such as that produced by traffic, wind turbines, and gas/oil fields, has been shown to correlate to a variety of negative effects, including changes in levels of stress hormones and stress physiology (Kleist et al. 2018; Zollinger et al 2019), acoustic que masking (Francis et al. 2011a; Francis & Barber 2013), changes in breeding behavior (Goudie & Jones 2004; Swaddle & Page 2007; Alquezar et al. 2020), changes in territorial behavior and aggression (Goudie & Jones 2004; Mockford & Marshall 2009; Wolfenden et al. 2019; Passos et al. 2020), impacts on reproduction and nest success (Halfwerk et al. 2011; Kleist et al. 2018; Zollinger et al. 2019), and declines in bird abundance (Francis et al. 2011b; McClure et al. 2013; Mejia et al. 2019; Rosa & Koper 2022), all of which have implications for survival and fitness (Francis & Barber 2013).

In many species, however, research has shown a lack of effect of chronic noise and evidence of habituation. It should, therefore, not be assumed that chronic noise exposure in birds is necessarily associated with the negative impacts listed above or that closely related species, or even individuals, will respond similarly. Yorzinski and Hermann (2016) found that peafowl (*Pavo* *cristatus*) exposed to continuous white noise showed no preference for roosting near or away from the noise source. Walthers and Barber (2020) found that traffic noise was not associated with stress indicators in nestling European starlings (*Sturnus vulgaris*). Similarly, stress physiology and immune function in nestling tree swallows (*Tachycineta bicolor*) was not altered when exposed to continuous white noise. Although Meillere et al. (2015) found differences in predator vigilance in house sparrows (*Passer domesticus*) exposed to traffic noise, they found no effect of the chronic exposure on reproductive performance. In response to loud, frequent, but non-sustained aircraft noise, a study of domestic turkeys (*Meleagris gallopavo domesticus*) showed they quickly acclimated to the noise (Bradley et al. 1990). Conomy et al. (1998) found that black duck (*Anas rubripes*) reactions to jet noise declined with exposure, but wood duck (*Aix sponsa*) reactions did not change. Aircraft noise was also shown not to have a significant effect on physiological stress in nestling tree sparrows (*Passer montanus*; Redondo et al. 2021).

The effect of increasing noise disturbances on LETE will be uncertain based on the scientific literature. However, none of these studies in the scientific literature are directly comparable to the noise impacts of the Proposed Action. Launch engine noise and sonic booms are acute, non-sustained, and unpredictable. It is more similar to aircraft noise disturbances studied in the literature, yet would be relatively much less frequent. Beyond the launch monitoring efforts discussed above, there are almost no studies on the effects of rocket launch on birds.

Conclusion

VSFB has determined that the Proposed Action may affect, and is likely to adversely affect, the LETE on VSFB. Individuals nesting, roosting, and foraging in the action area are likely to be distressed by visual disturbance, noise, and overpressures from launch and landing activities. These disturbances may startle LETE or disrupt foraging or breeding activities. If launch and landing occur during the breeding season (approximately April through August), brooding birds may startle and flush which could potentially damage eggs and leave eggs or chicks unattended. Unattended eggs and chicks may become vulnerable to exposure or predation.

Frequent exposure to sound and overpressure may cause effects that are not immediately evident and may cause reduced numbers of nesting adults or reduced productivity in the action area over time.

VSFB would monitor the impacts of noise from the Proposed Action to assess any potential adverse impacts on the species at VSFB as the launch frequency increases and reaches full tempo (Section 2.3.4). If adverse effects are found, VSFB would mitigate those effects by increasing predator management efforts on VSFB (Section 2.3.4) to comply with the USSF's sections 7(a)(1) and 7(a)(2) obligations under the ESA. Mitigation activities would align with the LETE Recovery Plan (USFWS 1985b) and 5-year review (USFWS 2020) with the goal of achieving no net loss to the species.

5.1.7 California Condor

Physical Impacts

No ground disturbing activities would occur within or near California condor habitat and the Action Area is outside the normal range of the species and the species. California condor is not known to breed within the Action Area; therefore, the Proposed Action would have no direct physical impacts on California condor or condor habitat.

Noise and Visual Disturbance

It has been difficult to analyze the effect human disturbance could have on California condors. Generally, California condors are less tolerant of human disturbances near nesting sites than at roosting sites. The species is described as being "keenly aware of intruders" and may be alarmed by loud noises from distances greater than 1.6 mi. (2.6 km). In addition, the greater the disturbance in either noise level or frequency, the less likely the condor would be to nest nearby. As such, USFWS typically requires isolating roosting and nesting sites from human intrusion (USFWS 1996). Noise from a launch coupled with visual disturbance could cause a startle response and disrupt behavior if a condor is within the Action Area.

Although launch noise, sonic booms, and visual disturbance may cause a startle response and disrupt behavior, the likelihood of a condor being present during these activities is extremely low and, therefore, the effect of the Proposed Action would be discountable.

Conclusion

The overall likelihood of a California condor occurring within the Action Area during a launch, landing, or static fire event is extremely unlikely, hence, discountable. Therefore, VSFB has determined that Proposed Action may affect, but is not likely to adversely affect, the California condor. The USSF will coordinate with the USFWS and Ventana Wildlife Society to monitor for condor presence prior to launches.

5.1.8 Southern Sea Otter

Physical Impacts

No ground disturbing activities would occur within or near southern sea otter habitat; therefore, the Proposed Action would have no direct physical impacts on southern sea otter or southern sea otter habitat.

Noise and Visual Disturbance

Areas present directly offshore of SLC-4 would receive visual disturbance and noise levels of less than 130 dB L_{max} during a Falcon 9 launch and approximately 110 dB L_{max} during a first stage landing at SLC-4W (Figure 4.8-1). During static fire events, noise directly off the coast of SLC-4 would be less than 125 dB L_{max} (Figure 4.8-2) and there would be no associated visual disturbance. Landing at SLC-4W would also generate a sonic boom directly offshore that would range from 1 to 5 psf (Figure 4.8-3). Otters are only occasionally observed along the coast between Purisima Point and Point Arguello transiting through the area between suitable habitat to the north and south. Beginning at the Boat Dock and continuing south along Sudden Flats, the inshore habitat supports expansive kelp beds and a relatively high density of otters. Noise levels would reach between 100 and 110 dB L_{max} during a Falcon 9 launch and less than 80 dB L_{max} during first stage landing at SLC-4W in these areas (Figure 4.6-1). Sonic booms during SLC-4W landing would range from 1 to 3 psf along Sudden Flats (Figure 4.6-3).

Exceptionally little sound is transmitted between the air-water interface; thus, in-air sound, whether from launch, landing, or sonic boom, would not have a significant effect on submerged animals (Godin 2008). In addition, according to Ghoul & Reichmuth (2014), "Under water, hearing sensitivity [of sea otters] was significantly reduced when compared to sea lions and other pinniped species, demonstrating that sea otter hearing is primarily adapted to receive airborne sounds." This study suggested that sea otters are less efficient than other marine carnivores at extracting noise from ambient noise (Ghoul & Reichmuth 2014). Therefore, the potential impact of underwater noise caused by in-air sound would be discountable.

Extensive launch monitoring has been conducted for sea otters on both north and south VSFB, with pre- and post-launch counts and observations conducted at rafting sites immediately south of Purisima Point for numerous Delta II launches from SLC-2 and one Taurus launch from Launch Facility-576E and at the rafting sites off of Sudden Flats for two Delta IV launches from SLC-6. No abnormal behavior, mortality, or injury of effects on the population has ever been documented for sea otter as a result of launch-related noise and visual disturbance (SRS Technologies, Inc. 2006b, 2006d, 2006e, 2006f, 2006g, 2006i, 2006k, 2006l; MSRS 2007a, 2007b, 2007c, 2008a, 2008b, 2009d). More recently, for the SpaceX Falcon 9 SAOCOM launch and landing on 7 October 2018, sea otters were monitored during pre- and post-launch surveys on south VSFB (MSRS 2018c). The sonic boom received at the otter monitoring location was estimated at 0.71 psf and the maximum landing engine noise at this location was estimated at 99.5 dB L_{max}. Count totals of both pups and adults were similar before and after the launch and there was no discernable impact on otters on south VSFB.

The lack of any demonstrated impact from launches on otter populations off the coast of Sudden Ranch is likely because there is little overlap in the hearing sensitivity of otters (primarily 2 to 22 kHz) and launch engine noise, which is primarily below 250 Hz, with moderate energy to 2 kHz range, and little energy above 2 kHz, as discussed more below. While a 2-psf sonic boom is approximately 135 dB (unweighted), it is likely that most of that acoustic energy from the sonic boom is not heard by sea otters anyway. Similarly, the frequency spectrum of a 1.5-psf sonic boom (recorded at San Nicolas Island on 12 December 2014) has little overlap with the hearing curve of a sea otter (Ghoul & Reichmuth 2014; Figure 5.1-8). Most of the sonic boom energy is less than 250 Hz, well below the region of best sensitivity of the sea otter (2–22.6 kHz; Figure 5.1-8). While the sea otter would likely hear the sonic boom, it would only be responding to acoustic energy that is above 250 Hz and total sound levels much less than 135 dB. As the sonic boom increases in pressure, it is likely that more energy would be detected by the sea otter, most notably in frequencies higher than 250 Hz; however, sonic booms produced by first stage booster landings at SLC-4W have typically been less than 2 psf in otter habitat.

Additionally, if disturbed, otters typically dive under the water and therefore minimize potential noise exposure anyway. As noted in Section 2.2.3, landing noise follows launch by approximately 5 to 7 minutes and typically occurs slightly before the sonic boom impacts land. Therefore, any individuals that flee into water as a result of launch disturbance would reduce their likelihood of being exposed to the landing engine noise and sonic boom due to the attenuation of sound in water (Godin 2008). As a result, there would not be an opportunity for chronic noise exposure in otters.

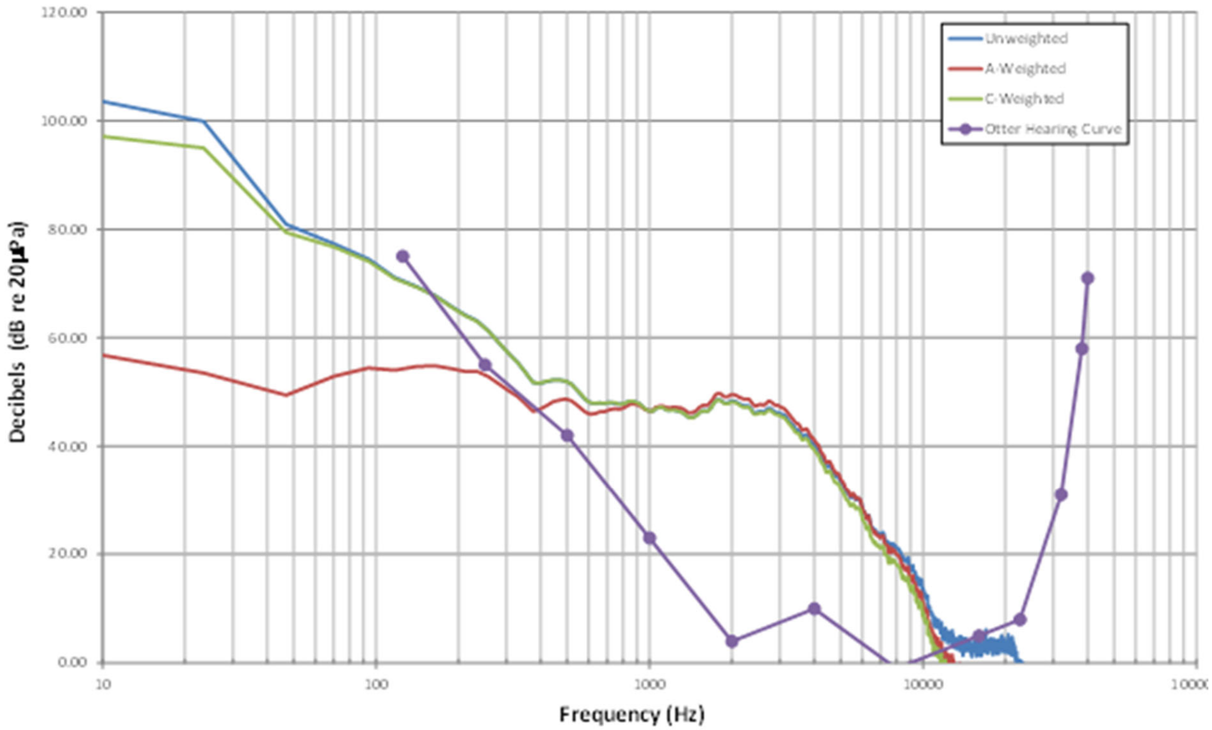

Figure 5.1-8. Sonic boom spectrum and sea otter hearing sensitivity curve.

To determine how much rocket engine noise otters would be able to sense, a frequency-weighting filter was developed for sea otters. Ghoul & Reichmuth (2014) developed an audiogram for the northern sea otter (*Enhydra lutris kenyoni*; Figure 5.1-9). Following methods established in Southall et al. (2019), this audiogram was used to derive an auditory weighting function to serve as a frequency-specific filter to quantify how noise may be perceived by otters, given its spectral content (Figure 5.1-10), and how that would relate to the spectral characteristics of an otter's potential susceptibility to noise. Weighting functions are used to de-emphasize noise at frequencies where susceptibility is lower and emphasize noise at frequencies where sensitivity is greater.

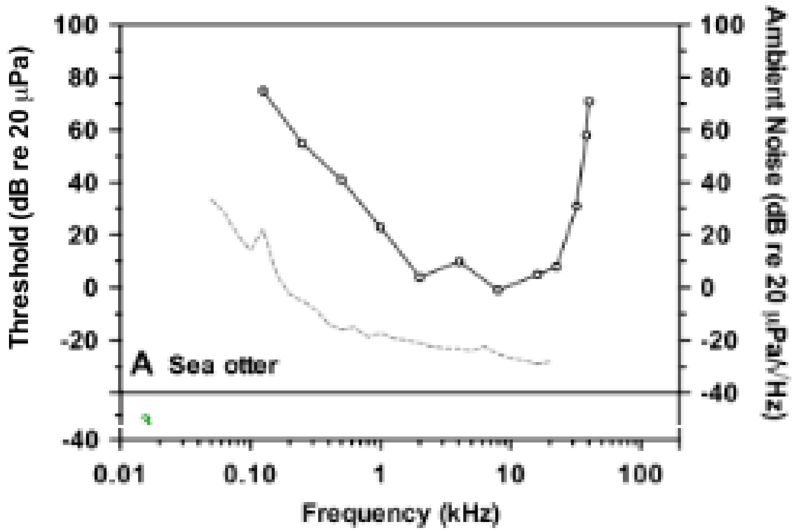

Figure 5.1-9. Northern sea otter audiogram (solid dotted line; source: Ghoul & Reichmuth 2014).

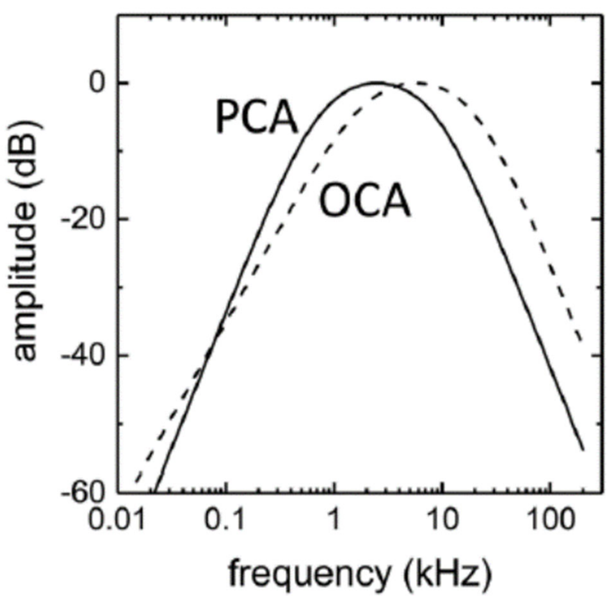

Figure 5.1-10. Sea otter derived auditory weighting function (dotted line; OCA = other carnivores in-air and is appropriate for otters; PCA = phocids in-air; Source: Southall et al. 2019).

To determine the resultant level of in-air noise that is potentially perceived by a sea otter during launch, the otter weighting function was applied to the timewave form recording of the June 2022 Falcon 9 SARah-1 launch. The unfiltered time waveform had a frequency spectra with an unweighted peak level of approximately 110 dB L_{max} (Figure 5.1.11). After applying the otter weighting function, the peak level was approximately 70 dB L_{max} (Figure 5.1.11), which by comparison to human hearing sensitivity is equivalent to the sound level of a household washing machine. Therefore, the perceived noise during rocket launches under the Proposed Action would be significantly less than the unweighted modeling results of between 100 and 110 dB L_{max} at Sudden Ranch would suggest.

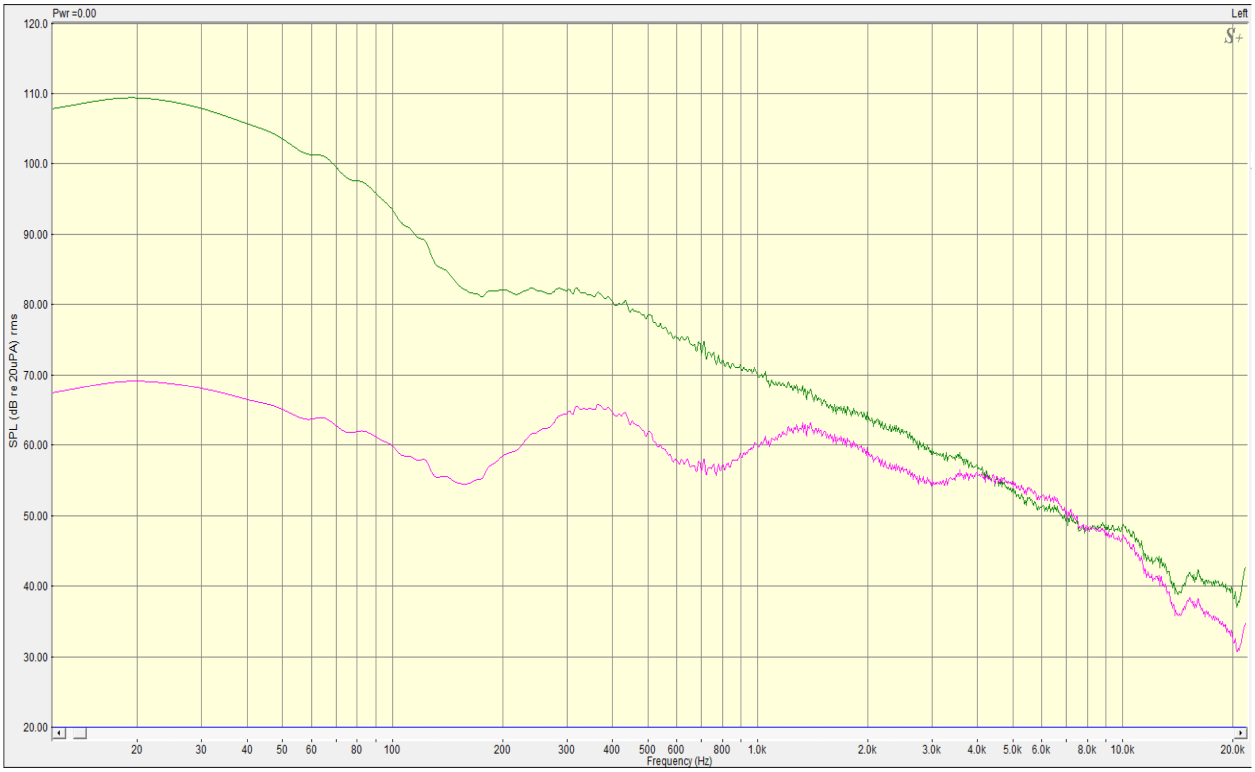

Figure 5.1-11. Launch peak noise level comparison of unweighted (green) versus otter-weighted (purple) decibels (note: time waveform recording from the June 2022 Falcon 9 SARah-1 launch).

Finally, otters have also been shown to quickly acclimate to disturbances from boats, people, and harassment devices (air horns). Davis et al. (1988) conducted a study of northern sea otter's reactions to various underwater and in-air acoustic stimuli. The purpose of the study was to identify a means to move sea otters away from a location in the event of an oil spill. Anthropogenic sound sources used in this behavioral response study included truck air horns and an acoustic harassment device (10 to 20 kHz at 190 dB) designed to keep dolphins and pinnipeds from being caught in fishing nets. The authors found that the sea otters often remained undisturbed and quickly became tolerant of the various sounds. When a fleeing response occurred as a result of the harassing sound, sea otters generally moved only a short distance (328 to 656 ft [100 to 200 m]) before resuming normal activity (Davis et al. 1988).

Curland (1997), studying the southern sea otter, also found that they may acclimate to disturbance. The author compared otter behavior in areas with and without human-related disturbance (e.g., kayaks, boats, divers, planes, sonic booms, and military testing at Fort Ord) near Monterey, California. Otters spent more time traveling in areas with disturbance compared to those without disturbance; however, there was no significant differences in the amount of time spent resting, foraging, grooming, and interacting, suggesting that the otters were becoming acclimated to regular disturbances from a variety of sources (Curland 1997). Extensive launch monitoring of sea otters on VSFB has shown that disturbance from rockets is not a primary driver of sea otter behavior or use of the habitat along Sudden Flats and has not had any apparent long-term consequences on populations, potentially indicating that this population has acclimated to launch activities. Therefore, any impacts as a result of noise (launch, landing, and sonic boom) or visual disturbance are expected to be limited to minor behavioral disruption and insignificant.

Conclusion

Because there is very little overlap in the hearing sensitivity of otters and noise produced during rocket launches and landings, otters would perceive very little noise during launch activities and VSFB has determined that impacts on southern sea otter would be insignificant as a result of the Proposed Action, including the collective effects of increased launch activities at VSFB. Therefore, the Proposed Action may affect, but is not likely to adversely affect, the southern sea otter off the coast of VSFB.

5.2 Direct and Indirect Effects on Critical Habitat

5.2.1 Tidewater Goby

The Action Area does not overlap TWG Critical Habitat. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.2 Unarmored Threespine Stickleback

The USFWS has not designated Critical Habitat for the UTS. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.3 California Red-Legged Frog

The Action Area includes the following designated critical habitat units for the CRLF: STB-2 and STB-4 (Figure 4.3-1). The Proposed Action would have no ground disturbing activities or impacts on water quality within critical habitat therefore no measurable impacts on vegetation, hydrology, habitat structure, or any other physical features of habitat. Unit STB 4 would receive landing noises in excess of 70 dB and units STB-2 and STB-4 would potentially receive infrequent sonic booms of 1 to 2 psf, which would not be expected to appreciably diminish habitat quality, including vegetation, prey base, or degradation of habitat structure. Therefore, the Proposed Action would have no effect on critical habitat for this species.

5.2.4 Marbled Murrelet

The Action Area does not overlap MAMU Critical Habitat. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.5 Western Snowy Plover

The Action Area includes portions of Santa Rosa Island which are designated Critical Habitat for the SNPL (Figure 4.5-4). Although the frequency of booms impacting Santa Rosa Island has been low (4 of last 29 launches), these areas may potentially receive sonic booms of up to 5 psf (Figure 4.5-4). The Proposed Action does not include any ground disturbance within Critical Habitat nor would it appreciably diminish the species' prey base or any other physical features of habitat. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.6 California Condor

The Action Area does not overlap California Condor Critical Habitat. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.7 Southern Sea Otter

The USFWS has not designated Critical Habitat for the southern sea otter. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.3 Collective Effects

In addition to direct and indirect effects, the USSF analyzed the collective effects of launch-related noise impacts on ESA-listed species on VSFB per prior USFWS requests. For each species, the USSF considered the potential effect of overlapping noise impacts from multiple launch programs. Over the past five years, VSFB has supported an average of 6.2 rocket launches per year with a high of 15 launches to date in 2022; however, several new launch programs have recently been, or will soon be, initiated. Of these launch programs, those that will have noise impacts on Honda Creek, Bear Creek, and/or the Santa Ynez River of at least 100 dB L_{max} include Phantom Daytona-E (SLC-8) and Minotaur (SLC-8), which have completed the National Environmental Policy Act (NEPA) approval process, and Phantom Daytona-E/Laguna-E (SLC-8), ULA Vulcan (SLC-3), Blue Origin New Glenn (SLC-9), Relativity Terran 1 (SLC-11), and the Proposed Action, which are projected to receive NEPA approval over the next several years.

5.3.1 California Red-legged Frog

If all of these programs, including the Proposed Action, achieve full launch tempo (estimated in 2028 to 2030), the total number of annual noise events (launch, static fire, landing) of at least 100 dB L_{max} would be 160 at Bear Creek, 217 at Honda Creek, and 129 at the Santa Ynez River (Note: Falcon 9 launch with landing at SLC-4W was treated a single noise event in these totals because launch and landing occur within minutes of each other). Although this type of disturbance is not directly comparable to those available from the scientific literature, it is reasonably likely that, in addition to being startled by these launch events, as launch tempo increases on VSFB, the frequency of disturbance could potentially result in chronic levels of stress hormone responses in CRLF, impacts on habitat occupancy, reduced breeding, and lower immunity in individuals. These in turn could reduce reproduction success, survival, and fitness, and cause individuals to leave the area, resulting in population level effects.

The monitoring program (see Section 2.3.2) that would be implemented to track CRLF habitat occupancy, breeding behaviors, and tadpole densities in Lower Honda Creek as the frequency of launch and static fire under the Proposed Action increases will also produce data that will enable the collective effects of launch-related noise from an increase in tempo across VSFB which will be assessed and mitigated under a programmatic base wide strategy using the same approach described in Section 2.3.2.

5.3.2 Western Snowy Plover

At full launch tempo under the Proposed Action and other current and reasonably foreseeable launch programs, up to 237 noise events above 100 dB L_{max} would affect SNPL at South Surf Beach annually. As discussed above, the launch noise levels perceived by SNPL (levels weighted for presumed SNPL hearing sensitivity) would be substantially less than the unweighted peak values. There are no thresholds in the literature that predict what level of noise disturbance would cause impacts on stress physiology, behavior, reproduction, survival, or factors related to fitness. As the launch tempo on VSFB increases, SNPL may habituate to the increased disturbances, or may develop chronic levels of stress hormones, changes in habitat use, impacts to reproduction and nest success, as well as the other negative factors discussed above, which are related to fitness, and may result in population level effects.

The effect of increasing noise disturbances on SNPL will be uncertain based on the scientific literature. However, none of the scientific literature studies are directly comparable to the noise impacts of the Proposed Action. Launch engine noise and sonic booms are acute, non-sustained, and unpredictable. The monitoring program (see Section 2.3.3) that would be implemented to monitor SNPL nesting and the noise environment as the frequency of launch, static fire, and landing under the Proposed Action increases will also produce data that will enable the collective effects of launch-related noise from an increase in tempo across VSFB which will be assessed and mitigated under a programmatic base wide strategy using the same approach described in Section 2.3.3.

5.3.3 California Least Tern

At full launch tempo under the Proposed Action and other current and reasonably foreseeable launch programs, approximately 47 launch noise events (one third of the annual noise events per year) above 100 dB L_{max} would affect LETE at the colony or Santa Ynez River mouth annually. As discussed above, the launch noise levels perceived by LETE (levels weighted for presumed LETE hearing sensitivity) would be substantially less than the unweighted peak values. There are no thresholds in the literature that predict what level of noise disturbance would cause impacts on stress physiology, behavior, reproduction, survival, or factors related to fitness. As the launch tempo on VSFB increases, LETE may habituate to the increased disturbances, or may develop chronic levels of stress hormones, changes in habitat use, impacts on reproduction and nest success, as well as the other negative factors discussed above, which are related to fitness, and may result in population level effects.

The monitoring program (see Section 2.3.4) that would be implemented to study LETE breeding effort, nest fates, and fledging success while recording patterns of habitat use through the season as the frequency of launch, static fire, and landing under the Proposed Action increases will also produce data that will enable the collective effects of launch-related noise from an increase in tempo across VSFB which will be assessed and mitigated under a programmatic base wide strategy using the same approach described in Section 2.3.2.

5.4 Cumulative Effects

Cumulative effects are defined in 50 C.F.R. § 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action

Area of the Federal action subject to consultation." Reasonable, foreseeable, future federal actions, and potential future federal actions, that are unrelated to the Proposed Action, are not considered in the analysis of cumulative effects because they would require separate consultation pursuant to Section 7 of the ESA. There are no known cumulative effects related to the Proposed Action.

5.5 Interrelated and Interdependent Effects

Under USFWS's regulations, interrelated actions are "those that are part of a larger action and depend on the larger action for their justification." Interdependent actions are "those that have no independent utility apart from the action under consideration" (50 C.F.R. § 402.02). There are no interrelated or interdependent actions related to the Proposed Action.

6 Conclusion

SpaceX proposes to increase the Falcon 9 annual launch cadence at VSFB to 36 launch and first stage landing events per year, not to exceed 12 first stage recoveries per year at SLC-4W, and include additional downrange offshore landing locations in the Pacific Ocean. This Proposed Action would result in increases in airborne noise and visual disturbance during launches, static fire, and landing events within the Action Area.

After reviewing the Proposed Action, including the proposed avoidance, minimization, monitoring, and mitigation measures (Section 2.3), the USSF has come to the conclusions which are summarized in Table 6.0-1.

Table 6.0-1. Federally listed species with potential to occur in Santa Barbara County and summary of effects determinations.

Common Name	Scientific Name	Federal Listing	Critical Habitat	General Habitat	Effects Determinations for the Proposed Action
Tidewater Goby	*Eucyclogobius newberryi*	Endangered	Designated, no overlap with Action Area	Estuaries and lagoons typically in areas of fresh-saltwater interface	May affect, but is not likely to adversely affect.
Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	Endangered	Not designated	Persistent, shallow, still-to-slow-moving lagoons, estuaries, and coastal streams	May affect, but is not likely to adversely affect.
California Red-legged Frog	*Rana draytonii*	Threatened	No effect	Coastal drainages of central California with aquatic breeding areas (ponds, creeks, marshes, springs, etc.) and upland habitat	May affect, and is likely to adversely affect.
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	Designated, no overlap with Action Area	Coastal species, nests in high trees within coastal forests	May affect, but is not likely to adversely affect.
Western Snowy Plover	*Charadrius nivosus*	Threatened	No effect	Coastal beaches, breeds above the high tide but may also breed in salt ponds and dredged material sites	May affect, and is likely to adversely affect.
California Least Tern	*Sternula antillarum browni*	Endangered	Not designated	Coastal areas, nesting on open beaches free of vegetation	May affect, and is likely to adversely affect.
California Condor	*Gymnogyps californianus*	Endangered	Designated, no overlap with Action Area	Large remote areas; nests in rock formations and trees	May affect, but is not likely to adversely affect.
Southern Sea Otter	*Enhydra lutris nereis*	Threatened	Not designated	Shallow coastal waters with kelp beds	May affect, but is not likely to adversely affect.

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APPENDIX B
National Marine Fisheries Service Consultations

Letter of Authorization

The 30th Space Wing, U.S. Air Force (USAF), is hereby authorized to take marine mammals incidental to those activities at Vandenberg Air Force Base (VAFB), California, in accordance with 50 CFR 217, Subpart G--Taking Of Marine Mammals Incidental To Rocket and Missile Launches and Aircraft Operations at Vandenberg Air Force Base (VAFB), California subject to the provisions of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*; MMPA) and the following conditions:

1. This Letter of Authorization (LOA) is valid for five years from the date signed.

2. This Authorization is valid only for rocket, missile, and aircraft activities activities at VAFB, California.

3. General Conditions

   (a) A copy of this LOA must be in the possession of the USAF, its designees, and personnel operating under the authority of this LOA.

   (b) The species authorized for taking by incidental harassment are: Pacific harbor seals (*Phoca vitulina richardsi*); California sea lions (*Zalophus californianus)*; northern elephant seals (*Mirounga angustirostris*); northern fur seals (*Callorhinus ursinus*); Guadalupe fur seals (*Arctocephalus philippii townsendi*); and Steller sea lions (*Eumetopias jubatus*).

   (c) The taking, by Level B harassment only, is limited to the species listed in condition 3(b). See Table 1 (attached) for numbers of take authorized.

   (d) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in condition 3(b) of the Authorization or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this LOA.

4. The following activities are authorized to take, by incidental harassment only, the species of marine mammals identified in condition 3(b) above and will take place at space launch complexes, launch facilities, and test pads on VAFB:

   (a) Launching of no more than 15 missiles annually;

   (b) Launching of no more than 110 rockets annually;

   (c) Recoveries of no more than 12 Falcon 9 rockets annually;

(d) Unmanned aerial systems (UAS) operations.

5. Mitigation Measures. Unless constrained by human safety or national security the holder of this Authorization is required to implement the following mitigation measures:

(a) Rocket launches must be scheduled to avoid launches which are predicted to produce a sonic boom on the Northern Channel Islands during the harbor seal pupping season of March through June, whenever possible.

(b) Aircraft and helicopter flight paths must maintain a minimum distance of 1,000 ft (305 m) from recognized pinniped haulouts and rookeries whenever possible, except for one area near the VAFB harbor over which aircraft may be flown to within 500 ft of a haulout, and except in emergencies or for real-time security incidents.

(c) For UAS, except during take-off and landing, the following minimum altitudes must be maintained over all known marine mammal haulouts when marine mammals are present: Class 0-2 UAS must maintain a minimum altitude of 300 feet; Class 3 UAS must maintain a minimum altitude of 500 feet; Class 4 or 5 UAS must not be flown below 1,000 feet.

(d) If any incident of injury or mortality of a marine mammal discovered during post-launch surveys or indications of affects to the distribution, size, or productivity of the affected pinniped populations as a result of the authorized activities are thought to have occurred, launch procedures and monitoring methods must be reviewed, in cooperation with NMFS, If necessary, appropriate changes must be made through modification to this Authorization prior to conducting the next launch of the same vehicle.

6. Monitoring. The holder of this Authorization is required to conduct marine mammal monitoring and to conduct acoustic monitoring as described below:

(a) The USAF must either use video recording, or, must designate a qualified on-site individual approved in advance by NMFS, with demonstrated proficiency in the identification of all age and sex classes of both common and uncommon pinniped species found at VAFB and the Northern Channel Islands and knowledge of approved count methodology and experience in observing pinniped behavior, to monitor and document pinniped activity as described in 6(b) through 6(k).

(b) For any launches of space launch vehicles or recoveries of the Falcon 9 First Stage occurring from January 1 through July 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to the launch and/or recovery.

(c) For any launches of new space launch vehicles that have not been monitored during at least three previous launches occurring from August 1 through December 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(d) For any launches of existing space launch vehicles that are expected to result in a louder launch noise or sonic boom than previous launches of the same vehicle type occurring from August 1 through December 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(e) For any launches of new types of missiles occurring from August 1 through December 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(f) For any recoveries of the Falcon 9 First Stage occurring from August 1 through December 31 that are predicted to result in a sonic boom of 1.0 pounds per square foot (psf) or above at VAFB, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(g) For any launches or Falcon 9 First Stage recoveries occurring from January 1 through July 31, follow-up surveys must be conducted within two weeks of the launch.

(h) For any launches or Falcon 9 First Stage recoveries, if it is determined by modeling that a sonic boom of greater than 2.0 psf is predicted to impact one of the Northern Channel Islands between March 1 and July 31, greater than 3.0 psf between August 1 and September 30, and greater than 4.0 psf between October 1 and February 28, pinniped activity at the Northern Channel Islands must be monitored. Monitoring must be conducted at the haulout site closest to the predicted sonic boom impact area, or, in the absence of pinnipeds at that location, at another nearby haulout.

(i) Marine mammal monitoring must include multiple surveys each day that record the species, number of animals, general behavior, presence of pups, age class, gender and reaction to launch noise, sonic booms or other natural or human caused disturbances, in addition to environmental conditions such as tide, wind speed, air temperature, and swell.

(j) Marine mammal monitoring of activities that occur during darkness at VAFB must include night video monitoring, when feasible.

(k) For any launches or Falcon 9 First Stage recoveries for which marine mammal monitoring is required, acoustic measurements must also be made.

7. Reporting. The holder of this Authorization is required to:

(a) Submit a report to the Office of Protected Resources, NMFS, and West Coast Regional Administrator, NMFS, within 90 days after each monitored rocket launch, missile launch or rocket recovery. This report must contain the following information:

i. Date(s) and time(s) of the launch,

ii. Design of the monitoring program, and

iii. Results of the monitoring program, including, but not necessarily limited to:

A. Numbers of pinnipeds present on the haulout prior to commencement of the launch.

B. Numbers of pinnipeds that may have been harassed, as noted by the number of pinnipeds estimated to have moved greater than two times the animal’s body length, or, if the animal was already moving and changed direction and/or speed, or, if the animal flushed from land into the water in response to launch noise or sonic boom.

C. For any marine mammals that entered the water, the length of time those animals remained off the haulout.

D. Description of observed behavioral modifications by pinnipeds that were likely the result of launch noise or the sonic boom.

E. Results of acoustic monitoring, including the intensity of any sonic boom (psf) and sound levels in SELs, SPL_{peak} and SPL_{rms}.

(b) Submit a draft annual report to the Permits and Conservation Division, Office of Protected Resources, NMFS at 1315 East-West Highway, Silver Spring, MD

20910 and the Assistant Regional Administrator, West Coast Region, NMFS. This report must contain detailed information on the following:

i. Date(s) and time(s) of each missile and rocket launch and/or recovery.

ii. Design of the monitoring program;

iii. Results of the monitoring programs described under conditions 7(a)iii including the following:

A. Dates and times of all monitoring activities;

B. Details of all marine mammal sightings, including the number of pinnipeds, by species and haulout location, that remained ashore and/or fled from the beach in response to authorized activities;

C. The number of marine mammals, by species, returned to the haulout subsequent to the disruption (including estimates of the time it took for pinnipeds to return to haulouts), and estimates of the amount and nature of all instances of harassment; and

D. Information on the weather, including tidal state and horizontal visibility.

E. Date(s) and location(s) of any research activities related to monitoring the effects of launch noise and sonic booms on marine mammal populations; and

F. A summary of observed effects of UAS operations on marine mammals at VAFB.

(c) Submit a final annual report, within 60 days of receipt of any recommendations made by NMFS following review of the draft annual report by the Permits and Conservation Division, Office of Protected Resources, NMFS.

(d) Submit a draft comprehensive report to the Permits and Conservation Division, Office of Protected Resources, NMFS at 1315 East-West Highway, Silver Spring, MD 20910 and the Assistant Regional Administrator, West Coast Region, NMFS, at least 180 days prior to the expiration of the current regulations. This report must:

i. Summarize the activities undertaken and the results reported in all previous reports;

ii. Assess the impacts at each of the major rookeries;

iii. Assess the cumulative impacts on pinnipeds and other marine mammals from VAFB activities; and

iv. State the date(s), location(s), and findings of any research activities related to monitoring the effects of launch noise and sonic booms on marine mammal populations.

(e) Submit a final comprehensive report, within 60 days of receipt of any recommendations made by NMFS following review of the draft comprehensive report by the Permits and Conservation Division, Office of Protected Resources, NMFS, and the West Coast Regional Administrator, NMFS.

(f) Reporting of injured or dead marine mammals:

i. In the event that the specified activity clearly causes the take of a marine mammal in a manner not authorized by this LOA, such as serious injury or mortality, the USAF shall immediately cease the specified activities and immediately report the incident to the NMFS Office of Protected Resources ((301) 427-8401) and the NMFS West Coast regional stranding coordinator ((562) 980-3230). The report must include the following information:
   A. Time, date, and location (latitude/longitude) of the incident;
   B. Description of the incident;
   C. Status of all sound source use in the 24 hours preceding the incident;
   D. Environmental conditions (*e.g.*, wind speed and direction, cloud cover, and visibility);
   E. Description of all marine mammal observations in the 24 hours preceding the incident;
   F. Species identification or description of the animal(s) involved;
   G. Fate of the animal(s); and
   H. Photographs or video footage of the animal(s).

   Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with the USAF to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The USAF may not resume their activities until notified by NMFS.

ii. In the event that the USAF discovers an injured or dead marine mammal, and determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), the USAF shall immediately report the incident to the NMFS Office of Protected Resources ((301) 427-8401) and the NMFS West Coast regional stranding coordinator ((562) 980-3230). The report must include the same information identified in condition 7(f)(i) of this LOA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with the USAF to determine whether additional mitigation measures or modifications to the activities are appropriate.

iii. In the event that the USAF discovers an injured or dead marine mammal, and determines that the injury or death is not associated with or related to the specified activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the USAF shall report the incident to the NMFS Office of Protected Resources ((301) 427-8401) and the NMFS West Coast regional stranding coordinator ((562) 980-3230), within 24 hours of the discovery. The USAF shall provide photographs, video footage or other documentation of the sighting to NMFS.

8. This Authorization may be modified, suspended or withdrawn if the USAF fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Donna S. Wieting, Director
Office of Protected Resources

APR 10 2019
Date

Table 1. Numbers of takes authorized annually.

Species (stock)	2019	2020	2021	2022	2023	2024
Harbor seal	19,524	22,733	27,652	35,466	43,489	16,742
California sea lion	28,187	36,019	51,307	63,805	83,385	21,756
Northern elephant seal	4,170	5,283	7,434	9,253	12,036	5,481
Steller Sea Lion	134	168	221	302	387	105
Northern fur seal	1,190	1,530	2,210	2,721	3,571	26
Guadalupe fur seal	46	59	85	104	137	36

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

January 20, 2023

Refer to NMFS No: WCRO-2023-00002

Beatrice L. Kephart
Chief, Installation Management Flight
30 CES/CEI
1028 Iceland Avenue
Vandenberg AFC, California 93437

Re: Endangered Species Act Section 7(a)(2) Concurrence Letter for increasing number of launches at the Vandenberg Space Force Base

Dear Mr. Kephart:

This letter responds to your December 19, 2022, request for concurrence from the National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act (ESA) for the subject action. Your request qualified for our expedited review and concurrence because it contained all required information on your proposed action and its potential effects to listed species and designated critical habitat.

We reviewed United States Space Force's consultation request document and related materials. Based on our knowledge, expertise, and your action agency's materials, we concur with the action agency's conclusions that the proposed action is not likely to adversely affect the NMFS ESA-listed species and/or designated critical habitat.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The concurrence letter will be available through NMFS' Environmental Consultation Organizer [https://appscloud.fisheries.noaa.gov]. A complete record of this consultation is on file at the NMFS Long Beach office.

Reinitiation of consultation is required and shall be requested by the United States Space Force or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the proposed action causes take; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16).

This concludes the ESA consultation.

Please direct questions regarding this letter to Chiharu Mori at Chiharu.Mori@noaa.gov.

Sincerely,

Dan Lawson
Long Beach Branch Chief
Protected Resource Division

cc: Rhys Evans, VAFB, rhys.evans@spaceforce.mil

Administrative Record Number: 151422WCR2023PR00013

Biological Assessment of Launch Cadence Increase at Vandenberg Space Force Base, California, and Offshore Landing Locations to Support Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service

16 December 2022

Prepared for

30th Space Wing, Installation Management Flight
1028 Iceland Avenue, Bldg. 11146
Vandenberg Air Force Base, California 93437

Prepared by

ManTech SRS Technologies, Inc.
300 North G Street
Lompoc, CA 93436

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

°F	Fahrenheit
BA	Biological Assessment
BIA	Biologically Important Area
C	Celsius
CDFW	California Department of Fish and Wildlife
C.F.R.	Code of Federal Regulations
DAF	Department of the Air Force
DoD	Department of Defense
DPS	Distinct Population Segment
E	east
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
ft	foot or feet
ft^2	square feet
FR	Federal Register
km	kilometer(s)
km^2	square kilometers
LOC	letter of concurrence
m	meter(s)
mi.	mile(s)
MMPA	Marine Mammal Protection Act
NCI	norther Channel Islands
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
psf	pounds per square foot
SAR	Stock Assessment Report
SLD 30	Space Launch Delta 30
SLC	Space Landing or Launch Complex
SMI	San Miguel Island
UME	Unusual Mortality Event
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USSF	United States Space Force
VSFB	Vandenberg Space Force Base
W	west

1 Introduction

The purpose of this Biological Assessment (BA) is to address the potential effects of a proposed increase in launch and first stage recovery activities at Vandenberg Space Force Base (VSFB), California. The Proposed Action includes increasing the annual launch cadence at VSFB to approximately 110 rocket launches per year, increasing from 12 up to 36 SpaceX Falcon 9 first stage recoveries per year on autonomous droneships and maintaining up to 12 recoveries (i.e., landings) per year at Space Landing Complex 4 West [SLC-4W]; Figure 1.1-1) and expanding the Falcon 9 first stage landing and fairing recovery area in the Pacific Ocean (Figure 1.1-2). This Proposed Action is inclusive of all launch proponents on VSFB, including SpaceX Falcon 9 operations at Space Launch Complex 4 (SLC-4), which have previously been covered under separate consultations (see Section 1.2). The USSF is the lead agency for the purposes of this BA. The USSF and the project proponents have utilized the best available scientific and commercial data in the preparation of this BA.

1.1 Background

VSFB occupies approximately 99,100 acres (400 square kilometers [km^2]) of central Santa Barbara County, California, and is approximately halfway between San Diego and San Francisco (Figure 1.1-1). The Santa Ynez River and State Highway 246 divide VSFB into two distinct parts: North Base and South Base. SLC-4 is located on South Base. SLC-4 East (E) is the existing launch facility for the Falcon 9 program, located approximately 0.9 miles (mi) (1.4 kilometers [km]) east of the Pacific Ocean. SLC-4W is the existing landing facility for the Falcon 9 program, located approximately 0.5 mi (0.8 km) inland from the Pacific Ocean.

The Space Launch Delta 30 (SLD 30) at VSFB is the Department of the Air Force (DAF)/USSF organization responsible for Department of Defense (DoD) space and missile launch activities on the west coast of the United States (U.S.). Satellite launches destined for polar or near-polar orbit and ballistic missile testing are conducted at VSFB. VSFB supports launch activities for the DAF/USSF, DoD, Missile Defense Agency, National Aeronautics and Space Administration, foreign nations, and various private contractors. There are currently seven active SLCs at VSFB used for rocket launch of satellites into orbit and several more planned. SpaceX is currently operating the Falcon 9 Launch Vehicle Program at SLC-4 on VSFB, including up to 12 Falcon 9 launches from SLC-4E and 12 first stage recoveries either at SLC-4W or an autonomous droneship downrange in the Pacific Ocean within the currently approved landing area (Figure 1.1-2). Launches may occur from any launch facility on VSFB. As NMFS concurred (NMFS 2022a), the launch site and the launch proponent is irrelevant, and any and all VSFB launch actions can be considered similarly for impacts to NMFS ESA-listed species.

The USSF proposes to increase space launch activities on VSFB from 100 per year to approximately 110 launches annually. The USSF also proposes to increase the annual number of SpaceX Falcon 9 first stage recoveries per year to 36 and expand potential downrange landing and fairing recovery locations in the Pacific Ocean to accommodate new trajectories, beginning in 2023 (Figure 1.1-2). Space launch vehicles on VSFB have generally utilized azimuths from 140 to 210 degrees; however, the USSF proposes to utilize new northerly trajectories with azimuths of 305-325 degrees to support the SpaceX Falcon 9 program at SLC-4 (Figure 1.1-3).

This BA evaluates the potential effects of increasing the launch cadence at VSFB from 100 to 110, increasing SpaceX Falcon 9 first stage recoveries to 36 times per year, and expanding the Falcon 9 first stage and fairing recovery areas on NMFS ESA-listed species and designated critical habitat. Only those species and designated critical habitat that may be affected by the Proposed Action are discussed in this BA. Consistent with the NMFS requirements for ESA section 7 analyses, the spatial and temporal overlap of activities with the presence of listed species is assessed in this BA. The definitions used by the USSF in making the determination of effect under section 7 of the ESA are based on the United States Fish and Wildlife Service (USFWS) and NMFS Endangered Species Consultation Handbook (USFWS & NMFS 1998).

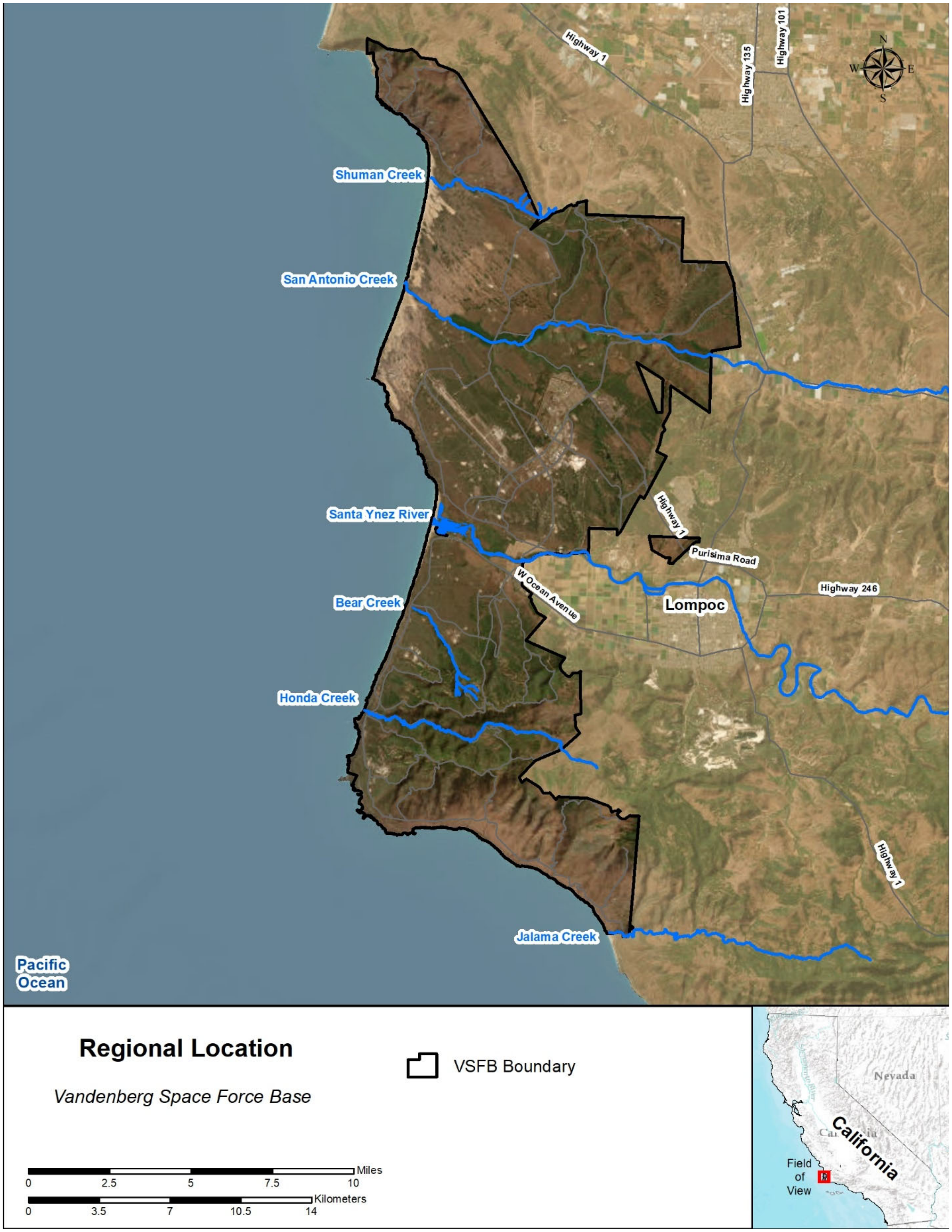

Figure 1.1-1. Regional Location of Vandenberg Space Force Base.

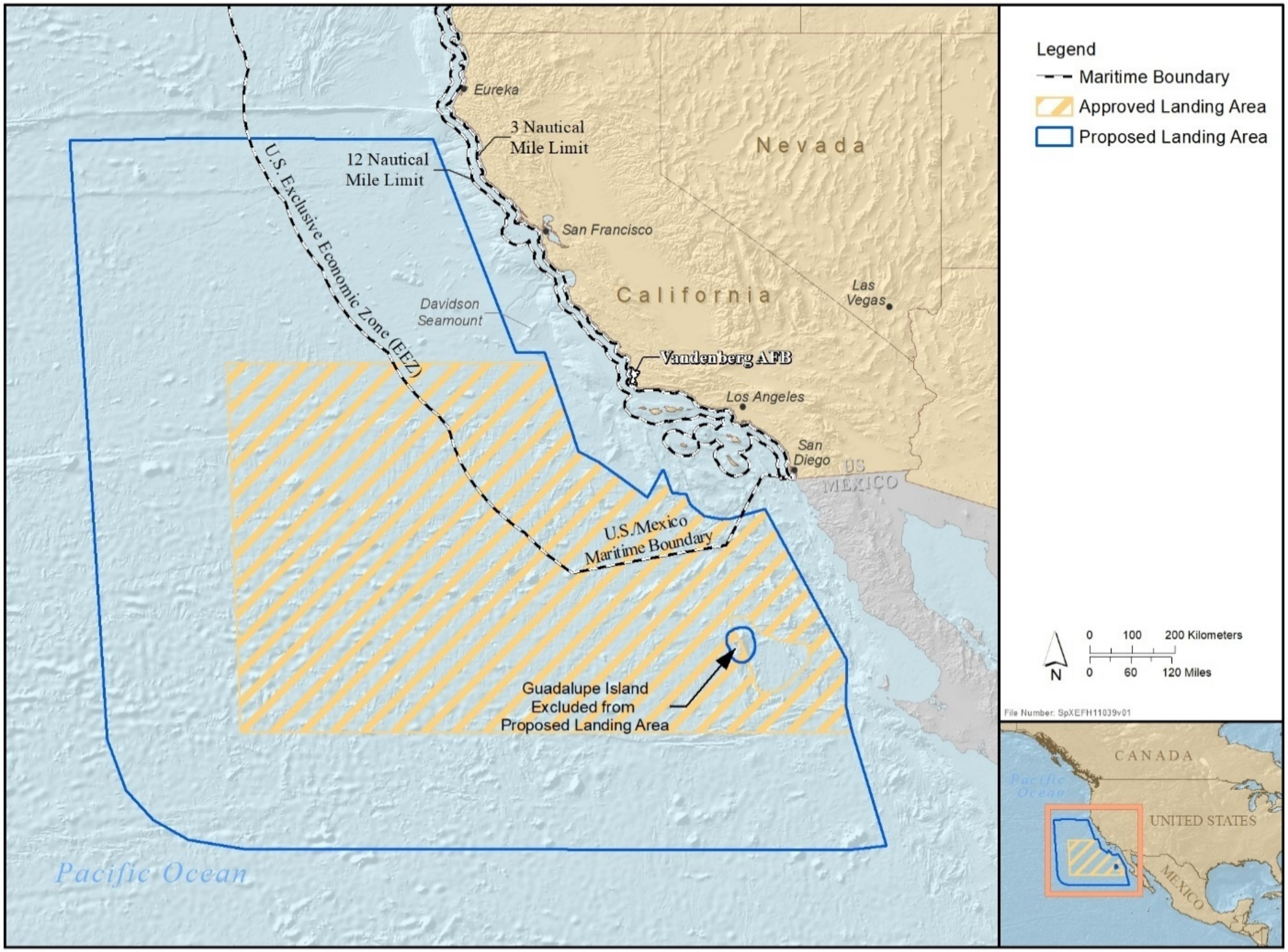

Figure 1.1-2. Approved and Proposed First Stage Landing and Fairing Recovery Areas.

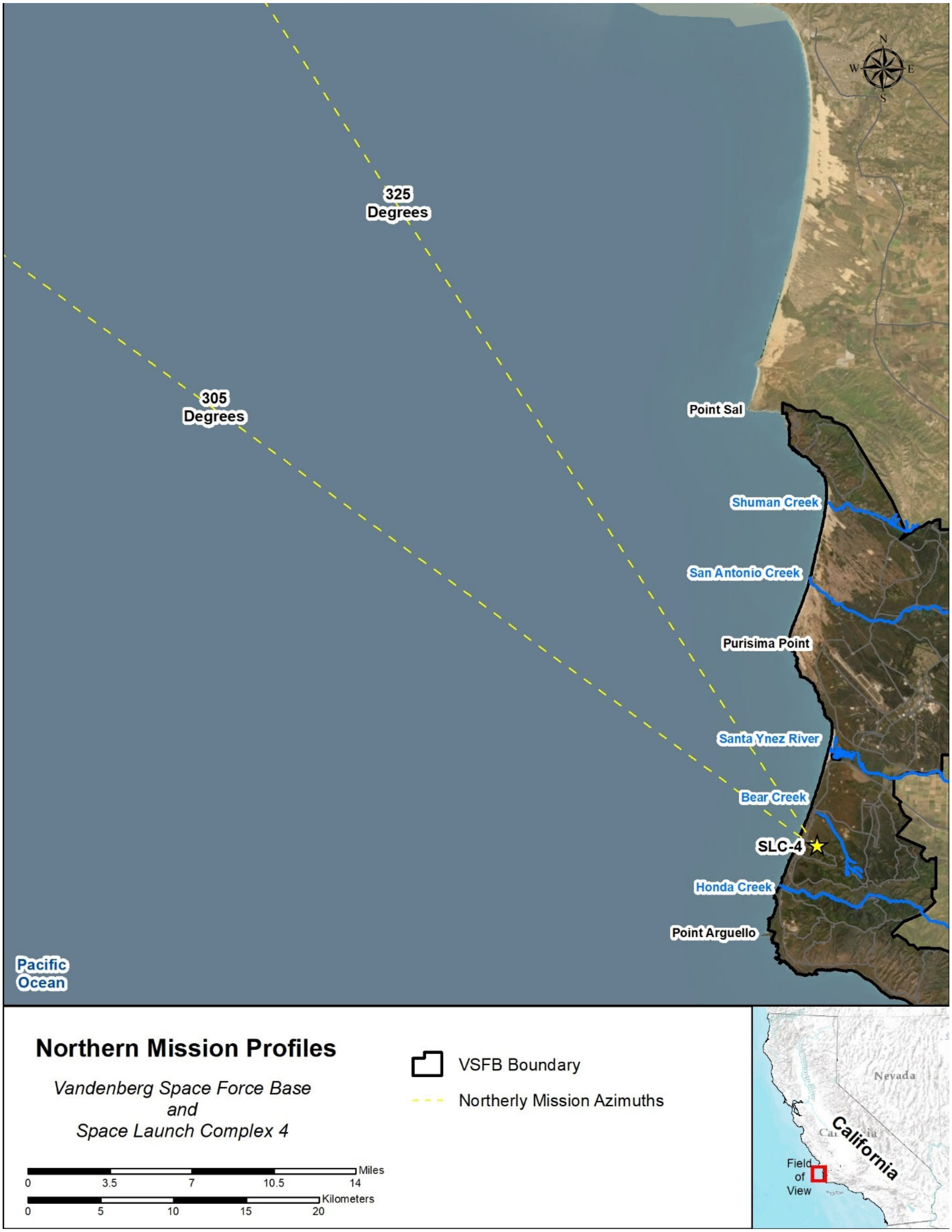

Figure 1.1-3. Northern mission azimuths.

1.2 Consultation History

In a letter dated 5 August 2015 (2015/3042; NMFS 2015), NMFS concurred that the SpaceX Boost-Back and landing of the Falcon 9 First Stage, including up to 6 launches and landings each year, was not likely to adversely affect Guadalupe fur seal (*Arctocephalus townsendi*), green sea turtle (*Chelonia mydas*), olive Ridley sea turtle (*Lepidochelys olivacea*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), gray whale (*Eschrichtius robustus*; Western North Pacific stock), humpback whale (*Megaptera novaeangliae*), sei whale (*B. borealis*), sperm whale (*Physeter macrocephalus*), hawksbill sea turtle (*Eretmochelys imbricata*), loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), steelhead (*Oncorhynchus mykiss*), green sturgeon (*Acipenser medirostris*), and scalloped hammerhead shark (*Sphyrna lewini*). The reasoning for the above determinations included the low density of animals potentially present in the proposed project area, the low likelihood that the proposed project's impacts at the water's surface would reach a submerged animal, and the short duration of the proposed activity. Critical habitat had not been designated or proposed for the marine mammals and the green sea turtle, loggerhead sea turtle, olive ridley sea turtle, hawksbill sea turtle; therefore, none was analyzed. NMFS concluded that the proposed action was not likely to adversely affect critical habitat for the leatherback sea turtle or steelhead.

In 2016, NMFS provided a letter of concurrence (LOC; dated 29 August 2016; 2016/5369:DDL; NMFS 2016a) for this same SpaceX Falcon 9 proposed action with additional downrange landing areas. This LOC replaced all previous letters that have been issued for this project.

NMFS issued the USSF (formerly the United States Air Force), a LOC on 18 July 2016 (2016/5232; NMFS 2016b) that sonic booms produced by up to 30 launches per year at VSFB were not likely to adversely affect Guadalupe fur seals. The LOC intentionally omitted SpaceX and only applied to other space launch providers operating at VSFB.

On 4 May 2022, NMFS issued the USSF an LOC (WCRO-2022-00970; NMFS 2022a) that the launch site and the launch provider on VSFB were irrelevant, therefore all VSFB launch actions (SpaceX and all other providers) were covered under this LOC. In addition, NMFS concurred that an increase in number of launch activities at VSFB to a maximum of 100 cumulative launch actions per year from all providers on VSFB was not likely to adversely affect Guadalupe fur seals. The LOC replaced the July 2016 LOC for the proposed action.

SpaceX has proposed to increase launch cadence at VSFB to 36 launches and 36 Falcon 9 first stage recoveries per year. To accommodate the SpaceX proposal, the USSF requests reinitiation of the 4 May 2022 LOC (NMFS 2022a) to add an additional 10 launches per year, for a total of 110 launches from any provider at VSFB per year, up to 36 SpaceX Falcon 9 first stage recoveries per year. No more than 12 first stage recoveries per year would be performed at SLC-4. In addition, the USSF proposes to increase the size of the downrange first stage and fairing recovery areas to accommodate new trajectories proposed for the SpaceX Falcon 9 program at SLC-4.

2 Description of the Action and the Action Area

2.1 Action Area

The action area is defined in 50 Code of Federal Regulations (C.F.R.) §402.02 as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." In general, the action area includes the portions of the Pacific Ocean where launch, reentry, and recovery activities are anticipated (Figure 1.1-2). These activities occur in the marine environment in deep waters between approximately 46-400 nm off Rockport, California at the northern limit, and 158- 910 nm off Baja California, Mexico at the southern limit (Figure 1.1-2). No recovery activities would occur within 12 nm of islands. The only component of the Proposed Action that occurs less than 12 nm from the U.S. are marine vessels transiting to and from a port in support of first stage and fairing recovery activities. These nearshore vessel transit areas in the action area include marine waters that lead to the Port of Long Beach and the VSFB Harbor.

2.2 Proposed Action

The Proposed Action is to increase space launch activities from VSFB from 100 per year to 110 launches annually. The USSF also proposes to increase the annual number of first stage recoveries per year to 36 and expand potential downrange droneship landing and fairing recovery locations in the Pacific Ocean to accommodate new trajectories, beginning in 2023 (Figure 1.1-2). Launches and recovery operations would occur day or night, at any time during the year.

2.2.1 Launch Operations

Space launch vehicles (commonly termed rockets) at VSFB place a payload into space by vertical launch. Currently, most of the vertical launch vehicles operating at VSFB are expendable (i.e., stages are disposed of in the ocean or in outer space), except for the SpaceX Falcon 9 first stage, which is recovered by landing at a launch site on VSFB or on an autonomous droneship in the Pacific Ocean. First stage recovery operations are discussed below in Section 2.2.2.

For expendable launch vehicles, the first stage and fairing would fall into the Pacific Ocean after stage separation and sink to the ocean floor. The fairing consists of two halves which separate, allowing the deployment of the payload at the desired orbit. First stage boosters and fairings are composed of heavy-duty metal components but may also include some carbon composite components that may float for several days (10 days maximum) before becoming waterlogged and sinking. Both expendable and reusable rockets at VSFB use liquid oxygen and either kerosene or alcohol as propellants. Current and reasonably foreseeable launch vehicles at VSFB are listed in Table 2.2-1.

Launches may occur from any launch facility on VSFB. Engine noise produced during launches would primarily impact VSFB and the surrounding area. During ascent, a sonic boom (overpressure of impulsive sound) with a peak generated over a relatively small area, typically between 3.0 to 5.0 pounds per square foot (psf), but potentially as high as 8.0 psf, would be generated. Depending on the launch trajectory, the sonic boom may or may not impact the surface of the earth. For instance, approximately 24 percent (7 out of 29) of Falcon 9 launches from SLC-4 since 2017 have not produced sonic booms that impact the surface of the earth because the ascent of the rocket was too steep. When the sonic booms do impact the earth's surface, they primarily impact the Pacific Ocean, but may overlap the Northern Channel Islands (NCI; see example shown in Figure 2.2-1). Since 2017, 24 percent (7 out of 29) of Falcon 9 launches have produced sonic booms that have impacted the NCI. Sonic boom modeling determined that launches with northerly mission profiles will not result in sonic booms impacting the surface of the earth.

Table 2.2-1. Launch Vehicles that May Affect the Marine Environment.

Launch Vehicle	Operator	Type	Launch Site
Alpha	Firefly	Expendable	SLC-2
Daytona-E	Phantom	Expendable	SLC-5/SLC-8
Falcon 9	SpaceX	Reusable	SLC-4
Laguna-E	Phantom	Expendable	SLC-5
Minotaur IV/Peacekeeper	Northrop Grumman	Expendable	SLC-8
New Glenn	Blue Origin	Expendable	SLC-9
RSL	ABL	Expendable	LF-576E
Terran 1	Relativity	Expendable	SLC-11
Vulcan	ULA	Expendable	SLC-3

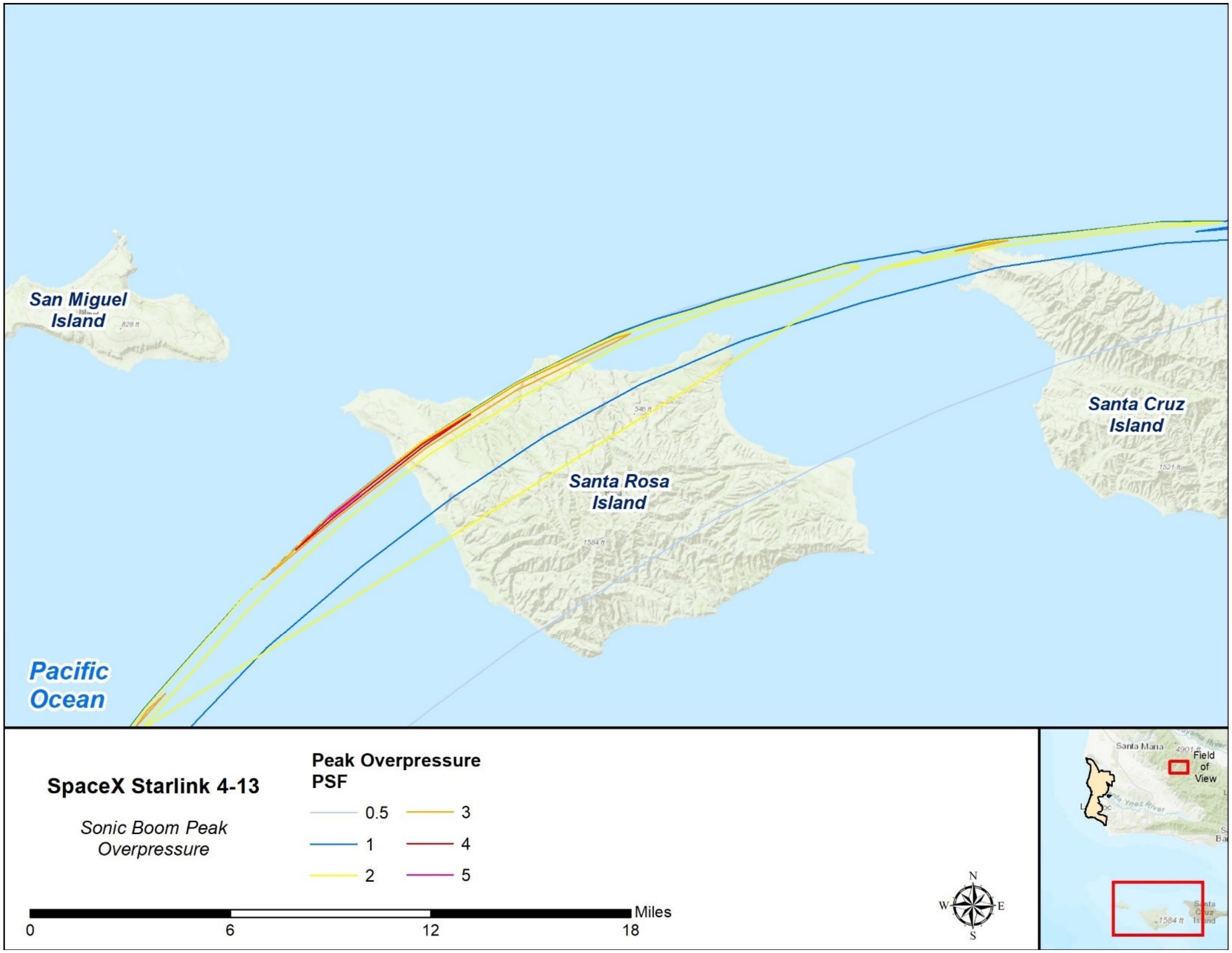

Figure 2.2-1. Sample Falcon 9 sonic boom profile generated during launch from Vandenberg Space Force Base.

2.2.2 First Stage Landing Operations

The Proposed Action includes conducting boost-back and landing of SpaceX Falcon 9 first stages on an autonomous droneship in the Pacific Ocean or at VSFB. Landing locations are specific to each mission. For each of the 36 launch attempts, the first stage will land downrange in the Pacific Ocean on a droneship within the proposed landing area (Figure 1.1-2) or at a landing complex on VSFB. Currently SLC-4W is the only active landing complex on VSFB. After the first stage engine cutoff and separation from the second stage, a subset of the first stage engines restart to conduct a reentry burn. Once the first stage is in position and approaching its landing target, the engines are cut off. A final burn is performed to slow the first stage to a velocity of zero for landing on the droneship or at VSFB.

During descent, the first stage will produce engine noise and sonic booms. Engine noise during downrange droneship landing operations would only impact open ocean and would not impact mainland or islands. Engine noise produced during landing operations at VSFB would primarily impact areas on VSFB (Figure 2.2-2). Landing engine noise follows launch and associated launch engine noise by approximately 5 to 7 minutes and typically occurs slightly before the sonic boom impacts land.

During descent, when the Falcon 9 first stage is supersonic, a sonic boom (overpressure of high-energy impulsive sound) would be generated. Sonic booms produced during landing may reach as high as 8.5 pounds per square foot (psf). When landing on VSFB, sonic booms are typically between 1.0 and 3.0 psf at VSFB pinniped haulout locations (Figure 2.2-3). During landing events at VSFB or in offshore areas near VSFB, sonic booms may impact the NCI (see examples in Figures 2.2-4 and 2.2-5). Although unlikely, the sonic boom received at San Miguel Island (SMI) could potentially be up to approximately 3.0 psf. However, during the majority of downrange droneship landings in the proposed landing areas, sonic booms would be directed entirely at the ocean surface without impacting any land (see examples in Figure 2.2-6 and 2.2-7).

The Proposed Action includes expanding the potential landing area in the Pacific Ocean to accommodate new trajectories proposed by SpaceX; first stage landing locations would be no closer than 12 nautical miles (nm) from either mainland or islands anywhere within the Proposed Landing Area (Figure 1.1-2). The proposed landing area is also no closer than 26 nm to the Davidson Seamount and no closer than 12 nm to Guadalupe Island (Figure 1.1-2).

During droneship landing events, wind speed in the landing area is measured using weather balloons. A radiosonde, which is approximately the size of a shoe box and is powered by a 9-volt battery, is attached to a weather balloon, and transmits data to the launch operator and to vehicle onboard predictive systems. The balloon, which is made of latex, rises to approximately 12 to 19 mi (19 to 30 km) and bursts. The balloon is shredded into many pieces as it falls back to Earth, along with the radiosonde, and lands in the Pacific Ocean. The radiosonde does not have a parachute and would not be recovered.

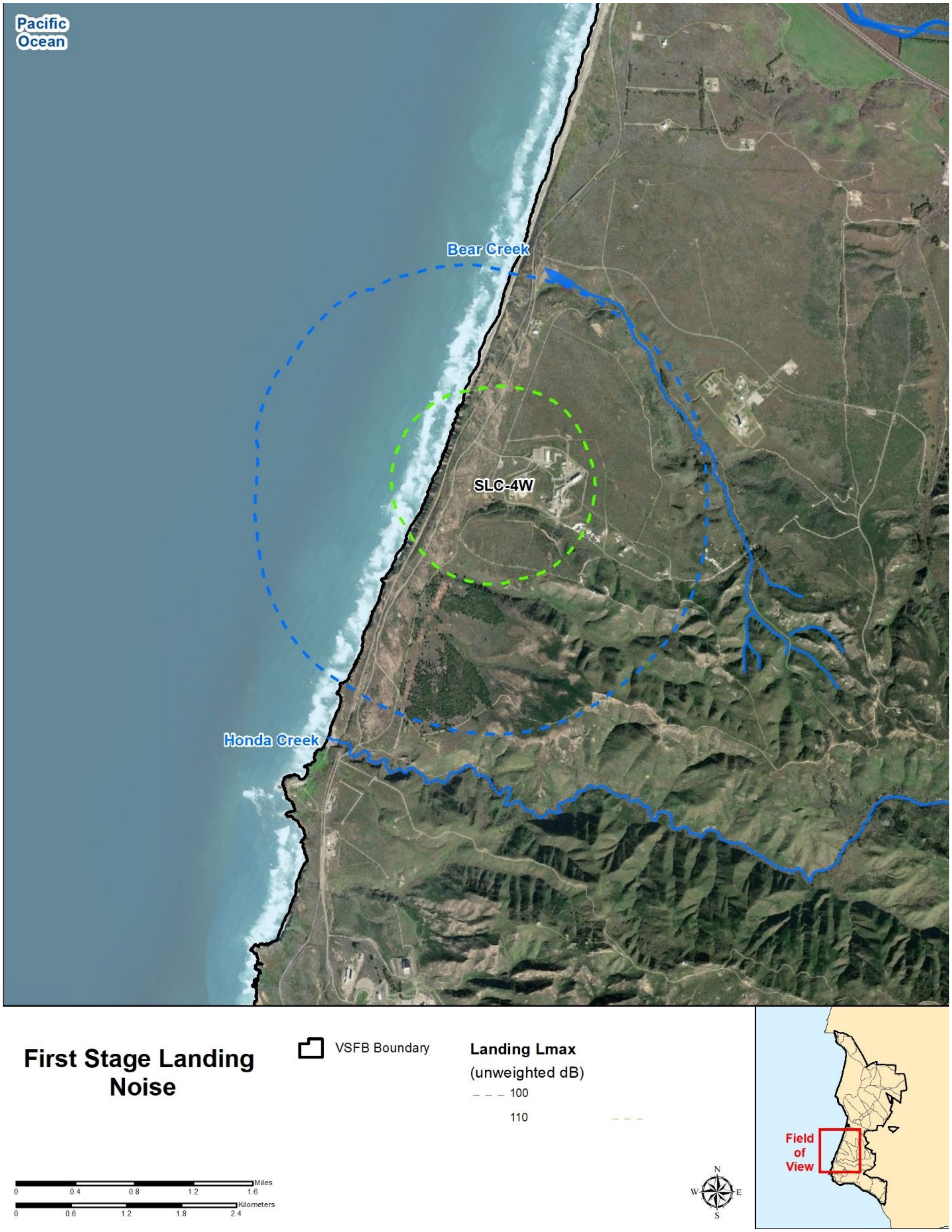

Figure 2.2-2. Falcon 9 first stage landing engine noise at SLC-4W.

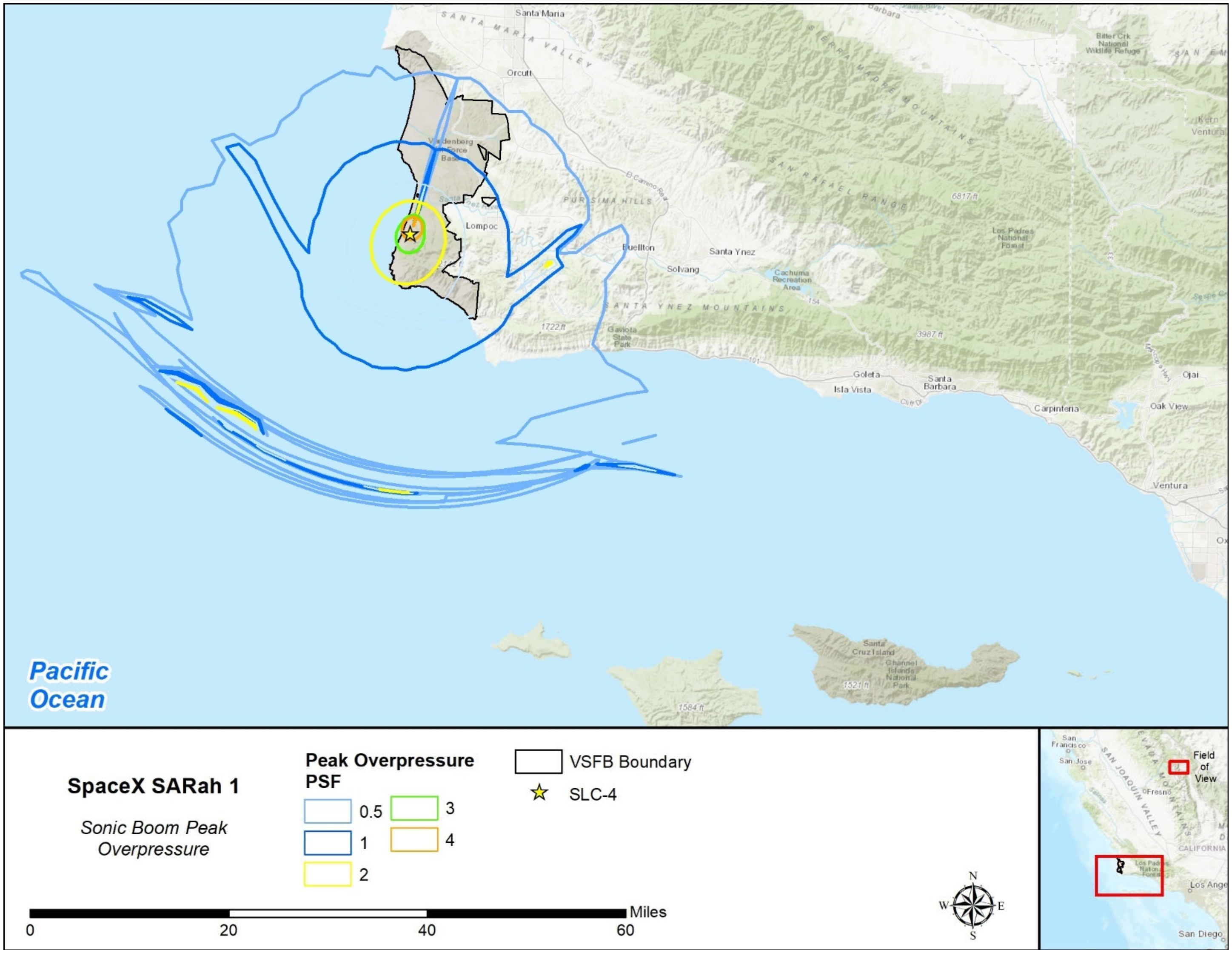

Figure 2.2-3. Example of a typical Falcon 9 sonic boom profile for first stage landing at SLC-4W.

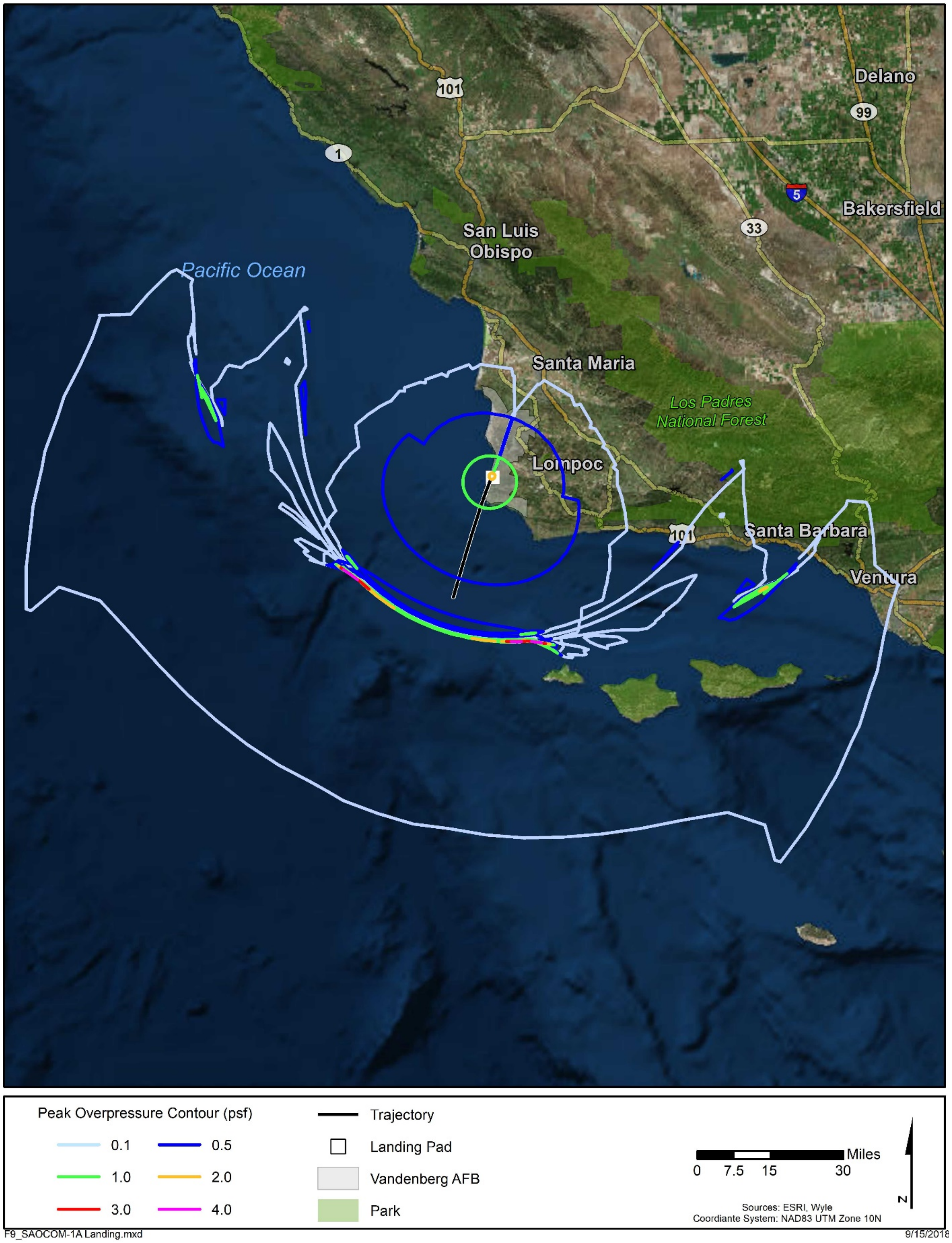

Figure 2.2-4. Sonic boom modeling results for first stage landing at SLC-4W for the Falcon 9 SAOCOM mission.

Figure 2.2-5. Sonic boom modeling results for first stage landing at an offshore droneship near VSFB for the Falcon 9 SSO-A mission.

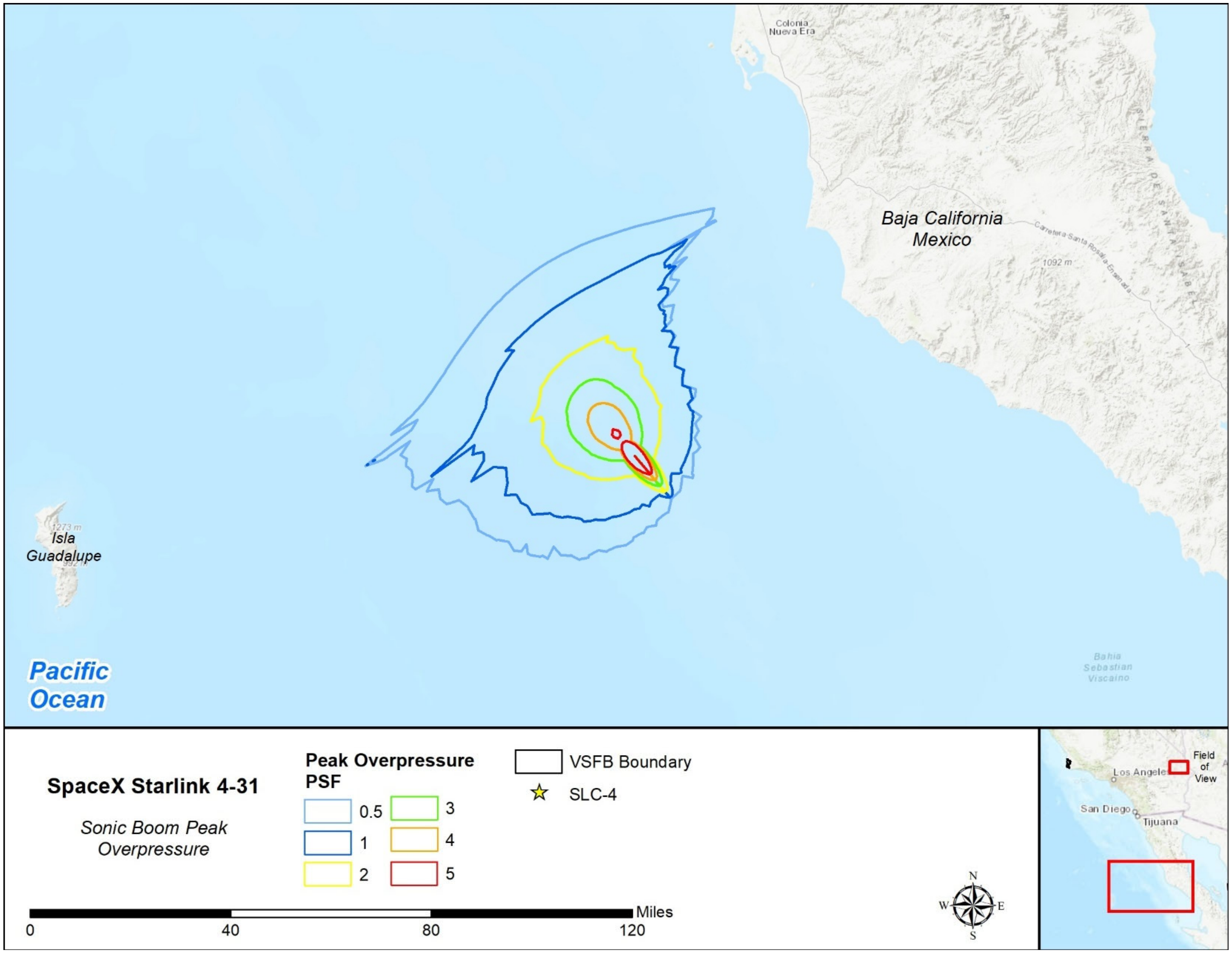

Figure 2.2-6. Example of a typical sonic boom profile for Falcon 9 first stage landing on a droneship in the proposed landing areas with a southerly mission profile.

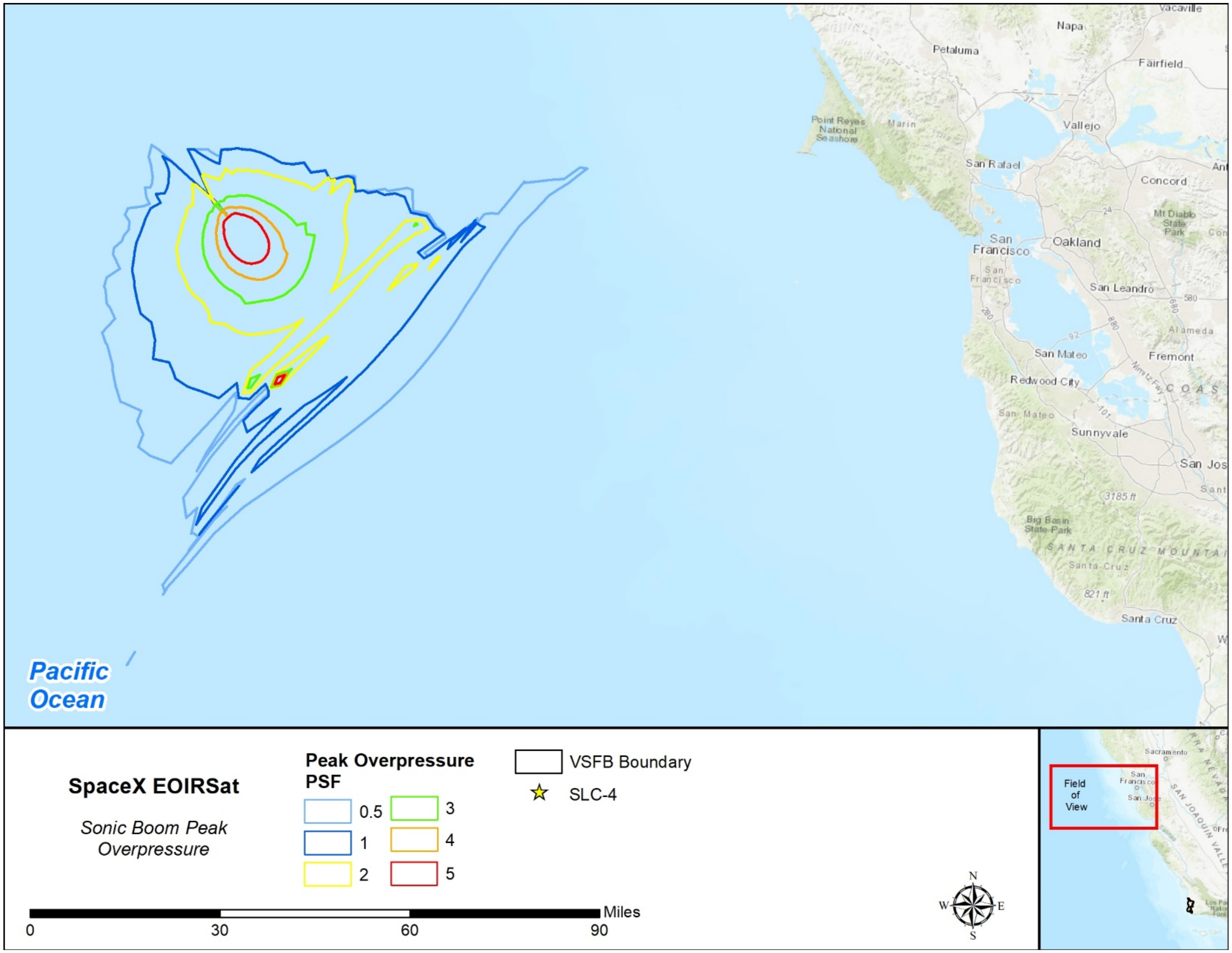

Figure 2.2-7. Example of a typical sonic boom profile for Falcon 9 first stage landing on a droneship in the proposed landing areas with a northerly mission profile.

2.2.3 Fairing Recovery Operations

SpaceX currently conducts fairing recovery operations for launches from VSFB. Each Falcon 9 fairing half contains a parachute system for recovery, which consists of one drogue parachute (hereafter "parachute") and one parafoil. The parachute system slows the descent of the fairing to enable a soft splashdown so that the fairing remains intact. Following re-entry of the fairing, the parachute deploys at a high altitude (approximately 50,000 feet [ft]) to begin the initial slow down and to extract the parafoil. The parachute cuts away following the successful deployment of the parafoil and lands in the ocean. The predicted impact points within desired recovery areas of the fairing, parafoil, and parachute are developed using modeling tools. The parachute canopy area is approximately 110 square feet (ft^2) and the fairing parafoils are approximately 3,000 ft^2. The parafoil suspension cables and risers are up to approximately 80 ft long and the parachute cables are up to approximately 60 ft long, but both may change with design improvements in the future. Both are made of Kevlar and approximately 1.75 inches in diameter.

For up to 36 first stage recoveries per year, up to 72 parachutes and 72 parafoils would land in the ocean annually. All parachutes and parafoils are meant to be recovered and they have been recovered during the majority of operations, but it is possible that some of the parafoils would not be recovered due to sea or weather conditions at the time of recovery. Parafoils are made of nylon and are expected to sink at a rate of approximately 1,000 ft in 145.5 minutes (NMFS 2022b). Recovery of the parachute assembly would be attempted if the recovery team can get a visual fix on the splashdown location. Because the parachute assembly is deployed at a high altitude, it is difficult to locate. In addition, based on the size of the assembly and the density of the material, the parachute assembly would saturate and begin to sink upon impact. This would make recovering the parachute assembly difficult and unlikely. Parachutes are made of nylon and Kevlar and are expected to sink at a rate of approximately 1,000 ft in 46 minutes (NMFS 2022b).

The fairing and parafoil would be recovered by a salvage ship stationed in the Proposed Landing Area near the anticipated splashdown site, but no closer than 12 nautical miles offshore (Figure 1.1-2). The salvage ship would be able to locate the fairing using GPS data from mission control and strobe lights on the fairing data recorders. Upon locating the fairing, a rigid hulled inflatable boat would be launched. Crew members would hook rig lines to the fairing and connect a buoy to the parafoil. Then the crew would release the parafoil riser lines and secure the canopy by placing it into a storage drum. If sea or weather conditions are poor, recovery of the fairing and parafoil may be unsuccessful.

2.2.4 Environmental Protection Measures

The USSF will ensure the following EPMs are implemented to reduce the risk of injury or mortality of ESA-listed species:

- The USSF will ensure that all personnel associated with vessel support operations are instructed about marine species and any critical habitat protected under the ESA that could be present in the proposed landing area. Personnel will be advised of the civil and criminal penalties for harming, harassing, or killing ESA-listed species.
- Support vessels will maintain a minimum distance of 150 ft (45 m) from sea turtles and a minimum distance of 300 ft (90 m) from all other ESA-listed species. If the distance ever

becomes less, the vessel will reduce speed and shift the engine to neutral. Engines would not be re-engaged until the animal(s) are clear of the area.

- Support vessels will maintain an average speed of 10 knots or less.
- Support vessels will attempt to remain parallel to an ESA-listed species' course when sighted while the watercraft is underway (e.g., bow-riding) and avoid excessive speed or abrupt changes in direction until the animal(s) has left the area.
- The USSF will immediately report any collision(s), injuries, or mortalities to ESA-listed species to the appropriate NMFS contact.

3 Description of the Species

The list of ESA-listed endangered and threatened species that may be affected by the Proposed Action were obtained from the NMFS endangered species web sites, species experts, and a review of available literature. Table 3.1-1 lists the ESA-listed species under NMFS jurisdiction that may be affected by the Proposed Action. Additional information regarding species distribution and presence within the Action Area is discussed in the sections following the table.

Table 3.1-1. ESA-listed Species Occurrence Within the Action Area.

Common Name	***Scientific Name***	***Distinct Population Segment or Evolutionarily Significant Units***	***ESA Status****	***Presence in Action Area***
Fishes				
Steelhead	*Oncorhynchus mykiss*	Southern California Coast	FE	Potentially present in the nearshore and offshore waters
Chinook salmon	*Oncorhynchus tshawytscha*	4 ESUs[1]	FT	Specific ESUs present or potentially present in the nearshore and offshore waters
Coho salmon	*Oncorhynchus kisutch*	2 ESUs[3]	FT	Present in the nearshore and offshore waters
Green sturgeon	*Acipenser medirostris*	Southern	FT	Likely present primarily along continental shelf waters of the West Coast
Oceanic whitetip shark	*Carcharhinus longimanus*	-	FT	Present in open ocean waters from Southern California to Peru
Scalloped hammerhead shark	*Sphyrna lewini*	Eastern Pacific	FE	Present in coastal and semi-oceanic water in temperate and tropical regions
Sea Turtles				
Green sea turtle	*Chelonia mydas*	East Pacific	FT	Present in offshore and nearshore subtropical waters
Leatherback sea turtle	*Dermochelys coriacea*	-	FE	Present in offshore and nearshore waters
Olive ridley sea turtle	*Lepidochelys olivacea*	Mexico Pacific coast	FE	Present in offshore and nearshore waters
Hawksbill sea turtle	*Eretmochelys imbricata*	-	FE	Present in offshore and nearshore waters of Mexico
Loggerhead turtle	*Caretta caretta*	North Pacific	FE	Present in small numbers in offshore waters generally north of Point Conception
Marine Mammals				
Blue whale	*Balaenoptera musculus*	-	FE	High densities during the summer and fall with single individuals in the winter and spring
Fin whale	*Balaenoptera physalus*	-	FE	Higher densities in the summer and fall although present year-round
Gray whale	*Eschrichtius robustus*	Western North Pacific	FE	Present during seasonal migration in the winter and spring

Humpback whale	*Megaptera novaeangliae*	Mexico	FT	Individuals present year-round with higher seasonal presence during the summer migrations from Mexico and Central America
		Central America	FE	
Killer whale	*Orcinus orca*	Southern Resident	FE	occasionally present offshore of Central and Southern California
Sei whale	*Balaenoptera borealis*	-	FE	Present year round with more likely presence in the winter and spring
Sperm whale	*Physeter macrocephalus*	-	FE	Present year round with a preference for deep waters and the continental shelf break and slope
Guadalupe fur seal	*Arctocephalus townsendi*	-	FT	Primarily present at NCI and between 50 and 300 km offshore seasonally when not at rookeries in Mexican waters

*Notes: ESU = Evolutionarily Significant Unit, FE = federally listed endangered, FT = federally listed threatened

[1] Chinook salmon ESUs include California Coastal (FT), Central Valley Spring-Run (FT), Lower Columbia River (FT), and Sacramento River Winter-Run (FT)

[2] Coho salmon ESUs include Central California Coast (FT) and Southern Oregon and Northern California Coasts (FT).

3.1 Fishes

3.1.1 Steelhead (Onchorhynchus mykiss)

3.1.1.1 Status and Trends

NMFS listed several Evolutionarily Significant Units of anadromous steelhead as endangered or threatened, including the Southern California Distinct Population Segment (DPS) of steelhead, which encompasses the populations occurring from the Santa Maria River in Santa Barbara County to the California-Mexico border, as endangered in 1997 (62 Federal Register [FR] 43937). In January 2012, NMFS issued a final Recovery Plan to stabilize and restore the southern California DPS steelhead trout populations (NMFS 2012).

Steelhead populations have experienced significant declines along the Pacific Coast of North America since the early 1900s. The Santa Ynez River in Santa Barbara County, California, once supported what was likely the largest steelhead run south of San Francisco Bay. The run size for the Santa Ynez, Santa Clara, and Ventura Rivers and Malibu Creek is estimated to have been between 32,000 and 46,000 individuals (Boughton & Fish 2003; Helmbrecht & Boughton 2005; Good et al. 2005; Williams et al. 2011). Even after the construction of Gibraltar Dam in 1920, 72 mi. upstream of the Santa Ynez River mouth, historic run sizes for the Santa Ynez River were estimated at 12,995 to 25,032 individuals (Shapovalov & Taft 1954; Busby et al. 1996). Runs remained large and supported a recreational fishing industry until the construction of Bradbury Dam in 1954 (Alagona et al. 2012). Bradbury Dam is located 48 mi (77 km) upstream from the Pacific Ocean on the mainstem of the Santa Ynez River. It is an impassable barrier that blocks two-thirds of the former steelhead spawning and rearing habitat (Alagona et al. 2012). Following Bradbury Dam's construction, runs of steelhead on the Santa Ynez River were reported at less than 100 individuals on an annual basis (Nehlsen et al. 1991; Reavis 1991). Between 2001 and 2011, an average of 3.4 adult steelhead were trapped per year at a lower Santa Ynez River monitoring station and no adults were observed between 2010 and 2016 (NMFS 2016d).

3.1.1.2 Distribution

The natural range of anadromous steelhead includes the U.S. Pacific Coast to Southern California (Good et al. 2005), but it has been introduced throughout the world. Spawning and rearing habitat are found outside of the Action Area in freshwater creek and river systems, where adults may migrate up to 930 mi (1,497 km) from their ocean habitats to reach their freshwater spawning grounds in high-elevation tributaries. Near the Action Area, the primary rivers that steelhead migrate into are the Santa Maria and Santa Ynez Rivers (Good et al. 2005). Steelhead hatch in freshwater streams, where they spend their first 1 to 3 years. They later move into the ocean, where most of their growth occurs. After spending between 1 and 4 years in the ocean, steelhead return to their home freshwater stream to spawn. Unlike other species of Pacific salmon, steelhead do not necessarily die after spawning and are able to spawn more than once. The name steelhead is used primarily for the anadromous form of this species.

There is considerable variation in this life history pattern within the population, partly due to Southern California's variable seasonal and annual climatic conditions. Some winters produce heavy rainfall and flooding, which allow juvenile steelhead easier access to the ocean, while dry seasons and periods of drought may close the mouths of coastal streams and rivers, limiting juvenile steelheads' access to marine waters (NMFS 1997) as well as adult access to spawning grounds (U.S. Bureau of Reclamation 2013).

3.1.1.3 Critical Habitat

In September 2005, the NMFS issued the final critical habitat designation for the Southern California Steelhead DPS (70 FR 52488). This critical habitat designation does not include VSFB because it was excluded under section 4(b)(2) and exempted under section 4(a)(3) of the ESA. In addition, designated critical habitat for steelhead in Southern California is restricted to rivers and estuaries and therefore does not overlap with the Action Area.

3.1.1 Chinook Salmon (Onchorhynchus mykiss)

3.1.1.1 Lower Columbia River ESU

The Lower Columbia River Chinook Salmon ESU was listed as threatened on 24 March 1999 (64 FR 14308), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls.

In general, the more abundant juvenile Lower Columbia River fall-run Chinook migrate north upon entering the Pacific Ocean (Fisher et al. 2014). However, the less-abundant juvenile Lower Columbia River spring-run Chinook, though more common beyond the continental shelf, with most migrating far offshore after their first year of marine residence (Quinn & Myers 2005; Sharma 2009), have been detected in the coastal waters of Oregon and Washington for much of the year (Fisher et al. 2014). Occurrence of chinook salmon from the Lower Columbia River ESU would be rare in the Action Area.

3.1.1.2 Central Valley Spring-Run ESU

The Central Valley Spring-Run Chinook Salmon ESU was listed as threatened on 16 September 1999 (64 FR 50394), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned spring-run Chinook salmon originating from the Sacramento River and its tributaries, and also spring-run Chinook salmon from the Feather River Hatchery Spring-run Chinook Program. This ESU does not include Chinook salmon that are designated as part of an experimental population (79 FR 20802).

Juvenile Central Valley spring-run Chinook salmon migrate downstream throughout spring of the same year they hatched, although a small portion remains through summer and enters the ocean the following spring. Central Valley spring-run Chinook have a relatively broad ocean distribution, ranging from central California to Cape Falcon (Oregon) (Satterthwaite et al. 2015). Return migrating adults enter San Francisco Bay and migrate up the Sacramento River from late January to early February, reaching spawning areas from March through June (NMFS 2019c). Central Valley Spring-Run Chinook salmon occurs within in the Action Area.

3.1.1.3 Sacramento River Winter-Run ESU

The Sacramento River Winter-Run Chinook Salmon ESU was listed as threatened on 4 August 1989 (54 FR 32085) and was reclassified as endangered in 1994 (55 FR 46515). This ESU includes all naturally spawned populations of winter-run Chinook salmon in the Sacramento River and its tributaries, as well as two conservation programs maintained at the Livingston-Stone National Fish Hatchery (79 FR 20802).

Juvenile fry and smolts emigrate downstream from July through March through the Sacramento River and reach the Delta from September through June (Satterthwaite et al. 2015). Due to limited data, Teel et al. (2015), combined this ESU with other California ESUs. They found that the distribution of these fish largely occurred in Oregon and California coastal waters, consistent with other authors (Hendrix et al., 2019; Moyle, 2002; Windell et al., 2017). Returning adults migrate through coastal waters and enter San Francisco Bay, then migrate up the Sacramento River in November and continue upstream from December through early August (California Department of Fish and Wildlife [CDFW] 2022a). Due to the coastal distribution of this ESU, Sacramento River Winter-Run Chinook salmon occur in the Action Area.

3.1.1.4 Critical Habitat

Designated critical habitat is restricted to rivers and estuaries and therefore does not overlap with the Action Area.

3.1.2 Coho Salmon (Oncorhynchus kisutch)

3.1.2.1 Southern Oregon and Northern California Coast ESU

The Southern Oregon and Northern California Coast Coho Salmon ESU was listed as threatened on 6 May 1997 (62 FR 24588), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned coho salmon originating from coastal streams and rivers between Cape Blanco, Oregon, and Punta Gorda, California (79 FR 20802).

Although juvenile behaviors, life histories, and habitat associations can be variable, the majority of coho juveniles reside about one year in fresh water before migrating to sea (NMFS 2019c). Upon entry into the open ocean, juvenile coho use nearshore marine habitats, with some fish remaining in local waters and others moving northward along the continental shelf to central Alaska (Fisher et al. 2014). In general, fish in this ESU exhibit a three-year life cycle, with adults entering natal streams and rivers from mid-November to January (NMFS 2019c). Due to prevalence of coho in Oregon coastal waters, Southern Oregon and Northern California Coast coho salmon are present in the Action Area.

3.1.2.2 Central California Coast ESU

The Central California Coast Coho Salmon ESU was listed as threatened on 31 October 1996 (61 FR 56138) and downgraded to endangered on 28 June 2005 (70 FR 37160). The ESU status was reaffirmed as endangered on 2 April 2012, (77 FR 19552) and subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned coho salmon originating from rivers south of Punta Gorda, California, to and including Aptos Creek, as well as such coho salmon originating from tributaries to San Francisco Bay (79 FR 20802).

Coho smolts from this population begin migrating downstream to the ocean in late March or early April but can sometimes begin prior to March and persist well into July (CDFW 2022b). Once in the ocean, immature coho remain in in-shore waters, congregating in schools as they move north along the continental shelf (CDFW 2022b; Fisher et al., 2014). Adults in this ESU generally enter freshwater to spawn from September through January, with spawning mainly from November to January, although it can extend into February or March (CDFW 2022b). Due to prevalence of coho in central and northern California coastal waters, Central California Coast coho salmon occur in the Action Area.

3.1.2.3 Critical Habitat

Designated critical habitat is restricted to rivers and estuaries and therefore does not overlap with the Action Area.

3.1.3 Green Sturgeon (Acipenser medirostris)

3.1.3.1 Status and Trends

The Southern DPS of North American Green Sturgeon was listed as threatened on 7 April 2006 (71 FR 17757) and critical habitat for this DPS was designated on 9 October 2009 (74 FR 52300).

3.1.3.2 Distribution

Subadult green sturgeon leave their Californian natal rivers and disperse widely along continental shelf waters of the West Coast within the 360-ft (110-meter [m] contour (Erickson & Hightower 2007; Moyle 2002; NMFS 2005). This DPS preferentially distributes north of their natal river during fall and moves into bays and estuaries during summer and fall (Heironimus et al. 2022; Israel et al., 2009). Sub-adult and mature fish exhibit a narrow and shallow depth distribution in marine habitat of < 328 ft (100 m) within the 360-ft (110-m) contour of the continental shelf, typically occupying depths of 130 to 230 ft (40–70 m; Erickson & Hightower, 2007; NMFS 2005; Payne et al., 2015). While Huff et al. (2011) found that green sturgeon appeared to prefer marine areas with high seafloor complexity and boulder presence, Payne et al. (2015) found that that green sturgeon are also associated with flat, soft bottom habitats that lack high relief bottoms. Information regarding their preference for areas of high seafloor complexity and prey selection in coastal waters (benthic prey) indicate green sturgeon reside and migrate along the seafloor while in coastal waters. Huff et al. (2011) found that green sturgeon in the open ocean may also occupy the upper 65 ft (20 m) of the water column on a seasonal basis (July to November) and use deeper habitats throughout the rest of the year.

The primary concentration of sturgeon is estimated to be approximately 41–51.5° North within the 656-ft (200-m) isobath in the coastal waters of Washington, Oregon, and Vancouver Island (Huff et al. 2012). Additionally, Huff et al. (2011) suggested that green sturgeon occur at low densities in the coastal marine environment. Southern DPS are likely to be present in the Action Area.

3.1.3.3 Critical Habitat

Critical habitat includes coastal U.S. marine waters within 360 ft (110 m) depth from Monterey Bay, California north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to the U.S. boundary. Critical habitat includes several rivers and estuaries along the U.S. West Coast (74 FR 52300).

For coastal marine areas, the physical or biological features of critical habitat designated for green sturgeon include food resources, migratory corridors, and water quality. Corresponding species life history events include subadult growth and development, movement between estuarine and marine areas, and migration between marine areas, as well as adult sexual maturation, growth and development, movements between estuarine and marine areas, migration between marine areas, and spawning migration (74 FR 52300). Green sturgeon critical habitat does not overlap the Action Area (Figure 3.1-1).

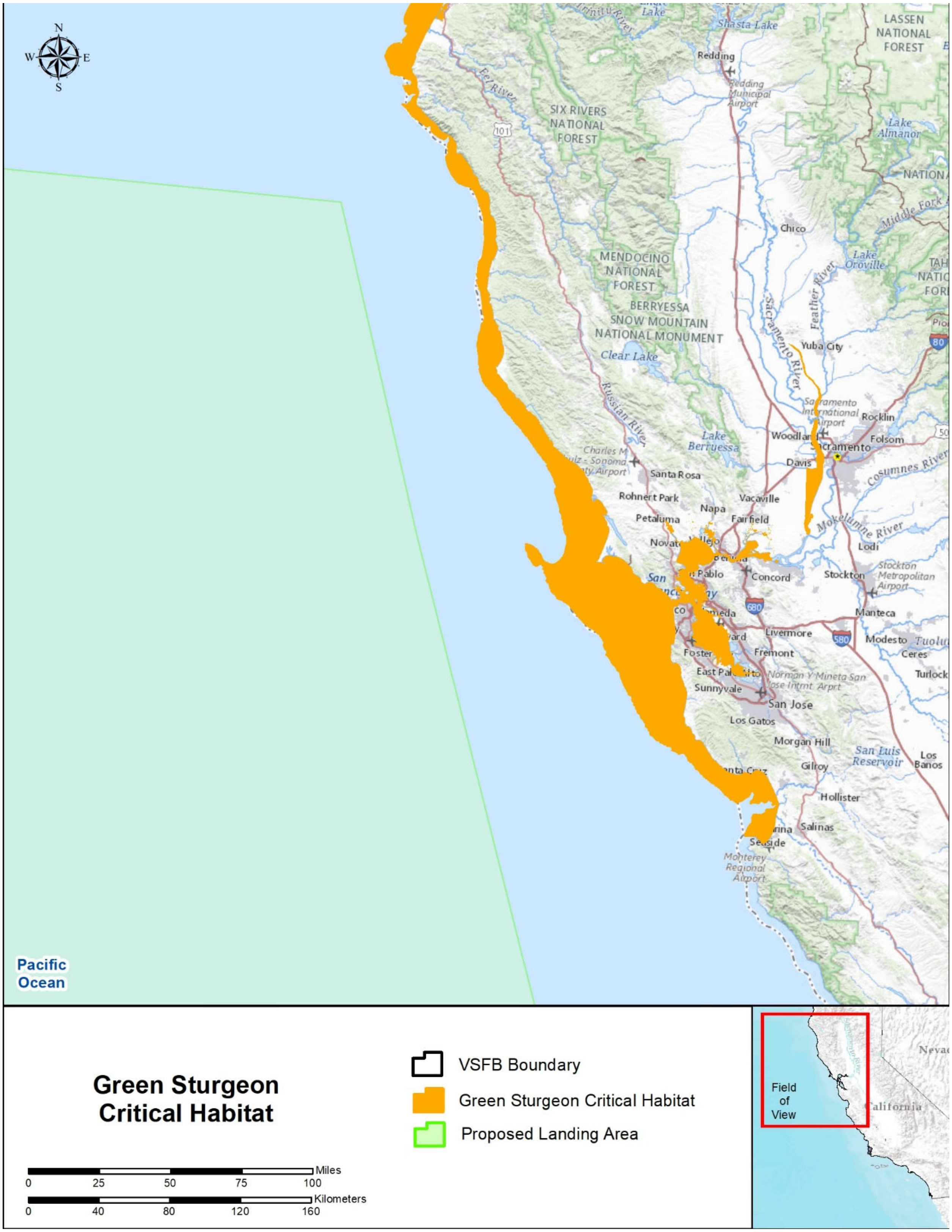

Figure 3.1-1. Green sturgeon critical habitat.

3.1.4 Oceanic Whitetip Shark (Carcharhinus longimanus)

3.1.4.1 Status and Trends

NMFS completed a comprehensive status review of the oceanic whitetip shark and based on the best scientific and commercial information available, including the status review report (Young et al. 2016), and listed the species as threatened on 1 March 2018 (83 FR 4153).

3.1.4.2 Distribution

Oceanic whitetip sharks are found worldwide in warm tropical and subtropical waters between the 30° North and 35° South latitude near the surface of the water column (Young et al. 2016). Oceanic whitetips occur throughout the Central Pacific, including the Hawaiian Islands south to Samoa Islands and in the eastern Pacific from Southern California to Peru, including the Gulf of California. This species has a clear preference for open ocean waters, with abundances decreasing with greater proximity to continental shelves. In terms of California fish fauna, Allen and Cross (2006) categorized oceanic white tip sharks as holoepipelagic and individuals would be found mostly far from shore. Preferring warm waters near or over 20°C (68°F), and offshore areas, the oceanic whitetip shark is known to undertake seasonal movements to higher latitudes in the summer (NOAA 2016) and may regularly survey extreme environments (deep depths, low temperatures) as a foraging strategy (Young et al. 2016).

Oceanic whitetip sharks could occur in deep open ocean areas in the California Current Large Marine Ecosystem. They are known to occur in Baja California and may be found in surface waters off the continental shelf (Baum et al. 2015). Oceanic whitetip sharks are therefore expected to occur within the Action Area.

3.1.4.3 Critical Habitat

Critical habitat has not been designated for this species.

3.1.5 Scalloped Hammerhead Shark (Sphyrna lewini)

3.1.5.1 Status and Trends

On 3 July 2014, four of six identified distinct population segments of scalloped hammerhead sharks were listed as endangered or threatened (79 FR 38214). The Eastern Pacific distinct population segment of the scalloped hammerhead population, which includes the west coast of the United States and the Southern California Range Complex, is listed as endangered under the ESA. The scalloped hammerhead shark has undergone substantial declines throughout its range (Baum et al. 2003a). There is evidence of population increases in some areas of the southeast U.S., such as the Gulf of Mexico (Ward-Paige et al. 2012), but because many catch records do not differentiate between the hammerhead species, or shark species in general, population estimates and commercial or recreational fishing landing data are unavailable in the Action Area. Most of the abundance data is from the Gulf of California, where it is estimated that the scalloped hammerhead population is currently decreasing by 6 percent per year (INP 2006).

3.1.5.2 Distribution

The scalloped hammerhead shark is a coastal and semi-oceanic species distributed in temperate and tropical waters (Froese & Pauly 2016). Distribution in the eastern Pacific Ocean extends from the coast of southern California (United States), including the Gulf of California, to Ecuador and possibly Peru (Compagno 1984) and off Hawaii in the central Pacific Ocean. A genetic marker study suggests that females remain close to coastal habitats, while males disperse across larger open ocean areas (Daly-Engel et al. 2012).

Juveniles rear in coastal nursery areas in the southern California portion of the Action Area (Duncan & Holland 2006), but rarely inhabit the open ocean (Kohler & Turner 2001). Sub adults and adults occur over shelves and adjacent deep waters close to shore and entering bays and estuaries (Compagno 1984). In the California Current Large Marine Ecosystem, records of the presence of scalloped hammerhead sharks in this area are very rare. Sighting and landings in the Action Area are documented to have occurred in San Diego Bay in 1981, 1996, and 1997 (Shane 2001).

3.1.5.3 Critical Habitat

Critical habitat has not been designated for this species.

3.2 Sea Turtles

3.2.1 General Background

Sea turtles are highly migratory, long-lived reptiles that occur throughout the open-ocean and coastal regions of the Action Area. Generally, sea turtles are distributed throughout tropical to subtropical latitudes (i.e., in warmer waters closer to the equator), with some species extending poleward into temperate seasonal foraging areas. In general, sea turtles spend most of their time at sea, with the notable exception of mature females returning to land, primarily beaches, to nest. The habitat preferred by sea turtles and their distribution at sea varies by species and life stage (i.e., hatchling, juvenile, adult).

3.2.2 Green Sea Turtle (*Chelonia mydas*)

3.2.2.1 Distribution

The green sea turtle is found in tropical and subtropical coastal and open ocean waters, between 30° North and 30° South. Green sea turtles are widely distributed in the subtropical coastal waters of southern Baja California, Mexico, and Central America (Cliffton et al. 1995; NMFS and USFWS 1998a). Another green sea turtle population resides in Long Beach, California, although less is known about this population (Eguchi et al. 2010). Ocean waters off southern California and northern Baja California are designated as areas of occurrence because of the presence of rocky ridges and channels and floating kelp habitats suitable for green sea turtle foraging and resting (Stinson 1984); however, these waters are often at temperatures below the thermal preferences of this primarily tropical species.

3.2.2.2 Critical Habitat

Critical habitat has not been designated in the Pacific Ocean.

3.2.3 Loggerhead Turtle (Caretta caretta)

3.2.3.1 Status and Trends

In September 2011, NMFS listed all three Pacific Ocean distinct population segments of loggerhead sea turtles as endangered (76 FR 588868). In the Pacific, there are two distinct population segments of loggerheads. The North Pacific Ocean DPS nests only on the coasts of Japan. This population has declined 50 to 90 percent during the last 60 years, however the overall nesting trend in Japan has been stable or slightly increasing over the last decade. The South Pacific Ocean DPS nests primarily in Australia with some nesting in New Caledonia. In 1977, about 3,500 females may have nested in the South Pacific—today there are only around 500 per year.

3.2.3.2 Distribution

Loggerhead turtles are found worldwide mainly in subtropical and temperate regions of the Atlantic, Pacific, and Indian Oceans, and in the Mediterranean Sea (Conant et al. 2009). In the eastern Pacific, the loggerheads primary range extends from offshore of Vancouver Island, south to Central America. The highest densities of loggerheads can be found just north of Hawaii in the North Pacific Transition Zone (Polovina et al. 2000). The North Pacific Transition Zone is defined by convergence zones of high productivity that stretch across the entire North Pacific Ocean from Japan to California (Polovina et al. 2001). The loggerhead turtle is known to occur at sea off of southern California, but does not nest on southern California beaches.

3.2.3.3 Critical Habitat

There is no critical habitat designated for the North Pacific Ocean DPS.

3.2.4 Olive Ridley Sea Turtle (Lepidochelys olivacea)

3.2.4.1 Status and Trends

The breeding population along the Pacific coast of Mexico was listed as endangered under the ESA in 1978 (43 FR 32800), because of extensive overharvesting of olive ridley turtles in Mexico, which caused a severe population decline (NMFS and USFWS 1998b). Olive ridleys offshore of California and Baja Mexico would likely belong to this population. All other populations are listed under the ESA as threatened. A five-year review was completed in 2014 (NMFS and USFWS 2014).

3.2.4.2 Distribution

Most olive ridley turtles lead a primarily open ocean existence (NMFS and USFWS 1998b). Individuals occasionally occur in waters as far north as California and as far south as Peru, spending most of their life in the oceanic zone (NMFS and USFWS 2007b). The olive ridley has a large range in tropical and subtropical regions in the Pacific Ocean, and is generally found between 40° North and 40° South. There are few documented occurrences of olive ridley sea turtles in waters off the west coast of the United States (NMFS and USFWS 1998b).

3.2.4.3 Critical Habitat

Critical habitat has not been designated for the olive ridley turtle.

3.2.5 Hawksbill Sea Turtle (Eretmochelys imbricata)

3.2.5.1 Status and Trends

The hawksbill turtle is listed as endangered throughout its range in 1970 under the ESA (35 FR 8491). A five-year review was completed in 2013 (NMFS and USFWS 2013a).

3.2.5.2 Distribution

Water temperature in the southern California offshore waters is generally too low for hawksbills, and their occurrence offshore of California would be considered rare. They are more common in nearshore foraging grounds, including coral reefs and mangrove estuaries from Baja California to South America (NMFS and USFWS 2013a). However, hatchlings utilize floating algal mats and drift lines in pelagic (open sea) habitat (NMFS and USFWS 2013a) and therefore may be found in the Action Area.

3.2.5.3 Critical Habitat

Critical habitat has not been designated for the hawksbill in the Pacific Ocean.

3.2.6 Leatherback Sea Turtle (*Dermochelys coriacea*)

3.2.6.1 Status and Trends

The leatherback sea turtle is listed as a single population and is classified as endangered under the ESA (35 FR 8491). Although USFWS and NMFS believe the current listing is valid, preliminary information indicates an analysis and review of the species should be conducted under the DPS policy (NMFS and USFWS 2013b). In early 2018, NMFS and the USFWS initiated a status review for the globally listed endangered leatherback sea turtles, to determine if DPS existed and if so, given their status, to consider whether the listing (currently "endangered") should be changed for each DPS. The status review was completed in 2020 (NMFS and USFWS 2020). While seven populations of leatherbacks were found globally distinct due to their genetic discontinuity, spatial differences (i.e., marked separation of the seven populations at nesting beaches), and separation due to physical factors, including land masses, oceanographic features and currents, all populations were found to be at risk of extinction. This is as a result of reduced nesting female abundance, declining nest trends, and numerous, severe threats (NMFS and USFWS 2020). Therefore, the leatherback sea turtle remains globally endangered under the ESA.

Most leatherback nesting populations in the Pacific Ocean are faring poorly and have declined by more than 80 percent since the 1980s. The International Union for Conservation of Nature has predicted a decline of 96 percent for the western Pacific subpopulation and a decline of nearly 100 percent for the eastern Pacific subpopulation by the year 2040 (Sarti-Martinez et al. 1996; Clark et al. 2010; NMFS 2016c). Causes for the decline in the Pacific include the intensive human egg harvest at leatherback rookeries and high levels of mortality through the 1980s associated with bycatch in the gill net fisheries (NMFS 2016c).

3.2.6.2 Distribution

The leatherback sea turtle is the most widely distributed of all sea turtles, found from tropical to subpolar oceans. Because leatherback nest on tropical and occasionally subtropical beaches, it has the most extensive range of any turtle (Eckert 1995; Myers & Hays 2006; NMFS and USFWS

2013b; NMFS and USFWS 2020). Leatherbacks are also the most migratory sea turtles, with populations traversing the Pacific, Atlantic, and Indian oceans between nesting and foraging grounds, and migratory routes extending into subpolar regions (Spotila 2004; Bailey et al. 2012; Gaspar & Lalire 2017).

Pacific leatherbacks are split into western and eastern Pacific subpopulations based on their distribution and biological and genetic characteristics (Bailey et al. 2012). Eastern Pacific leatherbacks nest along the Pacific coast of the Americas, primarily in Mexico and Costa Rica, and forage throughout coastal and pelagic habitats of the eastern tropical Pacific. Western Pacific leatherbacks nest in the Indo-Pacific, primarily in Indonesia, Papua New Guinea, and the Solomon Islands, disperse after hatching into the central North Pacific along the North Pacific Transition Zone, and forage in the eastern North Pacific as juveniles and adults (Bailey et al. 2012; Gaspar & Lalire 2017; NMFS and USFWS 2020).

Leatherback sea turtles are regularly seen off the west coast of the U.S., with the greatest densities found in waters along Central California during summer and fall when sea surface temperatures are highest (Bailey et al. 2012). The Action Area does not include any known or suitable leatherback sea turtle nesting habitat (NMFS and USFWS 2020).

3.2.6.3 Critical Habitat

In 2012, NMFS designated critical habitat for the leatherback sea turtle in California waters from Point Arena to Point Arguello out to the 3,000-m isobath (77 FR 4169; Figure 3.2-1). Critical habitat for leatherback sea turtles does not overlap the Action Area (Figure 3.2-1).

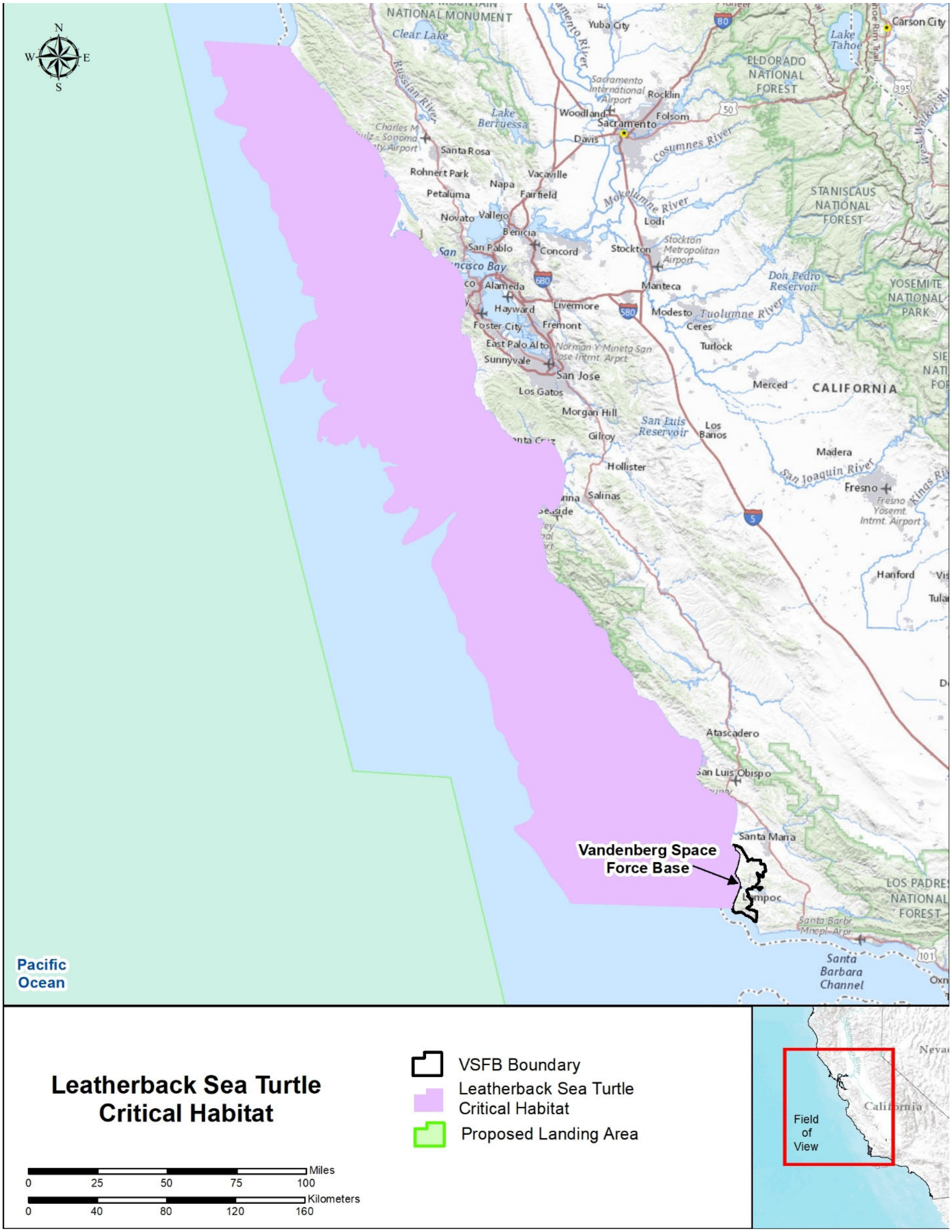

Figure 3.2-1: Leatherback sea turtle critical habitat.

3.3 Marine Mammals

3.3.1 Blue Whale (Balaenoptera musculus)

3.3.1.1 Status and Trends

The world's population of blue whales can be separated into three subspecies, based on geographic location and some morphological differences. Within the Action Area the subspecies *Balaenoptera musculus* is present. The blue whale is listed as endangered under the ESA and as depleted under the Marine Mammal Protection Act (MMPA) throughout its range (Carretta et al. 2018a; Muto et al. 2018; Carretta et al. 2019; Muto et al. 2019). A revised Recovery Plan was completed in 2020 (NMFS 2020).

Widespread whaling over the last century is believed to have decreased the global blue whale population to approximately 1 percent of its pre-whaling population size at its lowest point (Širović et al. 2004; Branch 2007; Monnahan 2013; Monnahan et al. 2014). Off the Pacific Coast, there was a documented increase in the blue whale population size between 1979–80 and 1991 (Barlow 1994) and between 1991 and 1996 (Barlow 1997). Calambokidis et al. (2009a) suggested that when feeding conditions off California are not optimal, blue whales may move to other regions to feed, including waters further north. In 2005–2006, during a period of cooler ocean temperatures, blue whales were found distributed more widely throughout Southern California waters than in previous years (Peterson et al. 2006). There had been a northward shift in blue whale distribution within waters off California, Oregon, and Washington (Calambokidis et al. 2009a; Bailey et al. 2009; Barlow 2010; Irvine et al. 2014; Širović et al. 2015; Barlow 2016; Abrahms et al. 2019; Santora et al. 2020).

Mark-recapture estimates reported on by Calambokidis et al. (2009a) "indicated a significant upward trend in abundance of blue whales" at a rate of increase just under 3 percent per year for the U.S. West Coast blue whale population in the Pacific (Calambokidis and Barlow 2013). The most current information suggests that the population in the Action Area may have recovered and has been at a stable level following the cessation of commercial whaling in 1971, despite the impacts of ship strikes, interactions with fishing gear, and increased levels of ambient sound in the Pacific Ocean (Monnahan 2013; Monnahan et al. 2014; Campbell et al. 2015; Carretta et al. 2015; Širović et al. 2015; International Whaling Commission 2016; NMFS 2018; Valdivia et al. 2019). The best overall estimate of abundance of blue whales along the U.S. West Coast has been provided by photo identification data gathered between 2015 and 2018 along the U.S. West Coast (Calambokidis & Barlow 2020). This estimate, which includes the Mexico DPS and the Central America DPS is 1,898 (Calambokidis & Barlow 2020).

3.3.1.2 Distribution

The blue whale inhabits all oceans and typically occur near the coast, over the continental shelf, though they are also found in oceanic waters (Stafford et al. 2001; Stafford et al. 2004; Ferguson 2005; Hamilton et al. 2009; Bradford et al. 2013; Klinck et al. 2015; Barlow 2016).

The Eastern North Pacific Stock of blue whales includes animals found in the eastern north Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta et al. 2019). Relatively high densities of blue whales occur off Central and Southern California during the summer and fall (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Becker et al. 2016). Data from year-round surveys conducted off Southern California from 2004 to 2013 show that the majority of blue whales were sighted in summer (62 sightings) and fall (9 sightings), with only single sightings in winter and spring (Campbell et al. 2015).

Most baleen whales spend their summers feeding in productive waters near the higher latitudes and winters in the warmer waters at lower latitudes (Širović et al. 2004). Blue whales in the eastern north Pacific are known to migrate between higher latitude feeding grounds of the Gulf of Alaska and the Aleutian Islands to lower latitudes, including Southern California; Baja California, Mexico; and the Costa Rica Dome (Calambokidis & Barlow 2004; Calambokidis et al. 2009a; Calambokidis et al. 2009b; Mate et al. 2015b; Mate et al. 2016; Palacios et al. 2019). The West Coast is known to be a blue whale feeding area for the Eastern North Pacific stock during summer and fall (Bailey et al. 2012; Calambokidis et al. 2015; Mate et al. 2015b; Calambokidis et al. 2019; Palacios et al. 2019). Nine feeding areas for blue whales were identified by Calambokidis et al. (2015) along the U.S. West Coast, termed "Biologically Important Areas" (BIAs). These BIAs do not overlap the proposed landing area (Figure 3.3-1).

The blue whale feeding areas identified in waters extending from Point Conception to the Mexico border represent only a fraction of the total area within those waters where habitat models predict high densities of blue whales (Calambokidis et al. 2015; Ferguson et al. 2015). Additionally, while those identified areas tend to have the highest blue whale density from July through October when averaged over multiple years, the areas are associated with ephemeral prey distributions that are less predictable over the short term (Ferguson et al. 2015; Abrahms et al. 2019).

Blue whales have shown site fidelity, returning to their mother's feeding grounds on their first migration (Calambokidis & Barlow 2004), and exhibit strong foraging site fidelity, even when conditions are not conducive to successful foraging in less than optimal years (Palacios et al. 2019; Cascadia Research 2019). However, a sufficient density of prey is necessary to balance the energy requirements of their lunge feeding strategy (Goldbogen et al. 2015; Hazen & Goldbogen 2015; Straley et al. 2017; Mate et al. 2019; Frisch-Jordan et al. 2019; Palacios et al. 2019; Irvine et al. 2019; Szesciorka et al. 2020), and there are daily, seasonal, interannual, and decadal variability in the locations and density of krill at a given feeding location (Brinton & Townsend 2003; Keister et al. 2011; Santora et al. 2011; Deutsch et al. 2015; Santora et al. 2017b; Zaba et al. 2018; Cimino et al. 2020; Fiechter et al. 2020; Rockwood et al. 2020; Santora et al. 2020), which influence how long they remain within a given feeding area.

3.3.1.3 Critical Habitat

There is no designated critical habitat for this species.

Figure 3.3-1: Blue whale Biologically Important Areas in the vicinity of the proposed landing area.

3.3.2 Fin Whale (Balaenoptera physalus)

3.3.2.1 Status and Trends

The fin whale is listed as depleted under the MMPA and endangered under the ESA throughout its range, but there is no designated critical habitat for this species. A Recovery Plan was completed for the fin whale in 2010 (NMFS 2010a). In the North Pacific, NMFS recognizes three fin whale stocks: (1) a Northeast Pacific stock in Alaska; (2) a California, Oregon, and Washington stock; and (3) a Hawaii stock. Although some fin whales migrate seasonally (Falcone et al. 2011; Mate et al. 2015b; Mate et al. 2016), NMFS does not recognize fin whales from the Northeast Pacific stock as being present in Southern California.

Based on a comparison of sighting records from the 1950s to 2012, (Smultea 2014) also showed an increase in the relative abundance of fin whales inhabiting Southern California. Širović et al. (2015) used passive acoustic monitoring of fin whale calls to estimate the spatial and seasonal distribution of fin whales in the Southern California Bight. An increase in the number of calls detected between 2006 and 2012 also suggests that the population of fin whales off the U.S. West Coast may be increasing. For the U.S. West Coast, Moore and Barlow (2011) predict continued increases in fin whale numbers over the next decade and suggest that fin whale densities are reaching “current ecosystem limits.” Increasing numbers of fin whales documented in coastal waters between Vancouver Island and Washington State may reflect recovery of populations in the North Pacific (Towers et al. 2018). These findings and the trend for an increase in population, appear consistent with the highest-yet abundances of fin whales in the 2014 NMFS survey of the U.S. West Coast (Barlow 2016).

3.3.2.2 Distribution

The fin whale is found in all the world’s oceans and is the second-largest species of whale (Jefferson et al. 2008). Fin whales prefer temperate and polar waters and are scarcely seen in warm, tropical waters (Reeves et al. 2002; Archer et al. 2019). This species has been documented from 60° North to 23° North. Fin whales have frequently been recorded in waters within Southern California and are present year-round (Širović et al. 2004; Barlow & Forney 2007; Mizroch et al. 2009; Jefferson et al. 2014; Smultea 2014; Campbell et al. 2015; Širović et al. 2015; Mate et al. 2016; Širović et al. 2016; Mate et al. 2017; Širović et al. 2017; Varga et al. 2018; Irvine et al. 2019).

Fin whales are not known to have a specific habitat and are highly adaptable, following prey, typically off the continental shelf (Azzellino et al. 2008; Panigada et al. 2008; Scales et al. 2017). Off the U.S. West Coast, fin whales typically congregate in areas of high productivity, allowing for extended periods of localized residency that are not consistent with the general baleen whale migration model (Scales et al. 2017).

Based on predictive habitat-based density models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, relatively high densities of fin whales are predicted off Southern California during the summer and fall (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Becker et al. 2016). Aggregations of fin whales are present year-round in Southern and Central California (Forney et al. 1995; Forney & Barlow 1998; Douglas et al. 2014; Jefferson et al. 2014; Campbell et al. 2015; Scales et al. 2017), although their distribution shows seasonal shifts. In 2005–2006, during a period of cooler ocean temperatures, fin whales were encountered more frequently than during normal years (Peterson et al. 2006). Sightings from year-round surveys off Southern California from 2004 to 2013 show fin whales farther offshore in summer and fall and closer to shore in winter and spring (Douglas et al. 2014; Campbell et al. 2015).

As was done for other species, a scientific review process (Ferguson et al. 2015) was undertaken to identify BIAs for fin whales occurring along the U.S. West Coast. Survey and acoustic data indicate that fin whale distributions shift both seasonally as well as annually (Peterson et al. 2006; Douglas et al. 2014; Jefferson et al. 2014; Calambokidis et al. 2015; Širović et al. 2015; Širović et al. 2017; Rice et al. 2018; Baumann-Pickering et al. 2018; Calambokidis et al. 2019; Trickey et al. 2020). Definitive areas of biological importance for fin whales have not yet been identified due to poor knowledge of fin whale population structure and biases inherent in different sampling methods that revealed high concentrations of fin whales in both coastal and offshore regions (Calambokidis et al. 2015).

3.3.2.3 Critical Habitat

No critical habitat has been designated for the fin whale.

3.3.3 Western North Pacific Gray Whale (*Eschrichtius robustus*)

3.3.3.1 Status and Trends

There are two north Pacific populations of gray whales: the Western subpopulation and the Eastern subpopulation designated in the Pacific Stock Assessment Report (SAR) (Weller et al. 2013; Carretta et al. 2019; Cooke 2019; Muto et al. 2019). Both DPSs could be present in the Action Area during their northward and southward migration (Sumich & Show 2011; Weller & Brownell 2012; Calambokidis et al. 2015; Cooke et al. 2015; Carretta et al. 2019).

The Western North Pacific DPS is considered depleted (Weller et al. 2002; Weller et al. 2013; Cooke et al. 2015; Carretta et al. 2017b; Cooke 2019). This subpopulation is endangered and should be very few in number in the Action Area given the small population and their known wintering areas in waters off Russia and Asia (Weller & Brownell 2012; Moore & Weller 2013; Weller et al. 2013; Mate et al. 2015a). Analysis of the data available for 2005 through 2016 estimates the combined Sakhalin Island and Kamchatka populations are increasing (Cooke 2019). The Eastern North Pacific subpopulation has recovered and was delisted under the ESA in 1994 (Swartz et al. 2006; Carretta et al. 2020).

3.3.3.2 Distribution

Gray whales of the Western North Pacific DPS primarily occur in shallow waters over the U.S. West Coast, Russian, and Asian continental shelfs and are considered to be one of the most coastal of the great whales (Jefferson et al. 2008; Jones & Swartz 2009). Feeding grounds for the population are the Okhotsk Sea off Sakhalin Island, Russia, and in the southeastern Kamchatka Peninsula (in the southwestern Bering Sea) in nearshore waters generally less than 225 ft (68 m) deep (Jones & Swartz 2009; Weller & Brownell 2012). The breeding grounds consist of subtropical lagoons in Baja California, Mexico, and suspected wintering areas in southeast Asia (Urban-Ramirez et al. 2003; Alter et al. 2009; Jones & Swartz 2009; Weller et al. 2012; Mate et al. 2015a). At least 12 members of the Western North Pacific DPS have been detected in waters off the

Pacific Northwest (Weller & Brownell 2012; Mate 2013; Moore & Weller 2018). NMFS reported that 18 Western North Pacific gray whales have been identified in waters far enough south to have passed through Southern California waters (NMFS 2014).

Gray whales migrate along the Pacific coast twice a year between October and July (Calambokidis et al. 2015). Although they generally remain mostly over the shelf during migration, some gray whales may be found in more offshore waters to the west of San Clemente Island and the Channel Islands (Mate & Urban-Ramirez 2003; Sumich & Show 2011; Smultea 2014; Calambokidis et al. 2015; Schorr et al. 2019; Guazzo et al. 2019). In aerial surveys occurring in December and April each year, gray whales were the third-most encountered large cetacean in Southern California (Smultea 2014).

The main gray whale migrations that pass through the Action Area can be loosely categorized into three phases (Rugh et al. 2008; Calambokidis et al. 2015). Calambokidis et al. (2015) note these migration phases are not distinct, the timing for a phase may vary based on environmental variables, and a migration phase typically begins with a rapid increase in migrating whales, followed by moderate numbers over a period of weeks, and then slowly tapering off. A southward migration from summer feeding areas in the Chukchi Sea, Bering Sea, Gulf of Alaska, and the Pacific Northwest begins in the fall (Mate et al. 2013; Calambokidis et al. 2015; Mate et al. 2015a). This Southbound Phase includes all age classes as they migrate primarily to the nearshore waters and lagoons of Baja California, Mexico, as a destination. During this southward migration, the whales generally are within 10 km of the coast (Calambokidis et al. 2015), although there are documented exceptions where migrating gray whales have bypassed the coast by crossing sections of the open ocean (Rice & Wolman 1971; Mate & Urban-Ramirez 2003; Mate 2013; Mate et al. 2015a).

The northward migration for gray whales to the feeding grounds in Arctic waters, Alaska, the Pacific Northwest, and Northern California occurs in two phases (Calambokidis et al. 2015). Northbound Phase A consists mainly of adults and juveniles that lead the beginning of the north-bound migration from late January through July, peaking in April through July. Newly pregnant females go first to maximize feeding time, followed by adult females and males, then juveniles (Jones & Swartz 2009). The Northbound Phase B consists primarily of cow-calf pairs that begin their northward migration later (March to July) remaining on the reproductive grounds longer to allow calves to strengthen and rapidly increase in size before the northward migration (Urban-Ramirez et al. 2003; Jones & Swartz 2009).

The gray whale migration corridors (north of Point Conception), the potential presence buffer area, and the months (October through July) these four sections of the Pacific coastal waters were designated as cumulatively in use, were identified by Calambokidis et al. (2015) as BIAs for gray whales. The proposed landing area does not overlap these BIAs (Figure 3.3-2).

3.3.3.3 Critical Habitat

There has been no designated critical habitat for the Western North Pacific gray whale DPS.

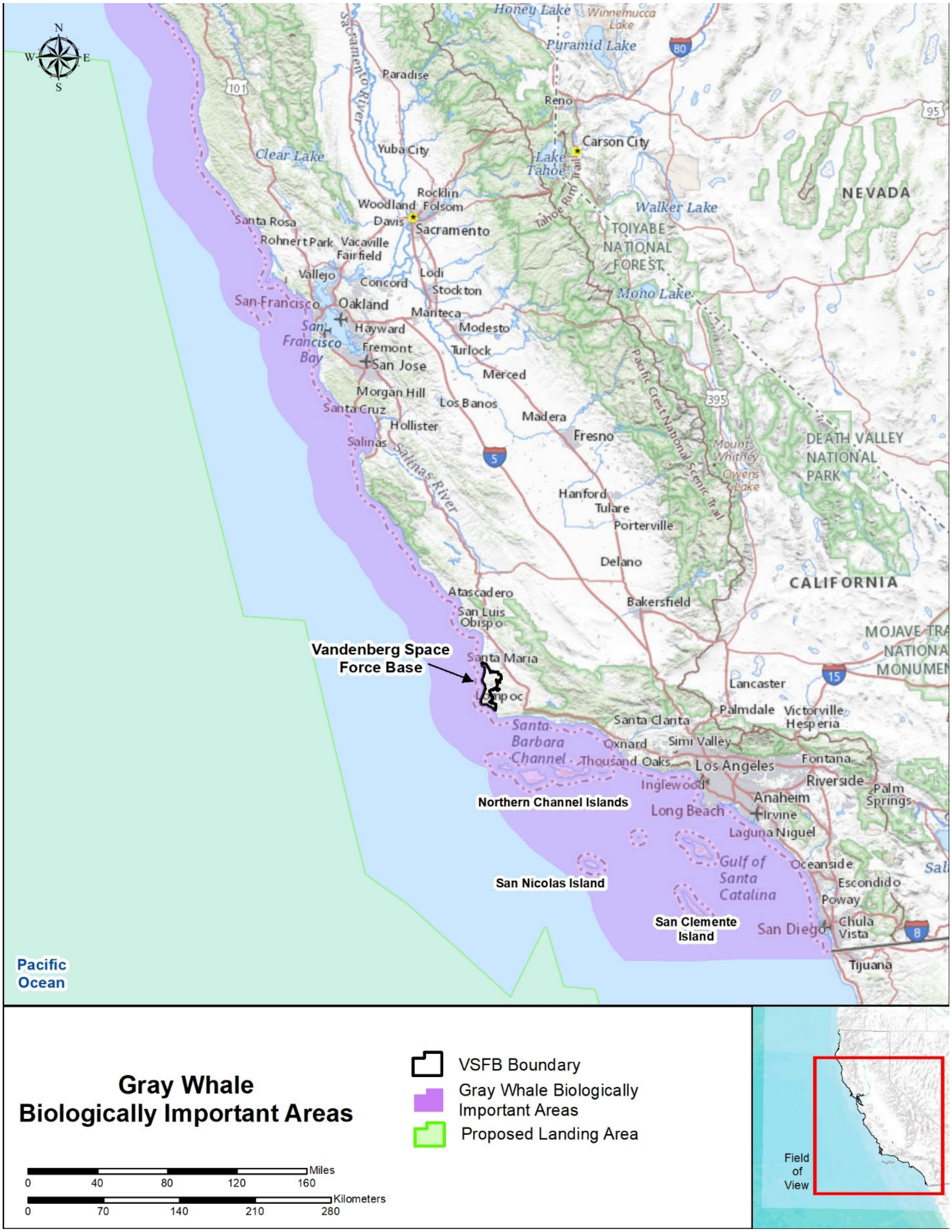

Figure 3.3-2. Gray whale Biologically Important Areas in the vicinity of the proposed landing area.

3.3.4 Humpback Whale (*Megaptera novaeangliae*), Mexico Distinct Population Segment and Central American Distinct Population Segment

3.3.4.1 Status and Trends

Humpback whales that are seasonally present in the Action Area are from two DPSs, given they represent populations that are both discrete from other conspecific populations and significant to the species of humpback whales to which they belong (NMFS 2016e). These DPSs are based on animals identified in breeding areas in Mexico and Central America (Bettridge et al. 2015; NMFS 2016f; Wade et al. 2016; Calambokidis et al. 2017; Carretta et al. 2019; Muto et al. 2019). Humpback whales of the Mexico DPS are listed as threatened, and those from the Central America DPS are listed as endangered under the ESA (NMFS 2016e).

Although estimates show variable trends in the number of humpback whales along the U.S. West Coast, the overall trend in the estimates is consistent with growth rate of 6–7 percent for the California, Oregon, Washington stock and appears consistent with the highest-yet abundances of humpback whales in the most recent 2014 survey of that stock (Smultea 2014; Barlow 2016; Calambokidis et al. 2017; Carretta et al. 2017b; Carretta et al. 2018a). For the DPSs in Mexico and in Central America, photo identification data collected between 2004 and 2006 are the main basis for the estimates for specific to those populations (Bettridge et al. 2015; NMFS 2016f; Wade et al. 2016). The new best overall estimate of abundance of humpback whales along the U.S. West Coast has been provided by photo identification data gathered between 2015 and 2018 along the U.S. West Coast (Calambokidis & Barlow 2020). This estimate, which includes the Mexico DPS and the Central America DPS, is 4,973, which is higher than the abundance (2,900) in the 2019 Pacific SAR (Calambokidis & Barlow 2020).

3.3.4.2 Distribution

The habitat requirements of wintering humpbacks appear to be controlled by the conditions necessary for calving, such as warm water (75–80° Fahrenheit [^{o}F]) and relatively shallow, low-relief ocean bottom in protected areas, nearshore, or created by islands or reefs (Smultea 1994; Clapham 2000; Craig & Herman 2000). In breeding grounds, females with calves occur in significantly shallower waters than other groups of whales, and breeding adults use deeper, more offshore waters (Smultea 1994; Ersts & Rosenbaum 2003). Breeding and calving areas for the Mexico DPS and for the Central America DPS are both located in the southern portion of the ERCA II Action Area in waters off Mexico.

Off the U.S. West Coast, humpback whales are more abundant in shelf and slope waters (<2,000 m deep) and are often associated with areas of high productivity (Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Redfern et al. 2013; Campbell et al. 2015; Becker et al. 2016; Calambokidis et al. 2019). While most humpback whale sightings are in nearshore and continental shelf waters, humpback whales frequently travel through deep oceanic waters during migration (Dohl et al. 1983; Forney & Barlow 1998; Campbell et al. 2015). Humpback whales migrating from breeding grounds in Central America to feeding grounds at higher latitudes may cross the Action Area.

Peak occurrence during migration occurs in the Action Area from December through June (Calambokidis et al. 2015). In quarterly surveys undertaken in the 10-year period between 2004 and 2013 off Southern California, humpback whales were generally encountered in coastal and shelf waters, with the largest concentration occurring in relatively shallow waters, north of Point Conception (Campbell et al. 2015). During winter and spring, a substantially greater proportion of the humpback whale population is found farther offshore than during the summer, with (in all seasons) the majority of the population found north of the Channel Islands (Forney & Barlow 1998; Campbell et al. 2015; Becker et al. 2017; Calambokidis et al. 2017).

BIAs for humpback whales overlap the Action Area (Figure 3.3-3). Passive acoustic monitoring at Monterey Bay California from 2015 to 2018 demonstrated that the timing of humpback whales feeding and migration in that area is variable, with detections generally occurring from September through May (Ryan et al. 2019). Location data from satellite tags also has demonstrated that in some cases the feeding BIAs do not represent the core area of humpback whale presence, at least for the time and sample of the population represented by humpback whales that were tagged and otherwise present in or around the area (Mate et al. 2018). In 2014, 2015, and 2016, humpback whales were more commonly sighted in coastal waters of Santa Monica Bay, and from Long Beach south to waters off Dana Point (Calambokidis et al. 2017). The variable use of the Santa Barbara Channel–San Miguel feeding BIA was also evident, corresponding to the 2014–2016 increase in ocean temperatures off California that resulted in the changes to the nominal distribution and availability of krill and anchovy (Zaba et al. 2018; Fiechter et al. 2020; Santora et al. 2020) and the distribution of humpback whales in 2014, resulting in a much higher density off Central California than a nominal year (Becker et al. 2018). Similar high ocean temperatures in 2016 also corresponded to a documented scarcity of healthy humpback whales in the Santa Barbara Channel–San Miguel feeding BIA and vicinity. However, more humpback whales were found further north off Central California and in better condition, which investigators suggested was indicative of good feeding areas that were likely to be sustained in that region in that anomalous year (Oregon State University 2017).

3.3.4.3 Critical Habitat

A final rule to designate critical habitat for humpback whales for the endangered Central America DPS and the threatened Mexico DPS was published on 21 April 2021 (75 FR 21082) pursuant to Section 4 of the ESA. This action followed a 9 October 2019 proposed rule to designate critical habitat for the humpback whales within the U.S. EEZ in the Pacific for the endangered Central America DPS and the threatened Mexico DPS pursuant to section 4 of the ESA (84 FR 54378). In the proposal, NMFS considered 19 Regions/Units of habitat as critical habitat for the listed humpback whale DPSs. These 19 areas include almost all coastal waters off California, Oregon, Washington, and Alaska in the Pacific. Humpback whale critical habitat is depicted in Figure 3.3-4; as shown, there is overlap between the proposed landing area, vessel routes, and the critical habitat.

Region/Unit 17 has been referred to by NMFS in the proposed rule as the “Central California Coast Area,” which covers an area of 6,697 square nm extending from 36° 00' to 34° 30' north latitude. Within those north and south boundaries, Region/Unit 17 begins at the 98 ft. (30 m) depth contour out to the 12,139 ft. (3,700 m) depth contour. This region’s area includes waters off of southern Monterey, San Luis Obispo, and Santa Barbara counties. This region/unit of habitat is characterized by NMFS as having a very high conservation value (84 FR 54378).

The essential feature for the Central America DPS as defined by NMFS (2019b) is "Prey species, primarily euphausiids (Thysanoessa, Euphausia, Nyctiphanes, and Nematoscelis) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth. The Mexico DPS is very similar, but adds capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) to the essential prey species lists. NMFS has noted that prey as an essential feature may require special management considerations or protections as a result of ecosystem shifts driven by climate change, commercial fisheries, and pollution (NMFS 2019b).

Humpback whales are generalists, taking a variety of prey while foraging and switching between target prey depending on what is most abundant in the system (Witteveen et al. 2014; Szabo 2015; Fleming et al. 2016). Consistent with the designated critical habitat, the humpback whales' diet is dominated by euphausiids and small pelagic fishes, such as northern anchovy, Pacific herring, Pacific sardine, and capelin (Santora et al. 2010; Szabo 2015; Fleming et al. 2016; Keen et al. 2017; Gabriele et al. 2017; Straley et al. 2017; Witteveen & Wynne 2017). Like other large mysticetes, they are a "lunge feeder," taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. All feeding behavior seem to involve patches of prey with sufficient density to support feeding bouts (Mate et al. 2019; Frisch-Jordan et al. 2019). The size of individual krill seems to be an aspect of prey quality for the species (Santora et al. 2010; Szabo 2015; Burrows et al. 2016). For example, Santora et al. (2010) found that different species of baleen whales aggregated to krill hotspots that were differentiated by the size of individual krill, with humpback whales having preference for small (<35 mm) juvenile krill.

In the California Current Ecosystem, changing oceanographic factors (e.g., upwellings, temperatures, winds, salinity) result in seasonal, interannual, and decadal variability in the locations and density of krill and forage fish (Brinton & Townsend 2003; Keister et al. 2011; Santora et al. 2011; Deutsch et al. 2015; Santora et al. 2017a; Zaba et al. 2018; Cimino et al. 2020; Rockwood et al. 2020; Fiechter et al. 2020; Santora et al. 2020). As a result, the location, timing, and intensity of prey aggregations can vary greatly both seasonally and from year to year. Given that concentrations of prey tend to be spatially and temporally ephemeral at scales on the order of tens of meters to kilometers and hours to days (Zaba et al. 2018; Hazen et al. 2018; Rockwood et al. 2020; Fiechter et al. 2020; Santora et al. 2020), the presence of feeding humpback whales and prey as an essential feature of the critical habitat are also highly variable over these small spatial and temporal scales.

The critical habitat overlaps with the humpback whale feeding BIAs designated in 2015 (Calambokidis et al. 2015), but in the Action Area it extends farther offshore to incorporate the maximum extent of the predicted humpback abundance in cooler months (Becker et al. 2016; Becker et al. 2017) and farther inshore to incorporate distributions derived from satellite telemetry data for 13 humpback whales (Mate et al. 2018). Although the location, timing, and intensity of humpback whale prey vary greatly (Santora et al. 2011; Santora et al. 2017a; Zaba et al. 2018; Santora et al. 2020; Fiechter et al. 2020), static spatial management strategies such as the designation of critical habitat can effectively mitigate risks associated with fixed large and long-term actions such as established commercial vessel traffic lanes (associated with ship strikes) or within fishery regulations (associated with entanglement) (Rockwood et al. 2017; Moore & Weller 2018; Redfern et al. 2019; Redfern et al. 2020; Rockwood et al. 2020; Santora et al. 2020).

Figure 3.3-3. Humpback whale Biologically Important Areas in vicinity of the proposed landing area.

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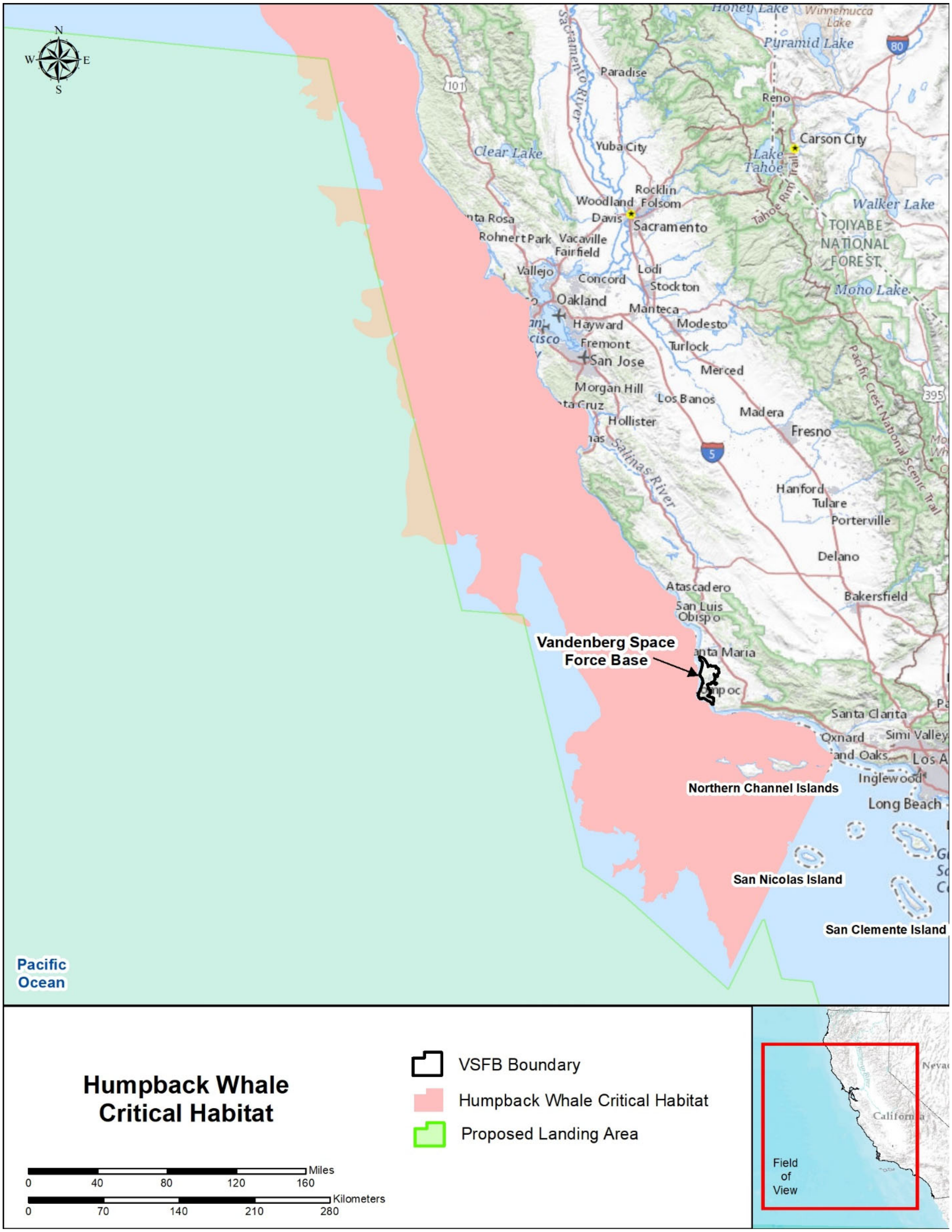

Figure 3.3-4. Humpback whale critical habitat.

3.3.5 Killer Whale (Orcinus orca)

3.3.5.1 Status and Trends

NMFS listed the Southern Resident killer whale DPS as endangered in 2005 (70 FR 69903) and adopted a recovery plan in 2008 (73 FR 4176; NMFS 2008). There are 73 Southern Resident killer whales in the DPS (Couture et al. 2022). The Southern Resident DPS is divided into three pods identified as J, K, and L (Carretta et al. 2021).

Concerns over impacts on the population from several sources have been raised in recent years, including disturbance from whale watching vessels (Ferrara et al. 2017; Holt et al. 2017; Lacy et al. 2017; NMFS 2021), commercial shipping noise (Cominellli et al. 2018; McWhinnie et al. 2021; Vagle et al. 2021; Veirs et al. 2016; Williams et al. 2019), and prey availability (Hanson et al. 2021; Shields et al. 2018; Wasser et al. 2017).

3.3.5.2 Distribution

Southern Resident killer whales occur mainly along the outer coast and inland waters of Washington and British Columbia, Canada. In recent years the population has shifted and expanded its range to areas up to hundreds of miles from Washington waters both north (as far as Southeast Alaska) and south as far as central California (Cogan 2015; Dahlheim et al. 2008; Ford et al., 2014; Hanson et al., 2021; Houghton et al., 2015a). Specifically, K-pod and L-pod have ranged widely along the coast and been sighted as far south as Monterey Bay in recent years; L-pod is known to have traveled as far north as Chatham Strait, Southeast Alaska. J-pod has largely remained in inland waters (Carretta et al. 2021).

Satellite-tag locations found that Southern Resident killer whales generally inhabit nearshore waters (Hanson et al. 2018; Hanson et al. 2017). Ninety-five percent of reported locations were within 18 nm (34 km) of shore, and 50 percent were within 5 nm (10 km) of shore. On the outer coast, 75 percent of tag locations were in a narrow corridor between 1.6 and 10 nm (3 and 19 km) offshore (Hanson et al. 2017). As noted in Section 2.1 (Action Area), the proposed landing and fairing recovery area is in deep waters between approximately 46-400 nm off Rockport, California in the north to 158- 910 nm off Baja California, Mexico in the south and no recovery activities would occur within 12 nm of islands (Figure 1.1-2). Therefore, relatively few killer whales are expected to occur in areas where these activities would be conducted.

3.3.5.3 Critical Habitat

NMFS amended and expanded the critical habitat designation for Southern Resident killer whales to include nearshore waters along the coasts of Washington, Oregon, and California in 2021. The elements of critical habitat essential for conservation of the Southern Resident killer whale are (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging (National Marine Fisheries Service: Northwest Region, 2006). The amended critical habitat designation extends along the entire Oregon coastline but is outside the Action Area (Figure 3.3-5).

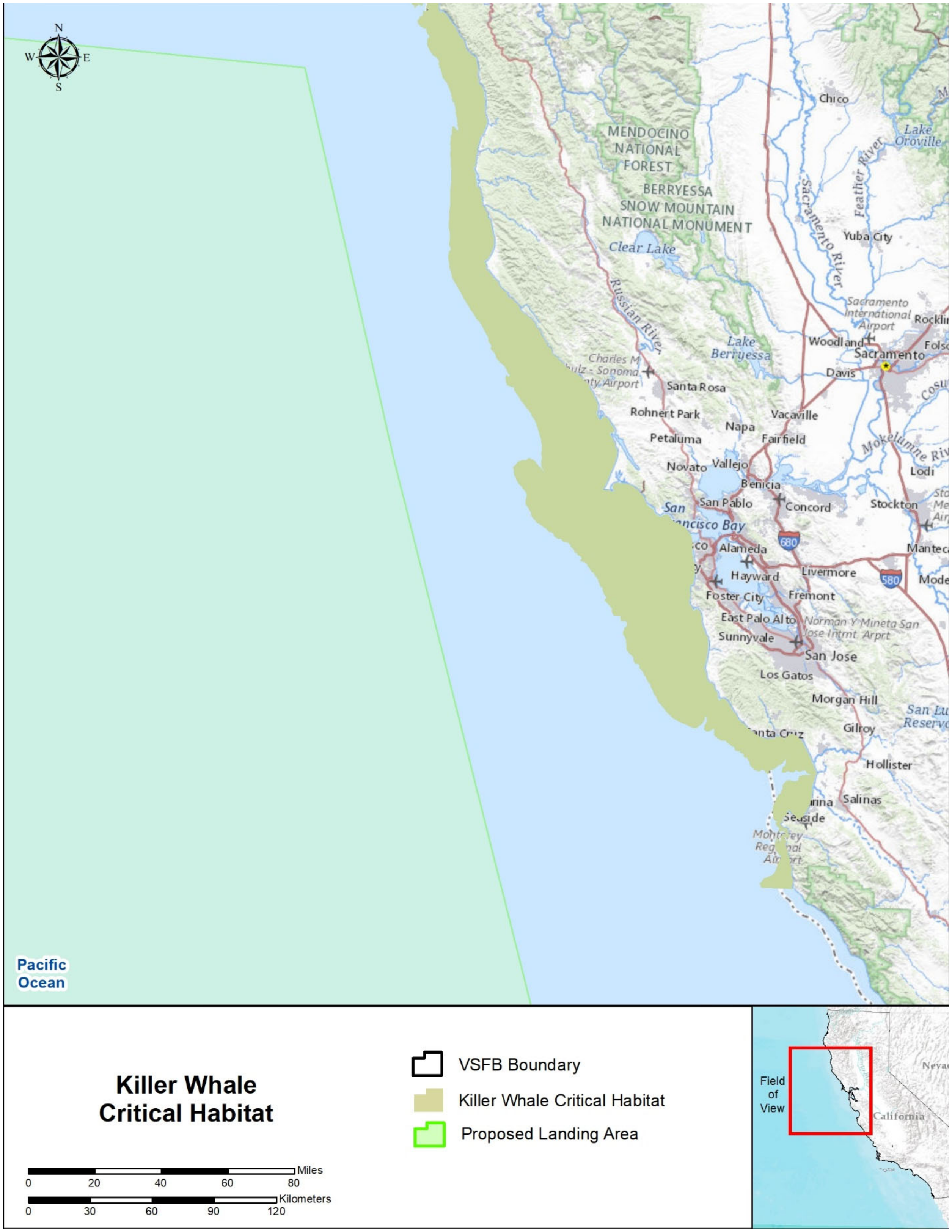

Figure 3.3-5. Killer Whale Critical Habitat.

3.3.6 Sei Whale (Balaenoptera borealis)

3.3.6.1 Status and Trends

The sei whale is listed as endangered under the ESA and as depleted under the MMPA throughout its range. A recovery plan for the sei whale was completed in 2011 and provided a research strategy for obtaining data required to estimate population abundance and trends, and to identify factors that may be limiting the recovery of this species (NMFS 2011). Sei whales along the U.S. West Coast are assigned to the Eastern North Pacific stock within the U.S. EEZ (Carretta et al. 2020). NMFS has determined that an assessment of the sei whale population trend will likely require additional survey data and reanalysis of all datasets using comparable methods (Carretta et al. 2018b). There are no data on Eastern North Pacific sei whale trends in abundance (Carretta et al. 2020).

3.3.6.2 Distribution

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes. During the winter, sei whales are found in warm tropical waters. Sei whales are also encountered during the summer off California and the North America coast from approximately the latitude of the Mexican border to as far north as Vancouver Island, Canada (Masaki 1976; Horwood 2009; Smultea et al. 2010).

A total of 10 sei whale sightings were made during systematic ship surveys conducted off the U.S. West Coast in summer and fall between 1991 and 2008 (Barlow 2010), with an additional 14 groups sighted during a 2014 survey (Barlow 2016). Sei whales are expected to be present in offshore waters in the Action Area.

3.3.6.3 Critical Habitat

There is no designated critical habitat for this species.

3.3.7 Sperm Whale (Physeter macrocephalus)

3.3.7.1 Status and Trends

The sperm whale has been listed as endangered since 1970 under the precursor to the ESA (NMFS 2009) and is depleted under the MMPA throughout its range. In the North Pacific sperm whales are divided into three stocks in the Pacific; one (California/Oregon/Washington) occurs within the Action Area (Carretta et al. 2020). Based on genetic analyses, Mesnick et al. (2011) found that sperm whales in the California Current are demographically independent from animals in the rest of the tropical Pacific. A Recovery Plan was completed for the sperm whale in 2010 (NMFS 2010b).

Line-transect surveys conducted off the U.S. West Coast from 1991 to 2014 include a high level of uncertainty but indicate that sperm whale abundance has appeared stable, with some evidence for an increasing number of sperm whales (Moore & Barlow 2014; Moore & Barlow 2017; Carretta et al. 2020).

3.3.7.2 Distribution

This species is primarily found in the temperate and tropical waters of the Pacific (Rice 1989; Merkens et al. 2019). Its secondary range includes areas of higher latitudes up to and including the Gulf of Alaska (Whitehead & Weilgart 2000; Jefferson et al. 2008; Whitehead et al. 2008; Whitehead et al. 2009). This species appears to prefer deep waters and the continental shelf break and slope (Rice 1989; Whitehead 2003; Jefferson et al. 2008; Whitehead et al. 2008; Baird 2013). Typically, sperm whale concentrations also correlate with areas of high productivity, generally near drop offs and areas with strong currents and steep topography (Gannier & Praca 2007; Jefferson et al. 2008).

Sperm whales are found year-round in California waters, but their abundance is temporally variable, most likely due to the availability of prey species (Forney & Barlow 1993; Barlow 1995; Barlow & Forney 2007; Smultea 2014). Based on habitat models derived from line-transect survey data collected between 1991 and 2008 off the U.S. West Coast, sperm whales show an apparent preference for deep waters (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012). During quarterly ship surveys conducted off Southern California between 2004 and 2008, there were a total of 20 sperm whale sightings, the majority (12) occurring in summer in waters greater than 2,000 m deep (Douglas et al. 2014).

Sperm whales are somewhat migratory. General shifts in distribution occur during summer months for feeding and breeding, while in some tropical areas sperm whales appear to be largely resident (Rice 1989; Whitehead 2003; Whitehead et al. 2008; Whitehead et al. 2009). Pods of females with calves remain on breeding grounds throughout the year, between 40° North and 45° North (Rice 1989; Whitehead 2003), while males migrate between low-latitude breeding areas and higher-latitude feeding grounds (Pierce et al. 2007). In the northern hemisphere, “bachelor” groups (males typically 15 to 21 years old and bulls [males] not taking part in reproduction) generally leave warm waters at the beginning of summer and migrate to feeding grounds that may extend as far north as the perimeter of the arctic zone. In fall and winter, most return south, although some may remain in the colder northern waters during most of the year (Pierce et al. 2007).

3.3.7.3 Critical Habitat

There is no designated critical habitat for this species.

3.3.8 Guadalupe Fur Seal (Arctocephalus townsendi)

3.3.8.1 Status and Trends

The Guadalupe fur seal was listed as threatened under the ESA in 1985 (50 FR 51252) and depleted under the MMPA throughout its range. Guadalupe fur seals were hunted nearly to extinction during the 1800s. All individuals alive today are descendants from one breeding colony at Isla Guadalupe and Isla San Benito off Mexico and are considered a single stock (Pablo-Rodríguez et al. 2016; Carretta et al. 2017a; Carretta et al. 2020). A recovery plan has not been initiated for the Guadalupe fur seal. However, a status review of the Guadalupe fur seals was conducted in 2021, showing that the population has grown and increased in distribution since 1985 (McCue et al. 2021). Despite this, since 2010, there have been dramatic shifts in the species distribution and abundance, mass strandings, and Unusual Mortality Events (UME) of Guadalupe fur seals caused by prey limitations (McCue et al. 2021).

A SAR has not been completed for Guadalupe fur seals since 2010 (Carretta et al. 2020), which indicated a total estimated population size of approximately 20,000 animals and an average annual growth rate of 10.3 percent (Carretta et al. 2020). The ongoing UME involving Guadalupe fur seals (National Oceanic and Atmospheric Administration [NOAA] 2018; NMFS 2019a, 2020c) is likely to have impacted the recent population trend (Elorriaga-Verplancken et al. 2016a; Elorriaga-Verplancken et al. 2016b; Ortega-Ortiz et al. 2019). However, based on counts off Mexico in 2018 at Guadalupe Island and the San Benito Archipelago, the minimum population estimate was 29,747 Guadalupe fur seals at those locations (Norris 2019). Valdivia et al. (2019) has noted that since being ESA-listed in 1985, the population of the Guadalupe fur seal increased about nine-fold at a rate of approximately 15 percent per year. The dispersion of Guadalupe fur seal from rookeries off Mexico may be an indicator of potential species recovery (Ortega-Ortiz et al. 2019; Norris & Elorriaga-Verplancken 2020; D'Agnese et al. 2020).

3.3.8.2 Distribution

Before intensive hunting decreased their numbers, Guadalupe fur seals ranged from Monterey Bay, California, to the Revillagigedo Islands, Mexico (Aurioles-Gamboa et al. 2010). Guadalupe fur seals are most common at their primary breeding ground of Guadalupe Island, Mexico (Melin & DeLong 1999). A second rookery was found in 1997 at the San Benito Islands off Baja California (Maravilla-Chavez & Lowry 1999; Aurioles-Gamboa et al. 2010; Esperon-Rodriguez & Gallo-Reynoso 2012), and they have been found in La Paz Bay in the Southern Gulf of California (Elorriaga-Verplancken et al. 2016a). Adult and juvenile males have occasionally been observed at San Miguel Island, California since the mid-1960s, and in the late 1990s, a pup was born on the island. Rare sightings of individuals have also occurred at Santa Barbara, San Nicolas, and San Clemente Islands (Stewart 1981; Stewart & Yochem 1984; Stewart et al. 1993; Stewart & Yochem n.d.). In NMFS aerial surveys between 2011 and 2015, Guadalupe fur seals were not observed on any of the Channel Islands, other than at SMI (Lowry et al. 2017); Guadalupe fur seals have not been observed at VSFB.

Data from animals leaving Guadalupe Island indicate that Guadalupe fur seals primarily use habitats offshore of the continental shelf between 31 and 186 mi (50 and 300 km) from the U.S. West Coast, with approximately one-quarter of the population foraging farther out and up to 435 mi (700 km) offshore (Norris 2019). Satellite tags have documented the movement of females without pups at least as far as 808 mi (1,300 km) north of Guadalupe Island (waters offshore of approximately Point Cabrillo in Mendocino County, California) (Norris 2019). Adult males, juveniles, and nonbreeding females may live at sea during some seasons or for part of a season (Reeves et al. 2002) and can be expected to occur in both deeper waters of the open ocean and coastal waters within the Action Area (Hanni et al. 1997; Jefferson et al. 2008; Jefferson et al. 2019). Guadalupe fur seals may be establishing the extent of their previous range, as they are increasingly observed and tracked by satellite using offshore waters of the Pacific Northwest (Etnier 2002; Lambourn et al. 2012; Norris et al. 2015). There are no records of Guadalupe fur seals breeding or hauling out on VSFB beaches. Breeding does occur nearby at very low number on the NCI.

3.3.8.3 Critical Habitat

Critical habitat for the Guadalupe fur seal has not been designated given that the only areas that meet the definition for critical habitat are outside of U.S. jurisdiction (NOAA 1985).

4 Effects of the Action

4.1 Introduction

This chapter evaluates how, and to what degree, the activities described under the Proposed Action potentially impact ESA-listed species known to occur within the Action Area. The stressors vary in intensity, frequency, duration, and location within the Action Area. The stressors considered in this BA include the following:

- Impact by fallen objects: fairing and radiosonde
- Entanglement in unrecovered parachutes and parafoils
- Ingestion of materials from unrecovered parachutes, parafoils, and weather balloons
- Acoustic (in-air)
- Ship strike
- Indirect Effects (impacts on habitat, impacts on prey availability)
- Cumulative Effects

The potential direct, indirect, and cumulative impacts of the Proposed Action were analyzed based on these potential stressors interacting with the ESA-listed species and using the best scientific and commercial data available to assess potential impacts. Direct impacts are caused by the action and occur at the same time and place. Indirect impacts could result under two scenarios. First, ESA-listed species could be affected by the Proposed Action later in time; or secondly, they could be affected via an indirect pathway as a result of an impact on one resource inducing an impact on another resource.

Acoustic impacts as a result of the Proposed Action are limited to in-air noise as a result of sonic boom or rocket engine noise. Exceptionally little sound is transmitted between the air-water interface; thus, in-air sound would not have a significant effect on submerged animals (Godin 2008). Therefore, in-air noise would have no effect on ESA-listed fish species. In addition, cetaceans and sea turtles spend most of their time (>90% for most species) entirely submerged below the surface. When at the surface, their bodies are almost entirely below the water's surface, with only the blowhole or turtle's head exposed briefly to allow breathing. This minimizes in-air noise exposure, both natural and anthropogenic, essentially 100% of the time because their ears are nearly always below the water's surface. As a result, in-air noise caused by sonic boom and engine noise will not have an effect on ESA-listed sea turtles or cetacean species. Similarly, when at-sea, pinnipeds spend varying amounts of time underwater and the potential for disruption from in-air noise within the limited area of potential exposure during the brief moment of the sonic boom or engine noise is extremely unlikely for animals that are at sea. As a result, in-air noise would have no effect on Guadalupe fur seals that are at-sea. The Proposed

Action, however, will create in-air noise that may impact Guadalupe fur seals that are hauled out and these potential impacts are analyzed below.

Finally, indirect impacts resulting from the Proposed Action were considered. Indirect impacts result when a direct impact on one resource induces an impact on another resource. Indirect impacts would be reasonably foreseeable because of a functional relationship between the directly impacted resource and the secondarily impacted resource.

4.2 Fishes

This section evaluates how, and to what degree, the activities described in Chapter 2 potentially impact ESA-listed fishes (Southern California DPS steelhead, lower Columbia River Chinook ESU, Southern Oregon and Northern California Coast Coho ESU, Central California Coast Coho ESU, green sturgeon, oceanic whitetip shark, and scalloped hammerhead shark) occurring within the Action Area. The stressors considered for the ESA-listed fishes are:

- Physical disturbance and impacts by fallen objects
- Entanglement
- Ingestion
- Indirect Effects
- Cumulative Effects

The USSF has identified no interrelated or interdependent projects that would impact ESA-listed fish species within the Action Area.

4.2.1 Physical Disturbance and Impacts by Fallen Objects

Unrecovered fairings and radiosondes have the potential to directly strike fish as they hit the water surface and below the surface to the point where the objects lose momentum. Fishes at and just below the surface would be most susceptible to injury or death from strikes, because velocity of these materials would rapidly decrease upon contact with the water and as they travel through the water column. Consequently, most water column fishes would have ample time to detect and avoid approaching projectiles or fragments that fall through the water column. A low possibility exists that a small number of fish at or just under the surface may be directly impacted if they are in the impact area at the time of splashdown, but population-level impacts would not occur.

The proposed landing and first stage recovery area are very large and ESA-listed fish species occur in very low densities of species across this area. In addition, most ESA-listed fish do not spend much time near the surface. For those species that do spend time at the surface, the chances of being present at the surface in an impact area when the impact occurs is very unlikely. Therefore, the probability of a fairing or radiosonde striking an ESA-listed fish species is extremely low. Fairings and radiosondes strike on ESA-listed fish would be discountable due to (1) the limited number of individuals found directly at the surface of the ocean, (2) the rare chance that a fish might be directly struck while at the surface, and (3) the ability of most fishes to detect and avoid an object falling through the water below the surface. The potential for impacts to occur would be short term (seconds) and localized and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Therefore, the USSF has determined that physical disturbance and strike stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed fish species because the potential impacts are discountable.

4.2.2 Entanglement

Unrecovered parafoils, parachutes, and weather balloons can potentially become entangled with an ESA-listed fish, causing injury or death. While individual fish could encounter expended materials that may pose a risk of entanglement, the likelihood of entanglement is extremely small because: (1) the encounter rate for these expended materials is low, (2) the types of ESA-listed fishes that are susceptible to these items is limited, (3) there is restricted overlap with susceptible fishes, and (4) the physical characteristics of the expended materials reduce entanglement risk to fishes compared to monofilament used for fishing gear. For example, a latex weather balloon would burst after reaching its elastic limit at an altitude of 12 to 19 mi (19 to 30 km). The temperature at this altitude range can reach negative 40 degrees Fahrenheit (°F) and even colder. Under these conditions of extreme elongation and low temperature, the balloon undergoes "brittle fracture" where the rubber shatters along grain boundaries of crystallized segments. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989). The balloon fragments would be positively buoyant, float on the surface, and begin to photo-oxidize due to UV light exposure. In addition, unrecovered parafoils and parachutes would sink quickly through the water column, at 7 ft and 22 ft per minute, respectively, and settle (NMFS 2022b). These activities will typically occur far offshore in deep waters where they are not expected to be encountered by ESA-listed fish species potentially affected by the Proposed Action. Entanglement with parachutes, unrecovered parafoils, or weather balloons is therefore extremely unlikely and therefore the risk of entanglement is very low.

As a result, the USSF has determined that entanglement stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed fish species because the potential impacts are discountable.

4.2.3 Ingestion Stressors

Pieces of weather balloons, parachutes, or parafoils may pose an ingestion stressor to ESA-listed fish. Ingestion of expended materials by fishes could occur at or just below the surface, in the water column, or at the seafloor depending on the size and buoyancy of the expended object and the feeding behavior of the fish. Floating material is more likely to be eaten by fishes that feed at or just under the water's surface (e.g., ocean sunfish, basking sharks, or flying fishes), while materials that sink to the seafloor present a higher risk to bottom-feeding fishes (e.g., rockfishes, skates, and flatfishes).

Parachutes and parafoils are made of nylon and Kevlar and thus do not degrade quickly. Photooxidation would break down nylon, however, the parachutes and parafoils would sink rapidly (discussed above) and settle on the ocean floor, typically far from shore at depths greater than the ESA-listed species discussed herein are expected to occur and where ultraviolet light would not penetrate. Because the degradation of these materials would be very slow and the presence of the ESA-listed fish species at these depths is unlikely, the risk of ingestion of parachute or parafoil materials by ESA-listed fish would be very low and discountable.

Weather balloons would burst at an altitude of 12 to 19 mi (19 to 30 km) where temperatures can reach negative 40 ^{o}F and even colder. As discussed above, the balloon would undergo "brittle fracture", and shatter into pieces approximately the size of a quarter (Burchette 1989). These pieces would become dispersed over a broad area as they fall to the surface of the ocean. The balloon fragments would be positively buoyant, float on the surface, and degrade over approximately 6 weeks as they photo-oxidize due to UV light exposure (Burchette 1989). After several weeks, the pieces of latex would be smaller and become neutrally buoyant (Ye and Andrady 1991; Lobelle and Cunliffe 2011). Because of the small amount of latex material expended, the dispersion of fragments as they descend to the ocean, and their limited amount of time on the surface, and low densities of ESA-listed fish species in the Action Area, the risk of ingestion of weather balloon material is very low and discountable.

Therefore, the USSF has determined that ingestion stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed fish species because the potential impacts are discountable.

4.2.4 Ship Strike

Support vessels which would be used during first stage and fairing recovery activities have the potential to strike ESA-listed fish species at or near the surface of the water. Salmonids (steelhead and salmon) and green sturgeon are rarely at the surface; however, oceanic whitetip sharks and scalloped hammerheads do spend time at the surface of the water. Vessels do not normally collide with adult fish since most species are capable of detection and avoidance. One study found that most adult fish exhibit avoidance responses to engine noise (Jørgensen et al. 2004), reducing the potential for vessel strikes. Misund (1997) found that fishes ahead of a ship showed avoidance reactions at ranges of 160 – 490 ft. (49 – 149 m). The salmonid ESA-listed species can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009) and are likely to avoid collision with vessels. Larger fish, including, oceanic whitetip sharks and scalloped hammerheads, may be more susceptible to strikes; however, the support vessels would maintain average speeds of 10 knots or less, providing ample time for recognition and avoidance by ESA-listed fish species. Additionally, ESA-listed fish species occur at low densities in the action area. The probability of a strike would be further reduced by implementation of the EPMs, discussed in Section 2.2.4. As a result, the USSF has determined that strike stressors as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed fish species because the potential impacts are discountable

4.2.5 Indirect Effects

Secondary stressors from the Proposed Action could pose indirect impacts on fishes via habitat or prey. For this analysis, indirect impacts via water could not only cause physical impacts, but prey might also be impacted by the Proposed Action. For example, the impact of expended materials on the ocean surface might cause injury or induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity of the activity. The abundances of fish and invertebrate prey species could be diminished for a brief period of time before being repopulated by animals from adjacent waters. Secondary impacts such as these would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts under the Proposed Action would not result in a decrease in the quantity or quality of fish populations or fish habitats in the Action Area.

Therefore, the USSF has determined that indirect effects of the Proposed Action may affect, but are not likely to adversely affect ESA-listed fish species because the potential impacts are insignificant.

4.2.6 Cumulative Effects

Cumulative effects on the ESA-listed fish species considered in this BA are those effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the Action Area (50 C.F.R. Part 402.02). For purposes of this BA and cumulative effects analysis, the USSF identified broad categories of activities that could affect ESA-listed fish, including commercial fishing and harvest, maritime traffic, coastal land development, ocean pollution, ocean noise, and offshore energy development. Any impacts that might occur could be additive to behavioral disturbance, injury, and mortality associated with other actions within the Action Area. Therefore, this section evaluates risks posed by non-federal activities in the Action Area that could result in cumulative adverse effects on ESA-listed fish populations.

Fish populations can be influenced by various human activities. There can be direct effects from commercial and recreational activities such as fishing, or indirect effects from reductions in prey availability or lowered reproductive success of individuals. Human-made impacts are widespread throughout the world's oceans, such that very few habitats remain unaffected by human influence (Halpern et al. 2008). Direct and indirect effects have shaped the condition of marine fish populations, particularly those species with large body size, late maturity ages, or low fecundity.

As discussed above, ESA-listed fish could be affected by physical disturbance, strike stressors, entanglement stressors, and ingestion stressors. Some stressors could also result in injury or mortality to a relatively small number of individuals, but the likelihood of these effects is discountable. It is anticipated that the Proposed Action may affect, but is not likely to adversely affect ESA-listed fish species within the Action Area.

Aggregate impacts associated with the other actions could result in injury and mortality. Many of these actions and their associated cumulative effects on fish cannot be determined with any specificity or certainty at this time. However, it can reasonably be assumed that there may be fish that could be affected by these other actions, but no specific details are known regarding the impacts or effects to individuals or populations. The Proposed Action may result in injury and mortality to fish from strikes, but the likelihood of these impacts is discountable. Injury and mortality that might occur under the Proposed Action would be additive to injury and mortality associated with other actions. However, the relative contribution of the Proposed Action to the overall injury and mortality would be low compared to other actions for the following reasons: (1) any impacts from the Proposed Action resulting in injury or mortality are very unlikely and would be limited to a relatively small number of individuals, and (2) no population-level impacts are anticipated.

The contribution of the Proposed Action to cumulative impacts would still be discountable and insignificant based on the reasons presented above. The incremental contribution of the Proposed Action would be insignificant relative to other stressors from non-USSF activities (e.g., commercial fisheries).

4.2.7 Critical Habitat

As discussed in Section 3.1, there is no overlap of the activities under the Proposed Action and designated critical habitat in the Action Area. Therefore, the Proposed Action would have no effect on critical habitat for any ESA-listed fish species.

4.3 Sea Turtles

This section evaluates how, and to what degree, the activities described in Chapter 2 potentially impact ESA-listed sea turtles (green, loggerhead, olive ridley, hawksbill, and leatherback) occurring within the Action Area. The stressors considered for the ESA-listed sea turtles are:

- Physical disturbance and impacts by fallen objects
- Entanglement
- Ingestion
- Ship Strike
- Indirect Effects
- Cumulative Effects

The USSF has identified no interrelated or interdependent projects that would impact ESA-listed sea turtle species within the Action Area.

4.3.1 Physical Disturbance and Impacts by Fallen Objects

If a fairing or radiosonde struck a sea turtle, it could result in injury or death. Once within the water column, disturbance or strike from an item falling through the water is possible, but its velocity would be greatly reduced (reducing the potential for serious injury) and the falling object could potentially be avoided by marine species once detected. A low possibility exists that a sea turtle would be at or just under the surface in the impact area at the time of splashdown, but population-level impacts would not occur. In addition, ESA-listed sea turtles occur in very low densities throughout the proposed landing area (U.S. Department of the Navy 2017), therefore, the probability of a strike would be very unlikely and discountable.

Therefore, the USSF has determined physical disturbance and potential strike as a result of the Proposed Action would be discountable and may affect, but is not likely to adversely affect the ESA-listed sea turtles.

4.3.1 Entanglement

Unrecovered parafoils, parachutes, and weather balloons can potentially become entangled with ESA-listed sea turtles, causing injury or death. While individual turtles could encounter expended materials that may pose a risk of entanglement, the likelihood of entanglement is extremely small because: (1) the encounter rate for these expended materials is low, (2) there is restricted overlap with susceptible turtles, and (3) the physical characteristics of the expended materials reduce entanglement risk to sea turtles compared to abandoned fishing gear. For example, latex weather balloons burst after reaching its elastic limit at an altitude of 12 to 19 mi (19 to 30 km). The temperature at this altitude range can reach negative 40 ^{o}F and even colder. Under these conditions of extreme elongation and low temperature, the balloon undergoes "brittle fracture" where the rubber shatters along grain boundaries of crystallized segments. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989). The balloon fragments would be positively buoyant, float on the surface, and begin to photo-oxidize due to UV light exposure. In addition, unrecovered parafoils and parachutes would sink quickly through the water column, at 7 ft and 22 ft per minute, respectively, and settle (NMFS 2022b). These activities will typically occur far offshore in deep waters where they are not expected to be encountered by ESA-listed sea turtles potentially affected by the Proposed Action. Entanglement with parachutes, unrecovered parafoils, or weather balloons is therefore extremely unlikely and therefore the risk of entanglement is very low.

As a result, the USSF has determined that entanglement stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed sea turtle species because the potential impacts are discountable.

4.3.2 Ingestion Stressors

Pieces of weather balloons, parachutes, or parafoils may pose an ingestion stressor to ESA-listed sea turtles. Ingestion of expended materials by turtles could occur at or just below the surface, in the water column, or at the seafloor depending on the size and buoyancy of the expended object and the feeding behavior of the turtle. Floating material is more likely to be eaten by a turtle that is feeding at or just under the water's surface.

Parachutes and parafoils are made of nylon and Kevlar and thus do not degrade quickly. Photooxidation would break down nylon, however, the parachutes and parafoils would sink rapidly (discussed above) and settle on the ocean floor, typically far from shore at depths greater than the ESA-listed sea turtles discussed herein are expected to occur and where ultraviolet light would not penetrate. Because the degradation of these materials would be very slow and the presence of the ESA-listed sea turtle species at these depths is unlikely the risk of ingestion of parachute or parafoil materials by ESA-listed sea turtle would be very low and discountable.

Weather balloons would burst at an altitude of 12 to 19 mi (19 to 30 km) where temperatures can reach negative 40 ^{o}F and even colder. As discussed above, the balloon would undergo "brittle fracture", and shatter into pieces approximately the size of a quarter (Burchette 1989). These pieces would become dispersed over a broad area as they fall to the surface of the ocean. The balloon fragments would be positively buoyant, float on the surface, and degrade over approximately 6 weeks as they photo-oxidize due to UV light exposure (Burchette 1989). After several weeks, the pieces of latex would be smaller and become neutrally buoyant (Ye and Andrady 1991; Lobelle and Cunliffe 2011). Because of the small amount of latex material expended, the dispersion of fragments as they descend to the ocean, and their limited amount of time on the surface, and low densities of ESA-listed sea turtle in the action area, the risk of ingestion of weather balloon material is very low and discountable.

Therefore, the USSF has determined that ingestion stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed sea turtle species because the potential impacts are discountable.

4.3.3 Ship Strike

Support vessels which would be used during first stage and fairing recover activities have the potential to strike of ESA-listed sea turtles that are at or near the surface of the water. Any of the sea turtle species found in the action area can occur at or near the surface in open ocean, whether feeding or periodically surfacing to breathe. However, sea turtles spend a majority of their time submerged (Renaud and Carpenter 1994; Sasso and Witzell 2006). Leatherback turtles are more likely to feed at or near the surface in open ocean areas. Green, hawksbill, olive ridley, and loggerhead turtles forage along the sea floor and are more likely to forage nearshore, outside of the proposed landing area. ESA-listed sea turtles occur in low densities in the action area and are widespread and scattered at sea. Therefore, ship strikes of ESA-listed sea turtles would be very unlikely. Additionally, the probability of a strike would be further reduced by implementation of the EPMs, discussed in Section 2.2.4. As a result, the USSF has determined that strike stressors as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed sea turtle species because the potential impacts are discountable.

4.3.4 Indirect Effects

Indirect effects (secondary stressors) on sea turtles would mainly be associated with the occurrence and availability of prey species and impacts on habitat. For example, the impact of expended materials on the ocean surface might cause injury or induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity of the activity. The abundances of prey species could be diminished for a brief period of time before being repopulated by animals from adjacent waters. Secondary impacts such as these would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts under the Proposed Action would not result in a decrease in the quantity or quality of prey species populations or sea turtle habitats in the Action Area.

Therefore, the USSF has determined that indirect effects of the Proposed Action may affect, but are not likely to adversely affect ESA-listed sea turtles because the potential impacts are insignificant.

4.3.5 Cumulative Effects

Cumulative effects on sea turtle species are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the Action Area (50 C.F.R. Section 402.02). For the purposes of this BA and cumulative effects analysis for sea turtles, the USSF identified broad categories of activities including commercial fishing and harvest, maritime traffic and vessel strikes, coastal land development, ocean pollution, ocean noise, and offshore energy development. Any impacts that might occur could be additive to behavioral disturbance, injury and mortality associated with other actions within the Action Area. Therefore, this section evaluates risks posed by non-federal activities in the Action Area that could result in cumulative adverse effects on sea turtles.

Based on the listing status of the sea turtle species within the Action Area, there is a clear indication that the current aggregate impacts of past human activities are significant for sea turtles. Bycatch, vessel strikes, coastal land development, and ocean pollution are the leading causes of mortality and population decline for sea turtles. Any incidence of injury and mortality that might occur under the Proposed Action, though unlikely and would affect a relatively small number of individuals, could be additive to injury and mortality associated with other actions in the region of influence.

As discussed above, ESA-listed sea turtles could be affected by physical disturbance, strike stressors, entanglement stressors, and ingestion stressors. Some stressors could also result in injury or mortality to a relatively small number of individuals but the likelihood of these effects is discountable. It is anticipated that the Proposed Action may affect, but is not likely to adversely affect ESA-listed sea turtle species within the Action Area. Effects from the Proposed Action to sea turtle food sources would be insignificant. Likewise, the stressors under the Proposed Action generally would not overlap other stressors in space and time as they occur as dispersed, infrequent, and isolated events that do not last for extended periods.

It is possible that the response of a previously stressed animal to impacts associated with the Proposed Action could be more severe than the response of an unstressed animal, or impacts from the Proposed Action could make an individual more susceptible to other stressors. Likewise, the Proposed Action could contribute incremental stressors to individuals, which would both compound effects on a given individual already experiencing stress which may further stress populations in significant decline. Although the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on all sea turtle species in the Action Area, the Proposed Action is not likely to incrementally contribute to declines in sea turtle populations within the Action Area.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on all sea turtle species in the Action Area. The Proposed Action could contribute incremental stressors to individuals, which may further stress populations in significant decline. However, the incremental stressors anticipated from the Proposed Action would be insignificant in light of the relative contribution from the Proposed Action in comparison to other actions and because the Proposed Action generally will not overlap in space and time with other stressors. Therefore, it is anticipated that the Proposed Action may affect, but are not likely to adversely affect ESA-listed sea turtles within the Action Area.

4.4 Marine Mammals

This section evaluates how, and to what degree, the activities described in Chapter 2 potentially impact ESA-listed marine mammals (blue whale, fin whale, western north Pacific gray whale, humpback whale, killer whale, sei whale, sperm whale, and Guadalupe fur seal) occurring within the Action Area. The stressors considered for the ESA-listed marine mammals are:

- Physical disturbance and impacts by fallen objects
- Entanglement
- Ingestion

- Ship Strike
- In-air noise (Guadalupe fur seal only)
- Indirect Effects
- Cumulative Effects

The USSF has identified no interrelated or interdependent projects that would impact ESA-listed marine mammal species within the Action Area.

4.4.1 Physical Disturbance and Impacts by Fallen Objects

If a fairing or radiosonde struck an ESA-listed marine mammal, it could result in injury or death. Once within the water column, disturbance or strike from an unrecovered fairing or radiosonde falling through the water is possible, but its velocity would be greatly reduced (reducing the potential for serious injury) and the falling object could potentially be avoided by marine species once detected. A very low possibility exists that an ESA-listed marine mammal would be at or just under the surface in the impact area at the time of splashdown, but population-level impacts would not occur. In addition, ESA-listed marine mammals occur in very low densities throughout the proposed landing area (U.S. Department of the Navy 2017), therefore, the probability of a strike would be very unlikely and discountable.

4.4.2 Entanglement

Unrecovered parafoils, parachutes, and weather balloons can potentially become entangled with an ESA-listed marine mammals, causing injury or death. While individual whales could encounter expended materials that may pose a risk of entanglement, the likelihood of entanglement is extremely small because: (1) the encounter rate for these expended materials is low, (2) there is restricted overlap with susceptible marine mammals, and (3) the physical characteristics of the expended materials reduce entanglement risk to marine mammals compared to abandoned fishing gear. For example, latex weather balloons burst after reaching its elastic limit at an altitude of 12 to 19 mi (19 to 30 km). The temperature at this altitude range can reach negative 40 ^{o}F and even colder. Under these conditions of extreme elongation and low temperature, the balloon undergoes "brittle fracture" where the rubber shatters along grain boundaries of crystallized segments. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989). The balloon fragments would be positively buoyant, float on the surface, and begin to photo-oxidize due to UV light exposure. In addition, all parachutes and parafoils are meant to be recovered and they have been recovered during the majority of operations. Even if the parachutes or a parafoil are not recovered, they would sink quickly through the water column, at 7 ft and 22 ft per minute, respectively, and settle and spend a short time passing through the water column (NMFS 2022b). Considering the low occurrence of parachutes or parafoils not being recovered, the limited time they would spend in the water column, and settling typically in the deep ocean, entanglement with parachutes and unrecovered parafoils is therefore extremely unlikely and therefore the risk of entanglement is very low.

As a result, the USSF has determined that entanglement stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed marine mammal species because the potential impacts are discountable.

4.4.1 Ingestion Stressors

Pieces of weather balloons, parachutes, or parafoils may pose an ingestion stressor to ESA-listed marine mammals. Ingestion of expended materials by marine mammals could occur at or just below the surface, in the water column, or at the seafloor depending on the size and buoyancy of the expended object and the feeding behavior of the marine mammal. Floating material is more likely to be inadvertently infested marine mammal that is feeding at or just under the water's surface.

Parachutes and parafoils are made of nylon and Kevlar and thus do not degrade quickly. Photooxidation would break down nylon, however, the parachutes and parafoils would sink rapidly (discussed above) and settle on the ocean floor, typically far from shore at depths greater than the ESA-listed marine mammal species discussed herein are expected to occur and where ultraviolet light would not penetrate. Because the degradation of these materials would be very slow and the presence of foraging ESA-listed marine mammal species at these depths is unlikely the risk of ingestion of parachute or parafoil materials by ESA-listed marine mammals would be very low and discountable.

Weather balloons would burst after an altitude of 12 to 19 mi (19 to 30 km) where temperatures can reach negative 40 ^{o}F and even colder. As discussed above, the balloon would undergo "brittle fracture", and shatter into pieces approximately the size of a quarter (Burchette 1989). These pieces would become dispersed over a broad area as they fall to the surface of the ocean. The balloon fragments would be positively buoyant, float on the surface, and degrade over approximately 6 weeks as they photo-oxidize due to UV light exposure (Burchette 1989). After several weeks, the pieces of latex would be smaller and become neutrally buoyant (Ye and Andrady 1991; Lobelle and Cunliffe 2011). Because of the small amount of latex material expended, the dispersion of fragments as they descend to the ocean, and their limited amount of time on the surface, and low densities of ESA-listed marine mammals in the action area, the risk of ingestion of weather balloon material is very low and discountable.

Therefore, the USSF has determined that ingestion stressors introduced into the marine environment as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed marine mammal species because the potential impacts are discountable.

4.4.2 Ship Strike

Support vessels which would be used during first stage and fairing recover activities have the potential to strike of ESA-listed marine mammals that are at or near the surface of the water. ESA-listed marine mammals spend time at the surface, but most of their time is spent submerged. Average vessel speeds would be very low (less than 10 knots) and therefore striking a marine mammal would be unlikely (Tejedor et al. 2007; Conn & Silber 2013; Cates et al. 2020). There have been no reported ship strikes with ESA-listed marine mammals for similar operations, per reports provided to NMFS during ESA section 7 consultations (NMFS 2020). In addition, all support vessels would comply with the EPMs listed in Section 2.2.4 to reduce risk ship collisions with ESA-listed marine mammals. Ship strikes with ESA-listed marine mammals would therefore be considered extremely unlikely to occur and discountable. As a result, the USSF has determined that ship strike stressors as a result of the Proposed Action may affect, but are unlikely to adversely affect ESA-listed marine mammal species.

4.4.3 In Air Noise Effects on Guadalupe Fur Seal

As noted in Section 4.1, in-air noise caused by sonic boom and engine noise will not have an effect on ESA-listed sea turtles, cetacean species, nor marine mammals that are at sea. In-air noise may impact Guadalupe fur seals that are hauled out and these potential impacts are analyzed below.

Sonic boom modeling of the planned trajectories predicts a maximum sonic boom up to 5 psf infrequently impacting the NCI. Noise and visual disturbance can cause variable levels of disturbance to pinnipeds that may be hauled out within the areas of exposure, depending on the species exposed and the level of the sonic boom. Typical reactions range from no response to raising head and moving from a resting position to flushing to water. Behavioral reactions to noise can be dependent on relevance and association to other stimuli. A behavioral decision is made when an animal detects increased background noise, or possibly when an animal recognizes a biologically relevant sound. An animal's past experience with the sound-producing activity or similar acoustic stimuli can affect its choice of behavior. Competing and reinforcing stimuli may also affect its decision. Other stimuli present in the environment can influence an animal's behavior decision. These stimuli can be other acoustic stimuli not directly related to the sound-producing activity; they can be visual, olfactory, or tactile stimuli; the stimuli can be conspecifics or predators in the area; or the stimuli can be the strong drive to engage in a natural behavior.

Competing stimuli tend to suppress behavioral reactions. For example, an animal involved in mating or foraging may not react with the same degree of severity to acoustic stimuli as it may have otherwise. Reinforcing stimuli reinforce the behavioral reaction caused by acoustic stimuli. For example, awareness of a predator in the area coupled with the acoustic stimuli may illicit a stronger reaction than the acoustic stimuli itself otherwise would have. The visual stimulus of the sonic boom would not be coupled with the sonic boom since the vehicles would be at significant altitude when the overpressure impacts the NCI. This would decrease the likelihood and severity of a behavioral response. Guadalupe fur seals are relatively insensitive to disturbance, occur in low numbers at SMI in isolated locations, and are adept at jumping into the water in the event that they do flee from a disturbance (Harris 2015).

Noise resulting from the Proposed Action is not expected to cause more than a temporary startle-response in Guadalupe fur seals. Therefore, USSF determined that in-air noise as a result of the Proposed Action may affect, but is not likely to adversely affect the Guadalupe Fur Seal.

4.4.4 Indirect Effects

Potential indirect impacts on ESA-listed marine mammals may occur as a result of impacts on their habitat (sediment or water quality) or prey. Indirect impacts on marine mammals via sediment or water quality that do not require trophic transfer (e.g., bioaccumulation) to be observed are considered here. Information from investigations at Navy testing and training ranges and sites where munitions were disposed of at sea following the end of World War II indicates that even in a variety of areas having concentrated expended military materials, there has been no significant impact on the immediate vicinity or the wider area as a result of those materials being present (Environmental Sciences Group 2005; University of Hawaii & Environet 2010; University of Hawaii 2014; Koide et al. 2016; Kelley et al. 2016; Briggs et al. 2016). Based on those data sources, the Proposed Action is unlikely to pose indirect impacts on ESA-listed marine mammals via habitat or prey as a result of expended materials.

Therefore, the USSF has determined that indirect stressors introduced into the marine environment as a result of the Proposed Action insignificant and may affect, but are not likely to adversely affect the ESA-listed marine mammals.

4.4.5 Effects to Humpback Whale Critical Habitat

As noted above, the humpback whale is the only species analyzed in this BA that has designated critical habitat which overlaps the Action Area. Section 3.3.4.3 of this document lists primary constituent elements for the species, emphasizing prey, especially euphausids and small schooling fish). Similar to the potential impacts discussed for ESA-listed fish species, humpback whale prey may experience direct and indirect effects as a result of potential debris strike, entanglement, ingestion stressors, and indirect effects.

4.4.5.1 Physical Disturbance and Strike Stressors

Physical disturbance and strike stressors that may impact humpback whale prey species are primarily from expended materials. Expended materials have the potential to directly strike fish and invertebrates as they hit the water surface and below the surface to the point where the projectile loses its forward momentum. Only humpback whale prey species present at and just below the surface would be most susceptible to injury or death from strikes, because velocity of these materials would rapidly decrease upon contact with the water and as they travel through the water column. Consequently, most water column fishes and invertebrates would have ample time to detect and avoid approaching projectiles or fragments that fall through the water column. A possibility exists that a small number of fish and invertebrates at or just under the surface may be directly impacted if they are in the target area and near the point of physical impact at the time an object strikes the surface, but population-level impacts would not occur as a result.

If prey items are killed within humpback whale critical habitat, it is likely that only a low number of individuals representing a very small portion of prey species' populations would be killed. Other prey items would be available to humpback whales in the immediate area surrounding the activity or would return to the area after the activity is complete. Although some individual prey items may be killed, long-term consequences for fish and invertebrate populations and the effect on overall quantity, quality, and availability of prey items for humpback whales would be insignificant.

4.4.5.2 Ingestion Stressors

Ingestion of expended materials by humpback whale prey species could occur at or just below the surface, in the water column, or at the seafloor depending on the size and buoyancy of the expended object and the feeding behavior of the fish and invertebrates. Floating material is more likely to be eaten by species that feed at or just under the water's surface. Parachutes and parafoils are made of nylon and Kevlar and thus do not degrade quickly. Photooxidation would break down nylon, however, the parachutes and parafoils would sink rapidly (discussed above) and settle on the ocean floor, typically far from shore at depths greater than most humpback whale prey species are expected to occur and where ultraviolet light would not penetrate. Because the degradation of these materials would be very slow and the presence of the humpback whale prey species at these depths is unlikely the risk of ingestion of parachute or parafoil materials by humpback whale prey species would be very low and discountable

Weather balloons would burst after an altitude of 12 to 19 mi (19 to 30 km) where temperatures can reach negative 40 °F and even colder. As discussed above, the balloon would undergo "brittle fracture", and shatter into pieces approximately the size of a quarter (Burchette 1989). These pieces would become dispersed over a broad area as they fall to the surface of the ocean. The balloon fragments would be positively buoyant, float on the surface, and degrade over approximately 6 weeks as they photo-oxidize due to UV light exposure (Burchette 1989). After several weeks, the pieces of latex would be smaller and become neutrally buoyant (Ye and Andrady 1991; Lobelle and Cunliffe 2011). It is possible that expended small fragments on the seafloor could be colonized by seafloor organisms and mistaken for prey or that expended small fragments could be accidentally or intentionally eaten during foraging. However, very few individuals would be affected. Because of the small amount of latex material expended, the dispersion of fragments as they descend to the ocean, and their limited amount of time on the surface, the risk of ingestion of weather balloon material by humpback whale prey species is very low. Therefore, long-term consequences of ingestion stressors for fish and invertebrate populations and the effect on overall quantity, quality, and availability of prey items for humpback whales would be discountable.

4.4.5.3 Indirect Effects

Secondary stressors could pose indirect impacts on humpback whale prey species via habitat, prey, sediment, and water quality. For example, the abundances of fish and invertebrate prey species could be diminished for a short period of time at any debris impact locations before being repopulated by animals from adjacent waters. Secondary impacts such as these would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts under the Proposed Action would not result in a decrease in the quantity or quality of fish populations or fish habitats in the Action Area.

Secondary stressors can also involve impacts on habitat (sediment or water quality) or prey (i.e., impacting the availability or quality of prey) that have the potential to affect humpback whale prey species. Plastics could impact other species in the food web, including those that these species prey upon. Harmful chemicals in plastics interfere with metabolic and endocrine processes in many plants and animals (Derraik 2002). Potentially harmful chemicals in plastics are not readily adsorbed to marine sediments; instead, marine fishes would be most at risk via ingestion or bioaccumulation. Humpback whale prey species could be indirectly impacted by chemicals from plastics but, absent bioaccumulation, these impacts would be limited to direct contact with the material. In addition, as discussed in Section 4.4.5.2, ingestion of materials by humpback whale prey species is very unlikely. Because of these conditions, population-level impacts attributable to expended materials are likely to be insignificant and not detectable.

4.4.5.4 Conclusion

Given the frequency and short duration of the launch events and the relatively large number of prey items available throughout the critical habitat, we conclude that any impacts resulting from the Proposed Action on prey availability for the humpback whale would be discountable. In summary, although debris strike may result in injury and mortality to humpback whale prey species within critical habitat units, there would be no measurable impact on the occurrence of prey species of sufficient condition, distribution, diversity, abundance, and density necessary to support individual, as well as population growth, reproduction, and development of the Central America and Mexico DPSs. The effects of each potential stressor analyzed on the humpback whale prey species were found to be discountable. Therefore, the USSF has determined that the proposed action may affect, but is not likely to adversely affect critical habitat for the Central America and Mexico DPSs of humpback whales.

4.4.6 Cumulative Effects

Cumulative effects on ESA-listed marine mammals are those effects of future state or private activities, not involving federal activities, which are reasonably certain to occur within the Action Area (50 C.F.R. Section 402.02). For the purposed of this BA and cumulative effects analysis for ESA-listed marine mammals, the USSF identified broad categories of activities, including commercial fishing and harvest (including bycatch, hunting, and entanglement), maritime traffic and vessel strikes, ocean pollution, ocean noise, maritime debris, and ingestions. Any impacts that might occur could be additive to behavioral disturbance, injury and mortality associated with other actions within the Action Area. Therefore, this section evaluates risks posed by non-federal activities in the Action Area that could result in cumulative adverse effects on ESA-listed marine mammals.

If the health of an individual marine mammal were compromised, it is possible this condition could alter the animal's expected response to stressors associated with the Proposed Action. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by various factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, and social position. Synergistic impacts are also possible; for example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing (Fechter & Pouyatos 2005). While the response of a previously stressed animal might be different from the response of an unstressed animal, no data are available at this time that accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with the Proposed Action.

The Proposed Action could contribute incremental stressors to individuals, which would both further compound effects on a given individual already experiencing stress and in turn has the potential to further stress populations in significant decline or those that exhibit positive recovery trends within the Action Area. Although the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on ESA-listed marine mammals in the Action Area, the Proposed Action would be insignificant and is not likely to incrementally contribute to declines in ESA-listed marine mammal populations, reverse positive trends some marine mammals, or alter distributions of ESA-listed marine mammals.

5 Determination of Effects

Table 5.1-1 presents the DAF's overall effects determinations for ESA-listed species analyzed in this BA.

Table 5.1-1: Overall Species Effect Determinations Under the Proposed Action

Common Name	Distinct Population Segment or Evolutionarily Significant Units	ESA Status	Effect Determination
Steelhead	Southern California Coast	FE	NLAA
Chinook salmon	4 ESUs[1]	FT	NLAA
Coho salmon	2 ESUs[3]	FT	NLAA
Green sturgeon	Southern	FT	NLAA
Oceanic whitetip shark	-	FT	NLAA
Scalloped hammerhead shark	Eastern Pacific	FE	NLAA
Green sea turtle	East Pacific	FT	NLAA
Leatherback sea turtle	-	FE	NLAA
Olive ridley sea turtle	Mexico Pacific coast	FE	NLAA
Hawksbill sea turtle	-	FE	NLAA
Loggerhead turtle	North Pacific	FE	NLAA
Blue whale	-	FE	NLAA
Fin whale	-	FE	NLAA
Gray whale	Western North Pacific	FE	NLAA
Humpback whale	Mexico	FT	NLAA
	Central America	FE	
Humpback whale critical habitat	Mexico/Central America DPS	-	NLAA
Killer whale	Southern Resident	FE	NLAA
Sei whale	-	FE	NLAA
Sperm whale	-	FE	NLAA
Guadalupe fur seal	-	FT	NLAA

[1] Chinook salmon ESUs include California Coastal (FT), Central Valley Spring-Run (FT), Lower Columbia River (FT), and Sacramento River Winter-Run (FT)

[2] Coho salmon ESUs include Central California Coast (FT) and Southern Oregon and Northern California Coasts (FT).

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Appendix D Air Quality – Definition of Resource & Regulatory Requirements

D.1 Introduction

Air quality is primarily defined by atmospheric concentrations of specific air pollutants—pollutants the United States Environmental Protection Agency (USEPA) determined to be harmful to human health or welfare of the public. The six major air pollutants of concern, called "criteria pollutants," are carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead. The Clean Air Act requires that the USEPA establish National Ambient Air Quality Standards for these criteria pollutants. These standards set specific concentration limits for criteria pollutants in the outdoor air. The particular pollutants were chosen because they are common in outdoor air, considered harmful to public health and welfare, and come from numerous and diverse sources. The concentration limits are designed to aid in protecting public health and the environment. Areas with air pollution problems typically have one or more criteria pollutants consistently present at levels that exceed the National Ambient Air Quality Standards. These areas are designated as a nonattainment area for one of those standards, or a maintenance area when a former nonattainment area has recently achieved attainment for an air quality standard that was previously exceeded.

Criteria air pollutants are classified as either primary or secondary pollutants based on how they are formed in the atmosphere. Primary air pollutants are emitted directly into the atmosphere from the source of the pollutant and retain their chemical form. Examples of primary pollutants are the smoke produced by burning wood and volatile organic compounds emitted by industrial solvents. Secondary air pollutants are those formed through atmospheric chemical reactions that usually involve primary air pollutants (or pollutant precursors) and normal constituents of the atmosphere. Ozone, a major component of photochemical smog, is a secondary air pollutant. Ozone precursors, nitrogen oxides, and volatile organic compounds chemically react in the atmosphere in the presence of sunlight to form ground-level ozone. Some criteria air pollutants are a combination of primary and secondary pollutants. PM_{10} and $PM_{2.5}$ are generated as primary pollutants by various mechanical processes (e.g., abrasion, erosion, mixing, or atomization) or combustion processes. They are generated as secondary pollutants through chemical reactions or through the condensation of gaseous pollutants (e.g., nitrogen oxides, sulfur oxides, and volatile organic compounds) into fine aerosols.

In addition to the six criteria pollutants, the USEPA has designated 187 substances as hazardous air pollutants under the federal Clean Air Act. Hazardous air pollutants, also known as toxic air pollutants or air toxics, are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects (U.S. Environmental Protection Agency, 2016a). National Ambient Air Quality Standards are not established for these pollutants; however, the USEPA developed rules that limit emissions of hazardous air pollutants from specific industrial sources. These emissions control standards are known as "maximum achievable control technologies" and "generally achievable control technologies." They are intended to achieve the maximum degree of reduction in emissions of the hazardous air pollutants, taking into consideration the cost of emissions control, non-air-quality health and environmental impacts, and energy requirements. These emissions are typically one or more orders of magnitude smaller than concurrent emissions of criteria air pollutants. Hazardous air pollutants are analyzed qualitatively in relation to the prevalence of the sources emitting these pollutants during testing and training activities. In this analysis, hazardous air pollutants are not further evaluated because mobile sources associated with the Proposed Action would be functioning intermittently over a large area, and produce negligible ambient hazardous air pollutants in a localized area not located near any publicly accessible areas.

Most air pollutant emissions are expressed as a rate (e.g., pounds per hour, pounds per day, or tons per year). Typical units for emission factors for a source or source activity are pound per thousand gallons of fuel burned, pound per ton of material processed, and grams per vehicle-mile of travel. Ambient air quality is reported as the atmospheric concentrations of specific air pollutants at a particular time and location. The units of measure are expressed as a mass per unit volume (e.g., micrograms per cubic meter [$\mu g/m^3$] of air) or as a volume fraction (e.g., parts per million by volume). The ambient air pollutant concentrations measured at a particular location are determined by the pollutant emissions rate, local meteorology, and atmospheric chemistry. Wind speed and direction, the vertical temperature gradient of the atmosphere, and precipitation patterns affect the dispersal, dilution, and removal of air pollutant emissions from the atmosphere.

D.2 Air Quality Standards

The current National Ambient Air Quality Standards for criteria pollutants are set forth in Table D.2-1. Areas that exceed a standard are designated as “nonattainment” for that pollutant, while areas that are in compliance with a standard are in “attainment” for that pollutant. An area may be nonattainment for some pollutants and attainment for others simultaneously. Areas classified as attainment, after being designated as nonattainment, may be reclassified as maintenance areas subject to maintenance plans showing how the area will continue to meet federal air quality standards. Nonattainment areas for some criteria pollutants are further classified, depending upon the severity of their air quality problem, to facilitate their management:

- ozone—marginal, moderate, serious, severe, and extreme
- carbon monoxide—moderate and serious
- particulate matter—moderate and serious

In addition to the National Ambient Air Quality Standards, individual states are able to develop their own air quality standards that are more stringent than the federal standards. States, through their air quality management agencies, are required under the Clean Air Act to prepare a State Implementation Plan to demonstrate how the nonattainment and maintenance areas will achieve and maintain the National Ambient Air Quality Standards.

If the state fails to develop an adequate plan to achieve and maintain the National Ambient Air Quality Standards, or a State Implementation Plan revision is not approved by USEPA, the USEPA will impose a Federal Implementation Plan. States may also choose to adopt the Federal Implementation Plan as an alternative to developing their own State Implementation Plan. States may establish air quality standards more stringent than the National Ambient Air Quality Standards. Regardless of whether USEPA has approved a State Implementation Plan, federal entities have to comply with all federal, state, and local requirements respecting control and abatement of air pollution, as long as the requirements are not discriminatory. That is, they are treated like other regulated entities.

The Clean Air Act applies to coastal waters within 3 nautical miles (NM) of shore. The Point Mugu Sea Range (PMSR) Study Area includes areas that are unclassified as to the attainment status (including offshore areas outside of State waters (>3 NM), areas in federal waters (>3 NM but <12 NM), areas beyond federal waters (>12 NM), and areas that are classified as nonattainment areas (portions of South Central Coast Air Basin [Ventura County] and South Coast Air Basin [Los Angeles County]).

Table D.2-1: National Ambient Air Quality Standards

Pollutant		*Primary/ Secondary*	*Averaging Time*	*Level*	*Form*
Carbon monoxide		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead		primary and secondary	Rolling 3-month period	0.15 $\mu g/m^3$ [(1)]	Not to be exceeded
Nitrogen dioxide		primary	1 hour	100 parts per billion (ppb)	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb[2]	Annual mean
Ozone		primary and secondary	8 hours	0.070 ppm[3]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (particulate matter)	$PM_{2.5}$	primary	1 year	12.0 $\mu g/m^3$	Annual mean, averaged over 3 years
		secondary	1 year	15.0 $\mu g/m^3$	Annual mean, averaged over 3 years
		primary and secondary	24 hours	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur dioxide		primary	1 hour	75 ppb[4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

[1]In areas designated nonattainment for the lead standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 micrograms per cubic meter as a calendar quarter average) also remain in effect.
[2]The level of the annual nitrogen dioxide standard is 0.053 parts per million. It is shown here in terms of parts per billion for the purposes of clearer comparison to the 1-hour standard level.
[3]Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
[4]The previous sulfur dioxide standards (0.14 parts per million 24-hour and 0.03 parts per million annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet one year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous sulfur dioxide standards or is not meeting the requirements of a State Implementation Plan call under the previous sulfur dioxide standards (40 Code of Federal Regulations 50.4(3)). A State Implementation Plan call is a USEPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required National Ambient Air Quality Standards. Notes: $PM_{2.5}$ = Particulate matter less than 2.5 microns in diameter, PM_{10} = Particulate matter less than 10 microns in diameter, ppm = parts per million, $\mu g/m^3$ = micrograms per cubic meter
Source: (U.S. Environmental Protection Agency, 2016b), last updated January 7, 2016.

D.3 Approach to Analysis

The air quality impact evaluation for this action requires two separate analyses: the Clean Air Act (CAA) General Conformity Analysis and an analysis under NEPA. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in State waters (i.e., up to 3 nm from the coast) are assessed under the General Conformity Rule. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in U.S. territorial seas (i.e., up to 12 nm from the coast) are assessed under NEPA. Each coastal state may claim the territorial sea that extends seaward up to 12 nm from its shores and exercise sovereignty over its territorial sea, the air space above it, and the seabed and subsoil beneath it (National Oceanic and Atmospheric Administration [NOAA] 2017). The state jurisdictions may extend the full distance of territorial seas or may retain historical limits.

Air pollutants emitted more than 3,000 ft above ground level are considered to be above the atmospheric inversion layer (mixing layer) and, therefore, do not affect ground-level air quality (U.S. Environmental Protection Agency 1992). These emissions thus do not affect the concentrations of criteria air pollutants in the lower atmosphere, measured at ground-level monitoring stations, upon which federal, state, and local regulatory decisions are based. For the analysis of the effects on global climate change, however, all emissions of greenhouse gases from activities are applicable regardless of altitude.

D.4 General Conformity Evaluation

Attainment areas are not subject to the General Conformity Rule. The General Conformity analysis is separate and distinct from the NEPA analysis. Conformity is concerned with ensuring that non-permitted, non-stationary projects conform to the State Implementation Plan. The SEA analysis is concerned with whether an activity significantly affects the human environment. The two analyses are related in that an air impact that violates a State Implementation Plan is likely “significant” in NEPA terms. Section 176(c)(1) of the Clean Air Act (the General Conformity Rule), requires federal agencies to ensure that their actions conform to applicable implementation plans for achieving and maintaining the National Ambient Air Quality Standards (NAAQS) for criteria pollutants for nonattainment and maintenance areas. Federal actions are required to conform with the approved State Implementation Plan for areas of the U.S. designated as nonattainment or maintenance areas for any criteria air pollutant under the CAA (40 C.F.R. Parts 51 and 93). The General Conformity Rule ensures that applicable federal actions within areas regulated by the CAA would not cause or contribute to a violation of an air quality standard and that the Proposed Action would not adversely affect the attainment and maintenance of NAAQS. A conformity evaluation must be completed for every applicable action that generates emissions to determine and document whether a proposed action complies with the General Conformity Rule. Conformity only applies to nonattainment and maintenance areas for nonattainment and maintenance pollutants and their regulated precursors.

If a federal action is not an emergency response action presumed to conform under the Rule, a listed exempt activity, or covered by the Transportation Conformity Rule, then a Conformity Applicability Analysis must be performed. The Conformity Applicability Analysis involves calculating the non-exempt direct and indirect emissions associated with the action. If the Proposed Action is completely new, then the sum of the non-exempt direct and indirect emissions equals the net change in emissions (the current level would be zero). If the action is a change from a current level of emissions, then the current level is defined as the current environmental baseline conditions that future emissions are evaluated against. The net change is the difference between the emissions associated with the action and the current environmental baseline. The emissions thresholds that trigger conformity requirements are *de minimis* levels. The net change calculated for the direct and indirect emissions are compared to the *de minimis* levels published in the Conformity Rule. If the net change in emissions do not exceed *de minimis* thresholds, then a General Conformity Determination is not required. The emissions are presumed to conform to the State Implementation Plan. If the net change in emissions equal or exceed the *de minimis* conformity applicability threshold values, a formal Conformity Determination must be prepared to demonstrate conformity with the approved State Implementation Plan.

The General Conformity Rule air quality evaluation requires an analysis of impacts of air pollutants within state air quality jurisdictions. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in State waters (i.e., up to 3 nm from the coast) are assessed under the General Conformity Rule and under NEPA. Section 4.1 of this SEA provides a comparison of the emissions within 3 nm of the coastline of nonattainment areas in the Study Area.

A Record of Non-Applicability must be prepared if the Proposed Action is subject to the General Conformity Rule, but exempt because it is exempt under categories listed in 40 C.F.R. 93B, because the action's projected emissions are below the *de minimis* conformity applicability threshold values, or because the action is presumed to conform. The *de minimis* levels for nonattainment and maintenance pollutants under the General Conformity Rule are shown in Table D-1.

Table D-1. *De Minimis* Thresholds for Conformity Determinations

Pollutant	***Nonattainment or Maintenance Area Type***	***de minimis Threshold (TPY)***
Ozone (VOC or NO_X)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_X)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
CO, SO_2 and NO_2	All nonattainment and maintenance	100
PM_{10}	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
$PM_{2.5}$	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
Lead (Pb)	All nonattainment and maintenance	25

Notes: CO = carbon monoxide, NO_X = nitrogen oxides, NO_2 = nitrogen dioxide, PM_{10} = particulate matter ≤ 10 microns in diameter, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, SO_2 = sulfur dioxide, SO_X =sulfur oxides, TPY = tons per year, VOC = volatile organic compound

Source: U.S. Environmental Protection Agency, 2010b

D.5 NEPA Evaluation

Health-based air quality impacts under NEPA are analyzed using estimates of criteria air pollutants for activities operating at or below the inversion layer or that involve vessels in U.S. territorial seas. Agencies must project the future emissions in the action area versus the future emissions without the action (i.e., the no action alternative). The total direct and indirect emissions consider all emission increases and decreases that are reasonably foreseeable and possibly controllable through agency's continuing program responsibility to affect emissions.

For nonattainment and maintenance criteria pollutants, the conformity *de minimis* levels are useful as NEPA analysis screening thresholds to determine significance. For these pollutants, the General Conformity "*de minimis*" thresholds are identical to "major source" thresholds applicable to new stationary sources under the federal CAA. As such, they represent reasoned decisions under two regulatory programs as quantities that represent thresholds of increased concern. The thresholds are lowered as the air quality of a nonattainment or maintenance area worsens.

The Prevention of Significant Deterioration (PSD) Program was adopted in the CAA under 40 C.F.R. § 52.21. The PSD Program applies to major stationary sources of air pollutants located in attainment areas, requiring that a source demonstrate that it does not significantly deteriorate the air quality in attainment areas. Under PSD, a "major source" is defined as a facility that emits ≥250 tons of a criteria pollutant or regulated precursor. In attainment areas, the major emitting facility threshold of 250 tons per year is the threshold of increased concern; therefore, this threshold is also a suitable screening threshold of significance in NEPA.

D.6 Greenhouse Gases

Greenhouse gases are compounds that contribute to the greenhouse effect—a natural phenomenon in which gases trap heat in the lowest layer of the earth's atmosphere (surface-troposphere system), causing heating (radiative forcing) at the surface of the earth. The primary long-lived greenhouse gases directly emitted by human activities are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride. Carbon dioxide, methane, and nitrous oxide occur naturally in the atmosphere. These gases influence global climate by trapping heat in the atmosphere that would otherwise escape to space. The heating effect of these gases is considered the probable cause of the global warming observed over the last 50 years (U.S. Environmental Protection Agency, 2009b). Global warming and climate change affects many aspects of the environment. Not all effects of greenhouse gases are related to climate. For example, elevated concentrations of carbon dioxide can lead to ocean acidification and stimulate terrestrial plant growth, and methane emissions can contribute to higher ozone levels.

The administrator of the USEPA determined that greenhouse gases in combination endanger both the public health and the public welfare of current and future generations. The USEPA specifically identified carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride as greenhouse gases (U.S. Environmental Protection Agency, 2009c) (74 Federal Register 66496).

To estimate global warming potential, the United States quantifies greenhouse gas emissions using the 100-year timeframe values established in the Intergovernmental Panel on Climate Change Fifth Assessment Report (Intergovernmental Panel on Climate Change, 2014), in accordance with United Nations Framework Convention on Climate Change (United Nations Framework Convention on Climate

Change, 2013) reporting procedures. All global warming potentials are expressed relative to a reference gas, carbon dioxide, which is assigned a global warming potential equal to 1. Six other primary greenhouse gases have global warming potentials of 25 for methane, 298 for nitrous oxide, 124 to 14,800 for hydrofluorocarbons, 7,390 to greater than 17,340 for perfluorocarbons, 17,200 for nitrogen trifluoride, and up to 22,800 for sulfur hexafluoride. To estimate the carbon dioxide equivalency of a non-carbon dioxide greenhouse gas, the appropriate global warming potential of that gas is multiplied by the amount of the gas emitted. All seven greenhouse gases are multiplied by their global warming potential, and the results are added to calculate the total equivalent emissions of carbon dioxide. The dominant greenhouse gas emitted is carbon dioxide, mostly from fossil fuel combustion (85.4 percent) (U.S. Environmental Protection Agency, 2015). Weighted by global warming potential, methane is the second-largest component of emissions, followed by nitrous oxide. Global warming potential-weighted emissions are presented in terms of equivalent emissions of carbon dioxide, using units of metric ton. The Proposed Action is anticipated to release greenhouse gases to the atmosphere. These emissions are quantified primarily using methods elaborated upon in the Inventory of *U.S. Greenhouse Gas Emissions and Sinks: 1990–2017* for the proposed activities.

D.7 Summary Tables

D.7.1 Baseline Criteria Pollutants

	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
Activity	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Launch	0.0000	1.3004	0.0000	0.0000	0.0000	-	-	-	-	-
Boostback (offshore)	-	-	-	-	-	-	-	-	-	-
Boostback (VFSB)	0.0000	0.0565	0.0000	0.0000	0.0000	-	-	-	-	-
Static Fire	0.0000	0.3958	0.0000	0.0000	0.0000	-	-	-	-	-
Booster Recovery	0.0166	0.0393	0.0078	0.0060	0.0029	0.0364	0.0866	0.0171	0.0133	0.0063
Fairing Recovery	0.0072	0.0169	0.0034	0.0027	0.0012	0.0157	0.0372	0.0075	0.0058	0.0027
Daily Operations - Worker transits	0.4019	0.0340	0.0624	0.0007	0.0036	-	-	-	-	-
Vendor Deliveries (RP-1)	0.8585	0.9132	0.1949	0.0041	0.0293	-	-	-	-	-
Vendor Deliveries (LN2)	0.4166	0.4280	0.0931	0.0019	0.0139	-	-	-	-	-
Vendor Deliveries (LOX)	0.3749	0.3865	0.0838	0.0017	0.0125	-	-	-	-	-
Vendor Deliveries (Helium)	0.1393	0.1506	0.0318	0.0007	0.0485	-	-	-	-	-
Generator	0.0029	0.0044	0.0011	0.0009	0.0010	-	-	-	-	-
Generator #2	0.0026	0.0038	0.0009	0.0008	0.0008	-	-	-	-	-
Generator #3	0.0050	0.0075	0.0018	0.0015	0.0016	-	-	-	-	-
Generators #4	0.0335	0.1261	0.0035	0.0001	0.0039	-	-	-	-	-
	2.2149	**3.7212**	**0.4773**	**0.0178**	**0.1119**	**0.0522**	**0.1238**	**0.0246**	**0.0191**	**0.0089**

D.7.2 Baseline Criteria Pollutants by Air District

	Total Emissions (tons) Santa Barbara County APCD					Total Emissions (tons) Ventura County APCD					Total Emissions (tons) South Coast AQMD				
Activity	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Launch	0.0000	1.3004	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Boostback (VFSB)	0.0000	0.0565	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Static Fire	0.0000	0.3958	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Booster Recovery	-	-	-	-	-	-	-	-	-	-	0.0166	0.0393	0.0078	0.0060	0.0029
Fairing Recovery	-	-	-	-	-	-	-	-	-	-	0.0072	0.0169	0.0034	0.0027	0.0012
Daily Operations - Worker transits	0.4019	0.0340	0.0624	0.0007	0.0036	-	-	-	-	-	-	-	-	-	-
Vendor Deliveries (RP-1)	0.0379	0.0403	0.0086	0.0002	0.0013	0.0213	0.0227	0.0048	0.0001	0.0007	0.0308	0.0328	0.0070	0.0001	0.0011
Vendor Deliveries (LN2)	0.1709	0.1756	0.0382	0.0008	0.0057	0.0961	0.0988	0.0215	0.0004	0.0032	0.1495	0.1536	0.0334	0.0007	0.0050
Vendor Deliveries (LOX)	0.1538	0.1586	0.0344	0.0007	0.0051	0.0865	0.0892	0.0193	0.0004	0.0029	0.1346	0.1388	0.0301	0.0006	0.0045
Vendor Deliveries (Helium)	0.0083	0.0090	0.0019	0.0000	0.0029	0.0047	0.0051	0.0011	0.0000	0.0016	0.0068	0.0073	0.0015	0.0000	0.0024
Generator	0.0029	0.0044	0.0011	0.0009	0.0010	-	-	-	-	-	-	-	-	-	-
Generator #2	0.0026	0.0038	0.0009	0.0008	0.0008	-	-	-	-	-	-	-	-	-	-
Generator #3	0.0050	0.0075	0.0018	0.0015	0.0016	-	-	-	-	-	-	-	-	-	-
Generators #4	0.0335	0.1261	0.0035	0.0001	0.0039	-	-	-	-	-	-	-	-	-	-
	0.7729	**2.1702**	**0.1455**	**0.0024**	**0.0186**	**0.2087**	**0.2157**	**0.0467**	**0.0010**	**0.0085**	**0.3454**	**0.3887**	**0.0833**	**0.0102**	**0.0170**

D.7.3 Baseline Greenhouse Gas Emissions

Activity	Type	Total Emissions (tons) CO2e
Launch	Rocket	5419.4000
Boostback	Rocket	2167.7531
Static Fire	Rocket	361.2000
Booster Recovery	Vessel Support	0.0000
Fairing Recovery	Vessel Support	0.0000
Daily Operations - Worker transits	Land Activities	66.7333
Vendor Deliveries (RP-1)	Land Activities	407.2667
Vendor Deliveries (LN2)	Land Activities	193.8333
Vendor Deliveries (LOX)	Land Activities	174.4333
Vendor Deliveries (Helium)	Land Activities	66.7667
Generator	Land Activities	0.5000
Generator #2	Land Activities	0.4000
Generator #3	Land Activities	0.9000
Generator #4	Land Activities	6.5000
	TOTAL	**8865.6864**

D.7.4 Alternative 1 Criteria Pollutants

		Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)					Total Emissions (tons) (>12 nm)				
Activity	Type	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Launch	Rocket	0.0000	3.9011	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Boostback (offshore)	Rocket	-	-	-	-	-	-	-	-	-	-	0.0000	0.6785	0.0000	0.0000	0.0000
Boostback (VFSB)	Rocket	0.0000	0.3392	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Static Fire	Rocket	0.0000	1.1873	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Booster Recovery	Vessel Support	0.0497	0.0974	0.0066	0.0051	0.0023	0.1093	0.2142	0.0146	0.0113	0.0052	7.2044	12.9686	0.8793	0.6802	0.3119
Fairing Recovery	Vessel Support	0.0215	0.0508	0.0103	0.0080	0.0036	0.0472	0.1117	0.0226	0.0175	0.0080	2.8521	6.7413	1.3651	1.0560	0.4842
RORO (Ocean Transport)	Vessel Support	0.2333	1.4834	0.1173	0.0683	0.0341	0.3500	2.2250	0.1760	0.1024	0.0511	11.8224	55.4481	7.1956	4.1859	2.0910
RORO (Land Transport)	Land Activities	0.0228	0.0314	0.0046	0.0001	0.0014	-	-	-	-	-	-	-	-	-	-
Booster Transports	Land Activities	0.8063	0.8577	0.1831	0.0038	0.0276	-	-	-	-	-	-	-	-	-	-
Solvent Use	Land Activities	-	-	7.4200	-	-										
Daily Operations - Worker transits	Land Activities	1.2057	0.1020	0.1872	0.0021	0.0107	-	-	-	-	-	-	-	-	-	-
Vendor Deliveries (RP-1)	Land Activities	2.5754	2.7395	0.5848	0.0122	0.0880	-	-	-	-	-	-	-	-	-	-
Vendor Deliveries (LN2)	Land Activities	1.2498	1.2839	0.2794	0.0058	0.0417	-	-	-	-	-	-	-	-	-	-
Vendor Deliveries (LOX)	Land Activities	1.1248	1.1596	0.2515	0.0052	0.0376	-	-	-	-	-	-	-	-	-	-
Vendor Deliveries (Helium)	Land Activities	0.4178	0.4517	0.0955	0.0020	0.1454	-	-	-	-	-	-	-	-	-	-
Generator	Land Activities	0.0029	0.0044	0.0011	0.0009	0.0010	-	-	-	-	-	-	-	-	-	-
Generator #2	Land Activities	0.0026	0.0038	0.0009	0.0008	0.0008	-	-	-	-	-	-	-	-	-	-
Generator #3	Land Activities	0.0050	0.0075	0.0018	0.0015	0.0016	-	-	-	-	-	-	-	-	-	-
Generator #4	Land Activities	0.0335	0.1261	0.0035	0.0001	0.0039	-	-	-	-	-	-	-	-	-	-
	TOTAL	**7.7511**	**13.8268**	**9.1476**	**0.1158**	**0.4000**	**0.5065**	**2.5509**	**0.2132**	**0.1312**	**0.0643**	**21.8789**	**75.8364**	**9.4401**	**5.9221**	**2.8871**

D.7.5 Alternative 1 Criteria Pollutant by Air District

		Total Emissions (tons) Santa Barbara County APCD					Total Emissions (tons) Ventura County APCD					Total Emissions (tons) South Coast AQMD				
Activity	Type	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Launch	Rocket	0.0000	3.9011	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Boostback (VFSB)	Rocket	0.0000	0.3392	0.0000	0.0000	0.0000	-	-	-	-	-	-	-	-	-	-
Static Fire	Rocket	0.0000	1.1873	0.0000	0.0000	0.0000	-	-	-	-	-	0.0497	0.0974	0.0066	0.0051	0.0023
Booster Recovery	Vessel Support	-	-	-	-	-	-	-	-	-	-	0.0215	0.0508	0.0103	0.0080	0.0036
Fairing Recovery	Vessel Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RORO (Ocean Transport)	Vessel Support	0.1167	0.7417	0.0587	0.0341	0.0170	-	-	-	-	-	0.1167	0.7417	0.0587	0.0341	0.0170
RORO (Land Transport)	Land Activities	0.0228	0.0314	0.0046	0.0001	0.0014	-	-	-	-	-	0.0000	0.0000	0.0000	0.0000	0.0000
Booster Transports	Land Activities	0.3909	0.4158	0.0888	0.0019	0.0134	0.2199	0.2339	0.0499	0.0010	0.0075	0.1955	0.2079	0.0444	0.0009	0.0067
Solvent Use	Solvents	-	-	7.4200	-	-						-	-	-	-	-
Daily Operations - Worker transits	Land Activities	1.2057	0.1020	0.1872	0.0021	0.0107	-	-	-	-	-	-	-	-	-	-
Vendor Deliveries (RP-1)	Land Activities	0.1137	0.1210	0.0258	0.0005	0.0039	0.0640	0.0680	0.0145	0.0003	0.0022	0.0924	0.0983	0.0210	0.0004	0.0032
Vendor Deliveries (LN2)	Land Activities	0.5127	0.5267	0.1146	0.0024	0.0171	0.2884	0.2963	0.0645	0.0013	0.0096	0.4486	0.4609	0.1003	0.0021	0.0150
Vendor Deliveries (LOX)	Land Activities	0.4615	0.4757	0.1032	0.0021	0.0154	0.2596	0.2676	0.0580	0.0012	0.0087	0.4038	0.4163	0.0903	0.0019	0.0135
Vendor Deliveries (Helium)	Land Activities	0.0250	0.0271	0.0057	0.0001	0.0087	0.0141	0.0152	0.0032	0.0001	0.0049	0.0203	0.0220	0.0046	0.0001	0.0071
Generator	Land Activities	0.0029	0.0044	0.0011	0.0009	0.0010	-	-	-	-	-	-	-	-	-	-
Generator #2	Land Activities	0.0026	0.0038	0.0009	0.0008	0.0008	-	-	-	-	-	-	-	-	-	-
Generator #3	Land Activities	0.0050	0.0075	0.0018	0.0015	0.0016	-	-	-	-	-	-	-	-	-	-
Generator #4	Land Activities	0.0335	0.1261	0.0035	0.0001	0.0039	-	-	-	-	-	-	-	-	-	-
	TOTAL	**2.8931**	**8.0109**	**8.0159**	**0.0466**	**0.0951**	**0.8459**	**0.8811**	**0.1902**	**0.0040**	**0.0329**	**1.3484**	**2.0951**	**0.3361**	**0.0526**	**0.0684**

D.7.6 Alternative 1 Greenhouse Gas Emissions

		Total Emissions (tons)
Activity	Type	CO2e
Launch	Rocket	13935.6000
Boostback (offshore)	Rocket	5574.2222
Static Fire	Rocket	928.8000
Booster Recovery	Vessel Support	4464.7909
Fairing Recovery	Vessel Support	25.9144
RORO (Ocean Transport)	Vessel Support	2.7201
RORO (Land Transport)	Land Activities	5.7000
Rocket Delivery form Hawthorne	Land Activities	382.8000
Daily Operations - Worker transits	Land Activities	200.2000
Vendor Deliveries (RP-1)	Land Activities	1221.8000
Vendor Deliveries (LN2)	Land Activities	581.5000
Vendor Deliveries (LOX)	Land Activities	523.3000
Vendor Deliveries (Helium)	Land Activities	200.3000
Generator	Land Activities	0.5000
Generator #2	Land Activities	0.4000
Generator #3	Land Activities	0.9000
Generator #4	Land Activities	6.5000
	TOTAL	**28055.9477**

D.7.7 Launch, Landing, and Static Fire

D.7.7.1 Launch, Landing, and Static Fire Criteria Pollutants

Inputs					Emission Factors						Outputs					
			<3,000ft		Pounds emitted per burn second						Tons emitted per launch					
Type	Stage	Fuel	Burn time (s)	Number of engines	CO	NOx	VOC	SOx	PM2.5	PM10	CO	NOx	VOC	SOx	PM2.5	PM10
Launch	1	RP1/LOX	23	9	0.00	9.423	0.00	0.00	0.00	0.00	0.000	0.108	0.000	0.000	0.000	0.000
Landing	1	RP1/LOX	18	3	0.00	3.141	0.00	0.00	0.00	0.00	0.000	0.028	0.000	0.000	0.000	0.000
Static Fire	1	RP1/LOX	7	9	0.00	9.423	0.00	0.00	0.00	0.00	0.000	0.033	0.000	0.000	0.000	0.000
										Totals	**0.000**	**0.170**	**0.000**	**0.000**	**0.000**	**0.000**

Draft Environmental Assessment for SpaceX Falcon Launches at Kennedy Space Center and Cape Canaveral Air Force Station, February 2020					
Pounds emitted per second (per engine)					
Propellant	CO	NOx	VOCs	SOx	PM
RP-1 or Kerosene or Jet A/LOX	0	1.047	0	0	0

NOTES

Launch emissions include fuel spent up to 3,000 ft AGL

Landing Emissions include all intermittent burns below 3,000 AGL

Launch is assumed to reach mixing layer within 21 seconds

Static Fire assumes all 9 engines with a 7 second burn time

Per Draft Environmental Assessment for SpaceX Falcon Launches at Kennedy Space Center and Cape Canaveral Air Force Station, February 2020

NO emission is predicted to be 1.047 lbm/s under nominal power (100%) operation.

Landing emissions assued to be 33% of nominal power (only 3 engines used)

D.7.7.1.1 Launch, Landing, and Static Fire Baseline

Activity	Annual Activities	Total Emissions (tons) (<3 nm)				
		CO	Nox	VOCs	Sox	PM
Launch	12	0.000	1.300	0.000	0.000	0.000
Landing (Offshore)	10	-	-	-	-	-
Landing (@ VFSB)	2	0.000	0.057	0.000	0.000	0.000
Static Fire	12	0.000	0.396	0.000	0.000	0.000
	TOTALS	**0.000**	**1.753**	**0.000**	**0.000**	**0.000**

D.7.7.1.2 Launch, Landing, and Static Fire Proposed Action

Activity	Annual Activities	Total Emissions (tons) (<3 nm)				
		CO	Nox	VOCs	Sox	PM
Launch	36	0.000	3.901	0.000	0.000	0.000
Landing (Offshore)	24	-	-	-	-	-
Landing (@ VFSB)	12	0.000	0.339	0.000	0.000	0.000
Static Fire	36	0.000	1.187	0.000	0.000	0.000
	TOTALS	**0.000**	**5.428**	**0.000**	**0.000**	**0.000**
		0.000	**5.428**	**0.000**	**0.000**	**0.000**

D.7.8 Greenhouse Gases

# of Launches	Metric Tons CO2e per year	Metric Tons Per Launch
60	23226	387.1

Landings	Tons CO2e	Per Landing
81	12542	154.8

Static Fires (	Tons Per second of burn	Metric Tons Per Static Fire
7	3.6857143	25.8

Type	Fuel	CO2e / event
Launch	RP1/LOX	387.100
Landing	RP1/LOX	154.840
Static Fire	RP1/LOX	25.800

NOTES:

Launch emissions include fuel spent up to 100,000 ft MSL (approximately 105 seconds)

Landing Emissions include all intermittent burns below 100,000 ft MSL

Environmental Assessment for SpaceX Falcon Launches at Kennedy Space Center and Cape Canaveral Air Force Station, February 2020 used to determine CO2e per launch or landing

D.7.9 Booster Recovery Operations

D.7.9.1 Booster Recovery Operations Criteria Pollutants

Type	Operations (b)	Ship Time on Range (hrs) (e)	Engines and Generators		Ave. Speed (Knots)	Power Level (%) or horsepower	Emissions Factors g/kWh					Emissions Factors lb/hr				
		Hours	No.	Load			CO	NOx	VOCs	SOx	PM10	CO	NOx	VOCs	SOx	PM10
Tugboat	12	68	0	0	8.5	633.845	1.1	2.6	0.5265	0.407275	0.18674	1.537126	3.633207	0.735724	0.569121	0.260948
	12	68	0	0	8.5	61.4904	1.1	2.6	0.5265	0.407275	0.18674	0.149119	0.352464	0.071374	0.055211	0.025315
Support Boat	12	68	0	0	8.5	1454.12	1.1	2.6	0.5265	0.407275	0.18674	3.526348	8.335005	1.687838	1.30563	0.598646
	12	68	0	0	8.5	52.7061	1.1	2.6	0.5265	0.407275	0.18674	0.127817	0.302112	0.061178	0.047324	0.021699
Barge	12	12	0	0	8.5	1163.29	1.1	2.6	0.5265	0.407275	0.18674	2.821078	6.668004	1.350271	1.044504	0.478917
	12	68	1	0.6	NA	89.484	0.9	2.5	0.18	0.16	0.22	0.17755	0.493196	0.03551	0.031565	0.043401

NOTES:

Assuming ALL VESSELS TIER 3

Emissions Factor source:

Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Go

The project would operate from Guadalupe Island to the Port of Long Beach (APPROX 29

Assumes average transit speed of 8.5 knots

EF_{SOx} = BSFC * Sact * FSC * MWR (Eq 3.5)

BFSC (SSD)	185
BFSC (MSD)	205
Sact	0.001
FSC	0.993353
MWR	2
EF_{SOx} (SSD)	0.367541
EFSOx (MSD)	0.407275

EF_{PM10} = Pmbase + (Sact * BFSC * FSC * MWR) [Eq 3.3

PMBAse	0.1545
Sact	0.001
BFSC (SSD)	185
BFSC (MSD)	205
FSC	0.02247
MWR	7
EF_{PM10} (SSD)	0.18360
EF_{PM10} (MSD)	0.18674

D.7.9.1.1 Booster Recovery Operations Baseline

Type	Operations (b)	Ship Time on Range (hrs) (e)	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
			CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Tugboat	12	68	0.00461	0.01090	0.00221	0.00171	0.00078	0.01015	0.02398	0.00486	0.00376	0.00172
	12	68	0.00045	0.00106	0.00021	0.00017	0.00008	0.00098	0.00233	0.00047	0.00036	0.00017
Support Boat	12	68	0.01058	0.02501	0.00506	0.00392	0.00180	0.02327	0.05501	0.01114	0.00862	0.00395
	12	68	0.00038	0.00091	0.00018	0.00014	0.00007	0.00084	0.00199	0.00040	0.00031	0.00014
Barge	12	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	12	68	0.00053	0.00148	0.00011	0.00009	0.00013	0.00117	0.00326	0.00023	0.00021	0.00029
			0.0166	**0.0393**	**0.0078**	**0.0060**	**0.0029**	**0.0364**	**0.0866**	**0.0171**	**0.0133**	**0.0063**

D.7.9.1.2 Booster Recovery Operations Proposed Action

Type	Operations (b)	Ship Time on Range (hrs) (e)	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
			CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Tugboat	36	68	0.01383	0.03270	0.00662	0.00512	0.00235	0.03044	0.07194	0.01457	0.01127	0.00517
	36	68	0.00134	0.06300	0.00000	0.00000	0.00000	0.00295	0.13860	0.00000	0.00000	0.00000
Support Boat	36	68	0.03174	0.00000	0.00000	0.00000	0.00000	0.06982	0.00000	0.00000	0.00000	0.00000
	36	68	0.00115	0.00165	0.00000	0.00000	0.00000	0.00253	0.00364	0.00000	0.00000	0.00000
Barge	36	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	36	68	0.00160	0.00000	0.00000	0.00000	0.00000	0.00352	0.00000	0.00000	0.00000	0.00000
			0.0497	**0.0974**	**0.0066**	**0.0051**	**0.0023**	**0.1093**	**0.2142**	**0.0146**	**0.0113**	**0.0052**

D.7.9.2 Booster Recovery Operations Greenhouse Gases Baseline

Type	Operations	Ship Time on Range (hrs)	Engines and Generators							Ave. Speed (Knots)	Power Level (%) or horsepower	Emissions Factors (g/kWh)			Emissions Factors (lb/hr)			Emissions (tons)			
			Propulsion	Engine Rating (HP)	Load	No.	Generator	No.	Load			CO2	CH4	N20	CO2	CH4	N20	CO2	CH4	N20	CO2e
Tugboat	12	68	Tier 3 - Main	850	0.5	2	None	0	0	8.5	633.845	656.123	0.01	0.029	914.9366	0.0139	0.0404	374.5858	0.0057	0.0166	379.6795
	12	68	Tier 3 - Auxillary	133	0.31	2	None	0	0	8.5	61.490422	656.123	0.01	0.029	88.7596	0.0014	0.0039	36.3392	0.0006	0.0016	36.8334
Support Boat	12	68	Tier 3 - Main	3900	0.5	1	None	0	0	8.5	1454.115	656.123	0.01	0.029	2098.9723	0.0320	0.0928	859.3439	0.0131	0.0380	871.0293
	12	68	Tier 3 - Auxillary	114	0.31	2	None	0	0	8.5	52.706076	656.123	0.01	0.029	76.0797	0.0012	0.0034	31.1479	0.0005	0.0014	31.5715
Barge	12	12	2600 HP (~1920 kW - MSD)	2600	0.6	1		0	0	8.5	1163.292	656.123	0.01	0.029	1679.1778	0.0256	0.0742	120.9008	0.0018	0.0053	122.5448
	12	68					200 kW w/9	1	0.6	NA	89.484	568.299	0.025	0.031	111.8781	0.0049	0.0061	45.8042	0.0020	0.0025	46.6052

Assume Marine Diesel Oil (MDO) and medium speed diesel (MSD) in USEPA 2009

Equation 3.4

EF_{CO2} = BSFC x CCF EF_{CO2}

CCF = 3.2006 656.123 MSD

BSFC(SSD) = 185

BSFC (MSD)=205

D.7.9.2.1 Booster Recovery Operations Greenhouse Gases Proposed Action

Type	Operations	Ship Time on Range (hrs)	Engines and Generators							Ave. Speed (Knots)	Power Level (%) or horsepower	Emissions (tons)			
			Propulsion	Engine Rating (HP)	Load	No.	Generator	No.	Load			CO2	CH4	N20	CO2e
Tugboat	36	68	Tier 3 - Main	850	0.5	2	None	0	0	8.5	633.845	1123.75745	0.017127	0.049669	1139.04
	36	68	Tier 3 - Auxillary	133	0.31	2	None	0	0	8.5	61.490422	109.017693	0.001662	0.004818	110.5
Support Boat	36	68	Tier 3 - Main	3900	0.5	1	None	0	0	8.5	1454.115	2578.0318	0.039292	0.113947	2613.09
	36	68	Tier 3 - Auxillary	114	0.31	2	None	0	0	8.5	52.706076	93.4437373	0.001424	0.00413	94.7144
Barge	36	12	2600 HP (~1920 kW - MSD)	2600	0.6	1		0	0	8.5	1163.292	362.702405	0.005528	0.016031	367.634
	36	68					200 kW w/9	1	0.6	NA	89.484	137.412593	0.006045	0.007496	139.816

D.7.10 Fairing Recovery Operations

D.7.10.1 Fairing Recovery Operations Criteria Pollutants

Type	Operations (b)	Number	Ave. Speed (Knots)	Power Level (%) or horsepower	Engines on Line	Generator - Load (kW)	Emissions Factors g/hp-hr					Emissions Factors lb/hr				
							CO	NOx	VOCs	SOx	PM10	CO	NOx	VOCs	SOx	PM10
Support Boat	12	1	8.5	984	1	NA	1.1	2.6	0.5265	0.407275	0.18674	2.386280688	5.6403	1.142161	0.88352	0.405104

NOTES:
Assuming support boat is Tier III SSD
Power Level asssumes a 60% load
Emissions Factor source:
Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (2022)

D.7.10.1.1 Fairing Recovery Operations Baseline

Type	Operations	Ship Time on Range (hrs)	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
			CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Support Boat	12	68.24	0.00716	0.01692	0.00343	0.00265	0.00122	0.01575	0.03723	0.00754	0.00583	0.00267
			0.0072	**0.0169**	**0.0034**	**0.0027**	**0.0012**	**0.0157**	**0.0372**	**0.0075**	**0.0058**	**0.0027**

D.7.10.1.2 Fairing Recovery Operations Proposed Action

Type	Operations	Ship Time on Range (hrs)	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
			CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Support Boat	36	68.24	0.02148	0.05076	0.01028	0.00795	0.00365	0.04725	0.11168	0.02261	0.01749	0.00802
			0.0215	**0.0508**	**0.0103**	**0.0080**	**0.0036**	**0.0472**	**0.1117**	**0.0226**	**0.0175**	**0.0080**

D.7.10.2 Fairing Recovery Operations Greenhouse Gases

Type	Engines and Generators				Ave. Speed (Knots)	Power Level (kW)	Generator - Load (kW)	Emissions Factors (g/kWh)			Emissions Factors (lb/hr)		
	Propulsion	No.	Generator	No.				CO2	CH4	N20	CO2	CH4	N20
Support Boat	Cat 3508 820hp	2	None	0	8.5	984	0.6	656.123	0.01	0.029	1420.38	0.02165	0.06278

Assume Marine Diesel Oil (MDO) and slow speed diesel (SSD) in USEPA 2009

D.7.10.2.1 Fairing Recovery Operations Greenhouse Gases Baseline

Type	Operations (b)	Number	Ship Time on Range (hrs)	Engines and Generators				Ave. Speed (Knots)	Power Level (kW)	Generator - Load (kW)	Emissions (tons)			
				Propulsion	No.	Generator	No.				CO2	CH4	N20	CO2e
Support Boat	12	1	68.2	Cat 3508 820hp	2	None	0	8.5	984	0.6	8.52225	0.00013	0.00038	8.63814

Assume Marine Diesel Oil (MDO) and slow speed diesel (SSD) in USEPA 2009

D.7.10.2.2 Fairing Recovery Operations Greenhouse Gases Proposed Action

Type	Operations (b)	Number	Ship Time on Range (hrs) (e)	Engines and Generators				Ave. Speed (Knots)	Power Level (kW)	Generator - Load (kW)	Emissions (tons)			
			Hours	Propulsion	No.	Generator	No.				CO2	CH4	N20	CO2e
Support Boat	36	1	68.2	Cat 3508 820hp	2	None	0	8.5	984	0.6	25.5668	0.00039	0.00113	25.9144

Assume Marine Diesel Oil (MDO) and slow speed diesel (SSD) in USEPA 2009

D.7.11 Roll-on Roll-off Operations (Vessels Only)

D.7.11.1 Roll-on Roll-off Operations Criteria Pollutants

Type	Engines and Generators				Ave. Speed (Knots)	Power Level (%) or horsepower	Engines on Line	Generator - Load (kW)	Emissions Factors g/kWh					Emissions Factors lb/hr				
	Propulsion	No.	Generator	No.					CO	NOx	ROG	SOx	PM10	CO	NOx	ROG	SOx	PM10
Tugboat	Tier 3 5000 HP (~3500 kW - SSD)	1	None	0	6	2100	1	NA	1.4	3.4	0.6318	0.367541	0.18360	6.481583	15.74099	4.875076	2.836009	1.416689
Support Tug	Tier 2 5000 HP (~3500 kW - SSD)	1	None	0	6	2100	1	NA	1.4	14.4	0.6318	0.367541	0.18360	6.481583	66.66771	1.643597	0.95614	0.477627

NOTES:
Assuming support tug is tier 2
Power Level asssumes a 60% load
Emissions Factor source:
Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movemen
Tugboat goes from Long Beach to VAFB Harbor
(Total one-way distance = 224 nm)
One Way Distance within CCW = 95 nm
One way Distance outside CCW = 129 nm
Support Tug goes from Port Hueneme to VAFB Harbor (Total One-way distance [all CCW] = 90 nm)

EF_{SOx} = BSFC * Sact * FSC * MWR (Eq 3.5)

BFSC (SSD)	185
BFSC (MSD)	205
Sact	0.001
FSC	0.993353
MWR	2
EF_{SOx} (SSD)	0.367541
EFSOx (MSD)	0.407275

EF_{PM10} = Pmbase + (Sact * BFSC * FSC * MWR) [Eq 3.3

PMBAse	0.1545
Sact	0.001
BFSC (SSD)	185
BFSC (MSD)	205
FSC	0.02247
MWR	7
EF_{PM10} (SSD)	0.18360
EF_{PM10} (MSD)	0.18674

D.7.11.1.1 Roll-on Roll-off Operations Baseline

Type	Operations	Ship Time on Range (hrs)	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
			CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Tugboat	12	75	0.03889	0.09445	0.02925	0.01702	0.00850	0.05833	0.14167	0.04388	0.02552	0.01275
Support Tug	12	32	0.03889	0.40001	0.00986	0.00574	0.00287	0.05833	0.60001	0.01479	0.00861	0.00430

D.7.11.1.2 Roll-on Roll-off Operations Proposed Action

Type	Operations	Ship Time on Range (hrs)	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
			CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Tugboat	36	75	0.11667	0.28334	0.08775	0.05105	0.02550	0.17500	0.42501	0.13163	0.07657	0.03825
Support Tug	36	32	0.11667	1.20002	0.02958	0.01721	0.00860	0.17500	1.80003	0.04438	0.02582	0.01290
		Total	**0.2333**	**1.4834**	**0.1173**	**0.0683**	**0.0341**	**0.3500**	**2.2250**	**0.1760**	**0.1024**	**0.0511**

D.7.11.2 Roll-on Roll-off Operations Greenhouse Gases

Type	Engines and Generators				Ave. Speed (Knots)	Power Level (%) or horsepower	Engines on Line	Generator - Load (kW)	Emissions Factors (g/kWh)			Emissions Factors (lb/hr)		
	Propulsion	No.	Generator	No.					CO2	CH4	N20	CO2	CH4	N20
Tugboat	Tier 3 5000 HP (~3500 kW - SSD)	1	None	0	6	2100	1	0.6	656.123	0.01	0.029	1.4434706	0.000022	0.0000638
Support Tug	Tier 2 5000 HP (~3500 kW - SSD)	1	None	0	6	2100	1	0.6	592.111	0.01	0.029	1.3026442	0.000022	0.0000638

Assume Marine Diesel Oil (MDO) and slow speed diesel (SSD) in USEPA 2009

EF_{CO2} = BSFC x CCF		EF_{CO2}
CCF = 3.2006	SSD	592.111
BSFC(SSD) = 185	MSD	656.123
BSFC (MSD)=205		

D.7.11.2.1 Roll-on Roll-off Operations Greenhouse Gases Baseline

Type	Operations	Number	Ship Time on Range (hrs)	Emissions (tons)			
				CO2	CH4	N20	CO2e
Tugboat	12	1	75	0.64667483	9.86E-06	2.86E-05	0.65547
Support Tug	12	1	32	0.2475024	4.18E-06	1.21E-05	0.25123
						Total	0.9067

D.7.11.2.2 Roll-on Roll-off Operations Greenhouse Gases Proposed Action

Type	Operations	Number	Ship Time on Range (hrs)	Emissions (tons)			
				CO2	CH4	N20	CO2e
Tugboat	36	1	75	1.94002449	2.96E-05	8.57E-05	1.96641
Support Tug	36	1	32	0.74250719	1.25E-05	3.64E-05	0.7537
						Total	2.7201

D.7.12 ACAM Summaries (including land transport activities, worker trips, vendor deliveries, and generator use)

D.7.12.1 Baseline

Baseline Activity	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
Daily Operations - Worker transits	0.40191	0.03400	0.06241	0.00069	0.00357	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (RP-1)	0.85848	0.91318	0.19493	0.00407	0.02934	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (LN2)	0.41659	0.42796	0.09313	0.00194	0.01392	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (LOX)	0.37493	0.38653	0.08382	0.00174	0.01252	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (Helium)	0.13926	0.15058	0.03183	0.00067	0.04848	0.00000	0.00000	0.00000	0.00000	0.00000
Generator	0.002936	0.004396	0.001107	0.000898	0.000960	0.000000	0.000000	0.000000	0.000000	0.000000
Generator #2	0.002560	0.003833	0.000930	0.000783	0.000837	0.000000	0.000000	0.000000	0.000000	0.000000
Generator #3	0.005024	0.007523	0.001825	0.001537	0.001642	0.000000	0.000000	0.000000	0.000000	0.000000
Generators #4	0.033497	0.126101	0.003486	0.000061	0.003939	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	**2.196664**	**1.912251**	**0.466122**	**0.009099**	**0.107832**	**0.000000**	**0.000000**	**0.000000**	**0.000000**	**0.000000**

D.7.12.2 Proposed Action

Alternative 1 Activity	Total Emissions (tons) (<3 nm)					Total Emissions (tons) (3-12 nm)				
	CO	Nox	VOCs	Sox	PM	CO	Nox	VOCs	Sox	PM
RORO Transport (Land Portion)	0.02279	0.03142	0.00460	0.00006	0.00145	0.00000	0.00000	0.00000	0.00000	0.00000
Booster Transport	0.80630	0.85768	0.18308	0.00382	0.02759	0.00000	0.00000	0.00000	0.00000	0.00000
Daily Operations - Worker transits	1.20572	0.10200	0.18722	0.00206	0.01071	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (RP-1)	2.57545	2.73955	0.58479	0.01220	0.08803	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (LN2)	1.24977	1.28388	0.27940	0.00581	0.04175	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (LOX)	1.12480	1.15959	0.25146	0.00523	0.03757	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor Deliveries (Helium)	0.41777	0.45175	0.09550	0.00200	0.14544	0.00000	0.00000	0.00000	0.00000	0.00000
Generator	0.00294	0.00440	0.00111	0.00090	0.00096	0.00000	0.00000	0.00000	0.00000	0.00000
Generator #2	0.00256	0.00383	0.00093	0.00078	0.00084	0.00000	0.00000	0.00000	0.00000	0.00000
Generator #3	0.00502	0.00752	0.00183	0.00154	0.00164	0.00000	0.00000	0.00000	0.00000	0.00000
Generators #4	0.03350	0.12610	0.00349	0.00006	0.00394	0.00000	0.00000	0.00000	0.00000	0.00000
TOTAL	**7.446615**	**6.767701**	**1.593396**	**0.034458**	**0.359908**	**0.000000**	**0.000000**	**0.000000**	**0.000000**	**0.000000**

D.7.12.3 ACAM Report

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location

Base: VANDENBERG AFB

State: California

County(s): Santa Barbara; Los Angeles

Regulatory Area(s):

- Action Title: Increased Cadence of Space X Launch Activities

- Project Number/s (if applicable): 1

- Projected Action Start Date: 1 / 2023

- Action Purpose and Need:

SpaceX's proposal is needed to increase the operational capabilities and cost effectiveness of its space flight programs, which serve various government and commercial satellite needs. The Proposed Action is needed so that SpaceX can continue to implement missions for the United States government and meet current and future commercial demand. This action would encourage, facilitate, and promote commercial space launches by the private sector, and would facilitate the strengthening and expansion of the U.S. space transportation infrastructure, in accordance with the requirements of the Commercial Space Launch Act of 1984.

- Action Description:

The Proposed Action is to increase the Falcon 9 annual launch cadence at VSFB and include additional downrange offshore landing locations in the Pacific Ocean. Under the Proposed Action, SpaceX would launch the Falcon 9 from SLC-4E up to 36 times per year. Following each launch, SpaceX would perform a boost-back and landing of the first stage up to 36 times, either downrange on a droneship or at SLC-4W at VSFB. No more than 12 first stage landings would occur at SLC-4W per year. There would be no change to the Falcon 9 specifications as presented and used for analyses in the 2011 EA and subsequent NEPA documents (2016 EA, 2016 SEA, and 2018 SEA).

- Point of Contact

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- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	RORO Transport (Land Portion)
3.	Construction / Demolition	Booster Transport

4.	Personnel	Daily Operations - Worker transits
5.	Construction / Demolition	Vendor Deliveries (RP-1)
6.	Construction / Demolition	Vendor Deliveries (LN2)
7.	Construction / Demolition	Vendor Deliveries (LOX)
8.	Construction / Demolition	Vendor Deliveries (Helium)
9.	Emergency Generator	Generator #1
10.	Emergency Generator	Generator #2
11.	Emergency Generator	Generator #3
12.	Emergency Generator	Generator #4

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: RORO Transport (Land Portion)

- Activity Description:

SPMT transit from VFSB Harbor to SpaceX facility (Approx 8 miles)

- Activity Start Date

Start Month: 1

Start Month: 2023

- Activity End Date

Indefinite: False

End Month: 2

End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.004600
SO_x	0.000060
NO_x	0.031416
CO	0.022790
PM 10	0.001445

Pollutant	Total Emissions (TONs)
PM 2.5	0.001432
Pb	0.000000
NH_3	0.000007
CO_2e	5.7

2.1 Building Construction Phase

2.1.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 1
Start Quarter: 1
Start Year: 2023

- Phase Duration

Number of Month: 1
Number of Days: 6

2.1.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial
Area of Building (ft^2): 1000
Height of Building (ft): 30
Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: No
Average Day(s) worked per week: 7

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Off-Highway Tractors Composite	1	2

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 8

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 0

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 0

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.1.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour)

Off-Highway Tractors Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.1255	0.0016	0.8515	0.6237	0.0390	0.0390	0.0113	151.67

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.018	000.006		000.025	00309.173
LDGT	000.237	000.004	000.201	001.951	000.019	000.007		000.027	00378.051
HDGV	000.297	000.006	000.328	002.246	000.031	000.011		000.052	00587.421
LDDV	000.029	000.002	000.282	000.357	000.035	000.022		000.008	00245.901
LDDT	000.019	000.003	000.091	000.166	000.026	000.014		000.009	00321.020
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.021	000.009		000.053	00228.363

2.1.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

3. Construction / Demolition

3.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara; Los Angeles

Regulatory Area(s): NOT IN A REGULATORY AREA; Los Angeles South Coast Air Basin, CA; Los Angeles County-South Coast Air Basin, CA

- Activity Title: Booster Transport

- Activity Description:

Deliveries of Space X Components

Hawthorne to VFSB

Assuming 18-wheel trucks

1 truck per component (2nd stage, interstage, and payload)

36 deliveries each

assume 12 additional trips for new 1st stages

Total Trips = 120

Total Round Trip Distance (340 miles, 160 miles R/T in SBAQCD)

- Activity Start Date

Start Month: 1

Start Month: 2023

- Activity End Date

Indefinite: False

End Month: 4

End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.183083
SO_x	0.003821
NO_x	0.857679
CO	0.806303
PM 10	0.027589

Pollutant	Total Emissions (TONs)
PM 2.5	0.027453
Pb	0.000000
NH_3	0.000261
CO_2e	382.8

3.1 Building Construction Phase

3.1.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 1

Start Quarter: 1

Start Year: 2023

- Phase Duration

Number of Month: 3

Number of Days: 0

3.1.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial

Area of Building (ft²): 1

Height of Building (ft): 1

Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: No

Average Day(s) worked per week: 7

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Off-Highway Trucks Composite	4	8

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 340

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

3.1.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour)

Off-Highway Trucks Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.1243	0.0026	0.5880	0.5421	0.0188	0.0188	0.0112	260.35

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.021	000.008		000.025	00339.296
LDGT	000.237	000.004	000.201	001.951	000.022	000.008		000.027	00409.212
HDGV	000.297	000.006	000.328	002.246	000.033	000.012		000.052	00587.421
LDDV	000.050	000.003	000.282	000.513	000.051	000.036		000.008	00281.428
LDDT	000.025	000.003	000.091	000.209	000.029	000.015		000.009	00362.269
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.022	000.009		000.053	00235.976

3.1.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Worker Trips On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)

BA: Area of Building (ft^2)

BH: Height of Building (ft)

(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)

HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Worker Trips On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

4. Personnel

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Daily Operations - Worker transits

- Activity Description:

Assumes 50 personnel originally, increasing by 100 workers.

Assume 10 mile trip for workers

- Activity Start Date

Start Month: 1

Start Year: 2023

- Activity End Date

Indefinite: No

End Month: 12

End Year: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.187218
SO_x	0.002055
NO_x	0.101996
CO	1.205717
PM 10	0.010710

Pollutant	Total Emissions (TONs)
PM 2.5	0.003830
Pb	0.000000
NH_3	0.015308
CO_2e	200.2

4.2 Personnel Assumptions

- Number of Personnel

Active Duty Personnel: 0
Civilian Personnel: 100
Support Contractor Personnel: 0
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: No

- Average Personnel Round Trip Commute (mile): 20

- Personnel Work Schedule

Active Duty Personnel: 5 Days Per Week
Civilian Personnel: 5 Days Per Week
Support Contractor Personnel: 5 Days Per Week
Air National Guard (ANG) Personnel: 4 Days Per Week
Reserve Personnel: 4 Days Per Month

4.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

4.4 Personnel Emission Factor(s)

- On Road Vehicle Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.018	000.006		000.025	00309.173
LDGT	000.237	000.004	000.201	001.951	000.019	000.007		000.027	00378.051
HDGV	000.297	000.006	000.328	002.246	000.031	000.011		000.052	00587.421
LDDV	000.029	000.002	000.282	000.357	000.035	000.022		000.008	00245.901
LDDT	000.019	000.003	000.091	000.166	000.026	000.014		000.009	00321.020
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.021	000.009		000.053	00228.363

4.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)

NP: Number of Personnel

WD: Work Days per Year

AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)

VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)

VMT_C: Civilian Personnel Vehicle Miles Travel (miles)

VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)

VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)

VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year

$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{Total}: Total Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Personnel On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

5. Construction / Demolition

5.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor Deliveries (RP-1)

- Activity Description:

- X8 vehicles per mission, 6,400 gallons each
- Engine type : Diesel
- Vehicle type : x18 wheel tractor trailer
- Distance truck is traveling: 1770 Miles from south Texas to Vandenberg
- Vendor – total energies

For buildup - assume 4 day trip per truck @ 65 mph

8 vehicles per mission * 4 days per truck = 32 driving days per mission

36 missions * 32 driving days/mission = 1152 days

- Activity Start Date

Start Month: 1

Start Month: 2023

- Activity End Date

Indefinite: False

End Month: 5

End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.584792
SO_x	0.012204
NO_x	2.739547
CO	2.575445
PM 10	0.088026

Pollutant	Total Emissions (TONs)
PM 2.5	0.087641
Pb	0.000000
NH_3	0.000833
CO_2e	1221.8

5.1 Building Construction Phase

5.1.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 1

Start Quarter: 1

Start Year: 2023

- Phase Duration

Number of Month: 4

Number of Days: 24

5.1.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial

Area of Building (ft^2): 1

Height of Building (ft): 1

Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: No

Average Day(s) worked per week: 7

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Off-Highway Trucks Composite	8	8

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 1770

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

5.1.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour)

Off-Highway Trucks Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.1243	0.0026	0.5880	0.5421	0.0188	0.0188	0.0112	260.35

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.018	000.006		000.025	00309.173
LDGT	000.237	000.004	000.201	001.951	000.019	000.007		000.027	00378.051
HDGV	000.297	000.006	000.328	002.246	000.031	000.011		000.052	00587.421
LDDV	000.029	000.002	000.282	000.357	000.035	000.022		000.008	00245.901
LDDT	000.019	000.003	000.091	000.166	000.026	000.014		000.009	00321.020
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.021	000.009		000.053	00228.363

5.1.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

6. Construction / Demolition

6.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor Deliveries (LN2)

- Activity Description:

- 40 tankers per mission (can vary mission to mission based on pad demand - conservative number)
- Engine type : Diesel
- Vehicle type : x18 wheel tractor trailer
- Distance truck is traveling: 180 miles from Santa Fe Springs CA to Vandenberg
- Vendor: Airgas

40*36 missions = 1,440 tanker trips

Assume 65 mph, trip duration is appox 3 hours

- Activity Start Date

Start Month: 1

Start Month: 2023

- Activity End Date

Indefinite: False

End Month: 2

End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.279397
SO_x	0.005809
NO_x	1.288388
CO	1.249772
PM 10	0.041746

Pollutant	Total Emissions (TONs)
PM 2.5	0.041256
Pb	0.000000
NH_3	0.001047
CO_2e	581.5

6.1 Building Construction Phase

6.1.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 1

Start Quarter: 1

Start Year: 2023

- Phase Duration

Number of Month: 1

Number of Days: 6

6.1.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial

Area of Building (ft^2): 1000

Height of Building (ft): 1

Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: No

Average Day(s) worked per week: 7

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Off-Highway Trucks Composite	40	3

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 180

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

6.1.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour)

Off-Highway Trucks Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.1243	0.0026	0.5880	0.5421	0.0188	0.0188	0.0112	260.35

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.018	000.006		000.025	00309.173
LDGT	000.237	000.004	000.201	001.951	000.019	000.007		000.027	00378.051
HDGV	000.297	000.006	000.328	002.246	000.031	000.011		000.052	00587.421
LDDV	000.029	000.002	000.282	000.357	000.035	000.022		000.008	00245.901
LDDT	000.019	000.003	000.091	000.166	000.026	000.014		000.009	00321.020
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.021	000.009		000.053	00228.363

6.1.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)

NE: Number of Equipment

WD: Number of Total Work Days (days)

H: Hours Worked per Day (hours)

EF_{POL}: Emission Factor for Pollutant (lb/hour)

2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)

BA: Area of Building (ft^2)

BH: Height of Building (ft)

(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)

HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Worker Trips On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)

WD: Number of Total Work Days (days)

WT: Average Worker Round Trip Commute (mile)

1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Worker Trips On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)

BA: Area of Building (ft^2)

BH: Height of Building (ft)

(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)

HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Worker Trips On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

7. Construction / Demolition

7.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor Deliveries (LOX)

- Activity Description:

- 36 tankers per mission (can vary mission to mission based on pad demand - conservative number)

• Engine type : Diesel

• Vehicle type : x18 wheel tractor trailer

• Distance truck is traveling: 180 miles from Santa Fe Springs CA to Vandenberg

• Vendor: Airgas

36 tankers * 36 missions = 1,296 trips

- Activity Start Date

Start Month: 1

Start Month: 2023

- Activity End Date

Indefinite: False

End Month: 2

End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.251460
SO_x	0.005229
NO_x	1.159585
CO	1.124804
PM 10	0.037574

Pollutant	Total Emissions (TONs)
PM 2.5	0.037132
Pb	0.000000
NH_3	0.000943
CO_2e	523.3

7.1 Building Construction Phase

7.1.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 1

Start Quarter: 1

Start Year: 2023

- Phase Duration

Number of Month: 1

Number of Days: 6

7.1.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial

Area of Building (ft^2): 1000

Height of Building (ft): 1

Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: No

Average Day(s) worked per week: 7

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Off-Highway Trucks Composite	36	3

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 180

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

7.1.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour)

Off-Highway Trucks Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.1243	0.0026	0.5880	0.5421	0.0188	0.0188	0.0112	260.35

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.018	000.006		000.025	00309.173
LDGT	000.237	000.004	000.201	001.951	000.019	000.007		000.027	00378.051
HDGV	000.297	000.006	000.328	002.246	000.031	000.011		000.052	00587.421
LDDV	000.029	000.002	000.282	000.357	000.035	000.022		000.008	00245.901
LDDT	000.019	000.003	000.091	000.166	000.026	000.014		000.009	00321.020
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.021	000.009		000.053	00228.363

7.1.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

8. Construction / Demolition

8.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor Deliveries (Helium)

- Activity Description:

- 2 tankers per mission (significant recent win with new compressors & pump systems)
- Engine type : Diesel DD13
- Vehicle type : Cascadia Freightliners
- Distance truck is traveling: 1,400 miles from Liberal, KS to Vandenberg
- Vendor: Air Products

- Activity Start Date

Start Month: 1

Start Month: 2023

- Activity End Date

Indefinite: False

End Month: 2

End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.095498
SO_x	0.002001
NO_x	0.451745
CO	0.417767
PM 10	0.014544

Pollutant	Total Emissions (TONs)
PM 2.5	0.014448
Pb	0.000000
NH_3	0.000093
CO_2e	200.3

8.1 Building Construction Phase

8.1.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 1

Start Quarter: 1

Start Year: 2023

- Phase Duration

Number of Month: 1

Number of Days: 6

8.1.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial

Area of Building (ft^2): 1000

Height of Building (ft): 1

Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: No

Average Day(s) worked per week: 7

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Off-Highway Trucks Composite	2	21

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 1400

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

8.1.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour)

Off-Highway Trucks Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.1243	0.0026	0.5880	0.5421	0.0188	0.0188	0.0112	260.35

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.182	000.003	000.108	001.439	000.018	000.006		000.025	00309.173
LDGT	000.237	000.004	000.201	001.951	000.019	000.007		000.027	00378.051
HDGV	000.297	000.006	000.328	002.246	000.031	000.011		000.052	00587.421
LDDV	000.029	000.002	000.282	000.357	000.035	000.022		000.008	00245.901
LDDT	000.019	000.003	000.091	000.166	000.026	000.014		000.009	00321.020
HDDV	000.192	000.008	002.261	000.607	000.132	000.073		000.033	00806.387
MC	006.064	000.002	000.834	020.289	000.021	000.009		000.053	00228.363

8.1.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

VMT_{VT} = BA * BH * (0.38 / 1000) * HT

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

9. Emergency Generator

9.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location

County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Generator #1

- Activity Description:

367 hp

load factor 0.73

1 generator

25 hours a year

- Activity Start Date

Start Month: 1

Start Year: 2023

- Activity End Date

Indefinite: No

End Month: 1

End Year: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.001067
SO_x	0.000898
NO_x	0.004396
CO	0.002936
PM 10	0.000960

Pollutant	Total Emissions (TONs)
PM 2.5	0.000960
Pb	0.000000
NH_3	0.000000
CO_2e	0.5

9.2 Emergency Generator Assumptions

- Emergency Generator

Type of Fuel used in Emergency Generator: Diesel

Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption

Emergency Generator's Horsepower: 367

Average Operating Hours Per Year (hours): 25

9.3 Emergency Generator Emission Factor(s)

- Emergency Generators Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251			1.33

9.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

10. Emergency Generator

10.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location

County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Generator #2

- Activity Description:

320 hp
load factor 0.73
1 generator
25 hours a year

- Activity Start Date

Start Month: 1
Start Year: 2023

- Activity End Date

Indefinite: No

End Month: 1

End Year: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.000930
SO_x	0.000783
NO_x	0.003833
CO	0.002560
PM 10	0.000837

Pollutant	Total Emissions (TONs)
PM 2.5	0.000837
Pb	0.000000
NH_3	0.000000
CO_2e	0.4

10.2 Emergency Generator Assumptions

- Emergency Generator

Type of Fuel used in Emergency Generator: Diesel

Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption

Emergency Generator's Horsepower: 320

Average Operating Hours Per Year (hours): 25

10.3 Emergency Generator Emission Factor(s)

- Emergency Generators Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251			1.33

10.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)

NGEN: Number of Emergency Generators

HP: Emergency Generator's Horsepower (hp)

OT: Average Operating Hours Per Year (hours)

EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

11. Emergency Generator

11.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Generator #3

- Activity Description:

314 hp

1 generator

50 hours a year

- Activity Start Date

Start Month: 1

Start Year: 2023

- Activity End Date

End Month: 1

End Year: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.001825
SO_x	0.001537
NO_x	0.007523
CO	0.005024
PM 10	0.001642

Pollutant	Total Emissions (TONs)
PM 2.5	0.001642
Pb	0.000000
NH_3	0.000000
CO_2e	0.9

11.2 Emergency Generator Assumptions

- Emergency Generator

Type of Fuel used in Emergency Generator: Diesel

Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption

Emergency Generator's Horsepower: 50

Average Operating Hours Per Year (hours): 576

11.3 Emergency Generator Emission Factor(s)

- Emergency Generators Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251			1.33

11.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)

NGEN: Number of Emergency Generators

HP: Emergency Generator's Horsepower (hp)

OT: Average Operating Hours Per Year (hours)

EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

12. Emergency Generator

12.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location

County: Santa Barbara

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Generator #4

- Activity Description:

779 hp

3 generators

50 hours a year

- Activity Start Date

Start Month: 1

Start Year: 2023

- Activity End Date

Indefinite: No

End Month: 1

End Year: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.003486
SO_x	0.000061
NO_x	0.126101
CO	0.033497
PM 10	0.003939

Pollutant	Total Emissions (TONs)
PM 2.5	0.003939
Pb	0.000000
NH_3	0.000000
CO_2e	6.5

12.2 Emergency Generator Assumptions

- Emergency Generator

Type of Fuel used in Emergency Generator: Diesel

Number of Emergency Generators: 3

- Default Settings Used: No

- Emergency Generators Consumption

Emergency Generator's Horsepower: 779

Average Operating Hours Per Year (hours): 50

12.3 Emergency Generator Emission Factor(s)

- Emergency Generators Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809			1.33

12.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)

NGEN: Number of Emergency Generators

HP: Emergency Generator's Horsepower (hp)

OT: Average Operating Hours Per Year (hours)

EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

D.8 Record of Non-Applicability for Clean Air Act Conformity

The Proposed Action falls under the Record of Non-Applicability (RONA) category and is documented with this RONA.

D.8.1 Introduction

The United States (U.S.) Environmental Protection Agency (EPA) published Determining Conformity of General Federal Actions to State or Federal Implementation Plans; Final Rule, in the November 30, 1993 Federal Register (40 Code of Federal Regulations [CFR] sections 6, 51, and 93). On April 5, 2010, the EPA finalized revisions to the General Conformity Rule (75 Federal Register 17253–17279). These publications provide implementing guidance to document CAA Conformity Determination requirements. This RONA is provided to document compliance of the Proposed Action.

Federal regulations state that “no department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity that does not conform to an applicable State Implementation Plan.” It is the responsibility of the federal agency to determine whether a federal action conforms to the applicable State Implementation Plan before the action is taken (40 CFR part 51.850[a]).

Federal actions may be exempt from conformity determinations if their emissions do not exceed designated *de minimis* levels for the criteria pollutants of nonattainment or maintenance in the areas of the federal action (40 CFR part 51.853[b]). The applicable *de minimis* levels (in tons/year) re shown in the conformity tables E-2 and E-3.

D.8.2 Proposed Action

<u>Action Proponent</u>: Space X

<u>Location</u>: Vandenberg Space Force Base, California

<u>Proposed Action Name</u>: Supplemental Environmental Assessment Falcon 9 Increased Cadence at Vandenberg Space Force Base, California and Offshore Landing Locations

<u>Proposed Action and Emissions Summary</u>:

The Proposed Action is to increase the Falcon 9 annual launch cadence at VSFB and include additional downrange offshore landing locations in the Pacific Ocean. Under the Proposed Action, SpaceX would launch the Falcon 9 from SLC-4E up to 36 times per year. Following each launch, SpaceX would perform a boost-back and landing of the first stage up to 36 times, either downrange on a droneship or at SLC-4W at VSFB. No more than 12 first stage landings would occur at SLC-4W per year. There would be no change to the Falcon 9 specifications as presented and used for analyses in the 2011 EA and subsequent NEPA documents (2016 EA, 2016 SEA, and 2018 SEA).

Alternative 1 (Preferred Alternative) is based on the highest potential annual level of increased tempo for planned operations as identified during interviews with range managers, training mission requirements, or existing National Environmental Policy Act documents for flight operations, vessel operations, or land-based operational activities. The majority of activities proposed under Alternative 1 are the same as or similar to those currently conducted currently.

Emissions from existing proposed launch, landing and static fire activities were based on data from the FAA. To estimate emissions, number of hours of operation and type of fuel for each rocket aircraft were evaluated. Activities or portions of those activities occurring below 3,000 feet are included in emissions estimates.

The methods for estimating ship and boat emissions involve evaluating the type of activity and generating the average running hours for ships in each operational area, both within State waters and beyond State waters. For all alternatives, the hourly data was used in conjunction with emission factors data generated from the EPA's Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions to calculate the emissions from the propulsion and onboard generation systems. Data included emission factors for each type of propulsion engine and type of onboard electrical power generation system by ship type, as well as the fuel used by engine systems.

Land-based activities and operations were modeled using the USAF Air Conformity Applicability Model (ACAM).

Based on the air quality analysis for the Proposed Action in the project's National Environmental Policy Act document (currently identified as Alternative 1, the maximum estimated emissions of applicable pollutants would still be below the conformity *de minimis* levels for both the South Central Coast (Ventura County APCD) and South Coast Air (South Coast AQMD) basins. Therefore, emissions from the Proposed Action would show conformity under the CAA. The estimated annual conformity emissions for operations and applicable conformity *de minimis* levels for the Proposed Action are shown in Table D-2 and E-4.

Table D-2: Estimated Annual Air Pollutant Emissions from Activities Between 0 and 3 NM from Shore, Ventura County APCD, Alternative 1

Criteria Pollutant	**Annual Emissions (tons per year)**				
	CO	**NO_x**	**VOC**	**SO_x**	**PM_{10}**
Total Emissions	0.8459	0.8811	0.1902	0.0040	0.0329
Baseline	0.2087	0.2157	0.0467	0.0010	0.0085
Net Increase (Decrease)	**0.6372**	**0.6654**	**0.1435**	**0.0030**	**0.0244**
De Minimis Threshold	100	50	50	100	100

[1]Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding.

Notes: CO = carbon monoxide, NO_X = nitrogen oxides, NO_2 = nitrogen dioxide, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_2 = sulfur dioxide, SO_X = sulfur oxides, VOC = volatile organic compound, NM = nautical miles

Table D-4: Estimated Annual Air Pollutant Emissions from Activities Between 0 and 3 NM from Shore, South Coast AQMD, Alternative 1

Criteria Pollutant	Annual Emissions (tons per year)				
	CO	NO_x	VOC	SO_x	PM_{10}
Total Emissions	1.3484	2.0951	0.3361	0.0526	0.0684
Baseline	0.3454	0.3887	0.0833	0.0102	0.0170
Net Increase (Decrease)	**1.003**	**1.7064**	**0.2528**	**0.0424**	**0.0514**
De Minimis Threshold	100	10	10	100	100

[1]Table includes criteria pollutant precursors (e.g., VOC). Individual values may not add exactly to total values due to rounding.

Notes: CO = carbon monoxide, NO_X = nitrogen oxides, NO_2 = nitrogen dioxide, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_2 = sulfur dioxide, SO_X = sulfur oxides, VOC = volatile organic compound, NM = nautical miles

Affected Air Basin: South Central Coast (Ventura County APCD) / South Coast Air Basin (Los Angeles County AQMD)

Date RONA Prepared: 11/18/2022

RONA Prepared by: ManTech International

D.8.3 Proposed Action Exemption(s)

The Proposed Action is exempt from General Conformity Rule Requirements, based on the determination that emissions associated with the Proposed Action are below all *de minimis* thresholds.

D.8.4 Attainment Area Status and Emissions Evaluation Conclusion

The USSF concludes that the conformity *de minimis* levels for applicable criteria pollutants would not be exceeded as a result of implementing the Proposed Action. Therefore, the Proposed Action is exempt from a formal conformity determination. The USSF concludes that further formal Conformity Determination procedures are not required, resulting in this RONA.

RONA APPROVAL

Signature: ____

Name/Rank: ____ Date: __________________________

Position:____

D.9 Applicable CalEEMod Reports (see following pages)

Space X Increased Cadence - Baseline

Santa Barbara County APCD Air District, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Heavy Industry	1.00	1000sqft	0.02	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.9	**Precipitation Freq (Days)**	37
Climate Zone	4			**Operational Year**	2024
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - 2024 operational

Land Use -

Construction Phase - RP-1 Vendor - 36 total trips
BC = RP-1 Vendor, BC2 = LN2 Vendor, BC3 = LOX Vendor, BC4 = He Vendor
BC5 = RORO Transport (Not used in baseline)
BC6 = Booster Transport
BC7 = Worker Transport

Off-road Equipment -

Off-road Equipment - no construction equipment used

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Trips and VMT - BC5 and BC6 not included in this baseline

Stationary Sources - Emergency Generators and Fire Pumps -

Energy Use -

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	240.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	0.00
tblConstructionPhase	NumDays	100.00	0.00
tblConstructionPhase	PhaseEndDate	1/19/2023	1/17/2023
tblConstructionPhase	PhaseEndDate	1/18/2024	12/21/2023

tblConstructionPhase	PhaseEndDate	2/7/2024	2/3/2023
tblConstructionPhase	PhaseEndDate	2/27/2024	2/23/2023
tblConstructionPhase	PhaseEndDate	3/18/2024	3/15/2023
tblConstructionPhase	PhaseEndDate	3/18/2024	3/17/2023
tblConstructionPhase	PhaseEndDate	3/18/2024	3/17/2023
tblConstructionPhase	PhaseStartDate	1/19/2024	1/19/2023
tblConstructionPhase	PhaseStartDate	2/8/2024	2/8/2023
tblConstructionPhase	PhaseStartDate	2/28/2024	2/28/2023
tblConstructionPhase	PhaseStartDate	3/19/2024	3/19/2023
tblConstructionPhase	PhaseStartDate	3/19/2024	3/19/2023
tblProjectCharacteristics	OperationalYear	2018	2024
tblStationaryGeneratorsPumpsUse	HorsePowerValue	0.00	314.00
tblStationaryGeneratorsPumpsUse	HorsePowerValue	0.00	320.00
tblStationaryGeneratorsPumpsUse	HorsePowerValue	0.00	367.00
tblStationaryGeneratorsPumpsUse	HorsePowerValue	0.00	779.00
tblStationaryGeneratorsPumpsUse	HoursPerYear	0.00	50.00
tblStationaryGeneratorsPumpsUse	HoursPerYear	0.00	25.00
tblStationaryGeneratorsPumpsUse	HoursPerYear	0.00	25.00
tblStationaryGeneratorsPumpsUse	HoursPerYear	0.00	50.00
tblStationaryGeneratorsPumpsUse	NumberOfEquipment	0.00	1.00
tblStationaryGeneratorsPumpsUse	NumberOfEquipment	0.00	1.00
tblStationaryGeneratorsPumpsUse	NumberOfEquipment	0.00	1.00
tblStationaryGeneratorsPumpsUse	NumberOfEquipment	0.00	3.00
tblTripsAndVMT	VendorTripLength	6.40	80.00
tblTripsAndVMT	VendorTripLength	6.40	80.00
tblTripsAndVMT	VendorTripLength	6.40	80.00
tblTripsAndVMT	VendorTripLength	6.40	80.00

tblTripsAndVMT	VendorTripLength	6.40	8.00
tblTripsAndVMT	VendorTripLength	6.40	80.00
tblTripsAndVMT	VendorTripNumber	0.00	8.00
tblTripsAndVMT	VendorTripNumber	0.00	40.00
tblTripsAndVMT	VendorTripNumber	0.00	36.00
tblTripsAndVMT	VendorTripNumber	0.00	2.00
tblTripsAndVMT	VendorTripNumber	0.00	1.00
tblTripsAndVMT	VendorTripNumber	0.00	120.00
tblTripsAndVMT	WorkerTripLength	8.30	10.00
tblTripsAndVMT	WorkerTripNumber	0.00	50.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	0.0263	0.2272	0.2190	1.5700e-003	0.0820	9.6000e-004	0.0830	0.0226	9.1000e-004	0.0235	0.0000	152.4519	152.4519	8.2300e-003	0.0000	152.6577
Maximum	**0.0263**	**0.2272**	**0.2190**	**1.5700e-003**	**0.0820**	**9.6000e-004**	**0.0830**	**0.0226**	**9.1000e-004**	**0.0235**	**0.0000**	**152.4519**	**152.4519**	**8.2300e-003**	**0.0000**	**152.6577**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	0.0263	0.2272	0.2190	1.5700e-003	0.0820	9.6000e-004	0.0830	0.0226	9.1000e-004	0.0235	0.0000	152.4519	152.4519	8.2300e-003	0.0000	152.6577
Maximum	**0.0263**	**0.2272**	**0.2190**	**1.5700e-003**	**0.0820**	**9.6000e-004**	**0.0830**	**0.0226**	**9.1000e-004**	**0.0235**	**0.0000**	**152.4519**	**152.4519**	**8.2300e-003**	**0.0000**	**152.6577**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**1-1-2023**	**3-31-2023**	0.4206	0.4206
2	**4-1-2023**	**6-30-2023**	0.0079	0.0079
3	**7-1-2023**	**9-30-2023**	0.0080	0.0080
		Highest	0.4206	0.4206

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	3.8626	3.8626	1.4000e-004	5.0000e-005	3.8805
Mobile	3.9000e-004	1.4600e-003	4.1600e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.1263	1.1263	5.0000e-005	0.0000	1.1277
Stationary	0.1229	0.5042	0.3133	5.9000e-004		0.0181	0.0181		0.0181	0.0181	0.0000	57.0149	57.0149	7.9900e-003	0.0000	57.2147
Waste						0.0000	0.0000		0.0000	0.0000	0.2575	0.0000	0.2575	0.0128	0.0000	0.5767
Water						0.0000	0.0000		0.0000	0.0000	0.0818	0.3640	0.4458	3.0000e-004	1.8000e-004	0.5073
Total	**0.1285**	**0.5069**	**0.3185**	**6.1000e-004**	**1.2100e-003**	**0.0182**	**0.0194**	**3.2000e-004**	**0.0182**	**0.0185**	**0.3393**	**62.3678**	**62.7071**	**0.0213**	**2.3000e-004**	**63.3070**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	3.8626	3.8626	1.4000e-004	5.0000e-005	3.8805
Mobile	3.9000e-004	1.4600e-003	4.1600e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.1263	1.1263	5.0000e-005	0.0000	1.1277
Stationary	0.1229	0.5042	0.3133	5.9000e-004		0.0181	0.0181		0.0181	0.0181	0.0000	57.0149	57.0149	7.9900e-003	0.0000	57.2147
Waste						0.0000	0.0000		0.0000	0.0000	0.2575	0.0000	0.2575	0.0128	0.0000	0.5767
Water						0.0000	0.0000		0.0000	0.0000	0.0818	0.3640	0.4458	3.0000e-004	1.8000e-004	0.5073
Total	**0.1285**	**0.5069**	**0.3185**	**6.1000e-004**	**1.2100e-003**	**0.0182**	**0.0194**	**3.2000e-004**	**0.0182**	**0.0185**	**0.3393**	**62.3678**	**62.7071**	**0.0213**	**2.3000e-004**	**63.3070**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Building Construction	Building Construction	1/1/2023	1/17/2023	5	12	Vendor (RP-1)
2	Building Construction 2	Building Construction	1/19/2023	2/3/2023	5	12	Vendor (LN2)
3	Building Construction 3	Building Construction	2/8/2023	2/23/2023	5	12	Vendor (LOX)
4	Building Construction 4	Building Construction	2/28/2023	3/15/2023	5	12	Vendor (He)
5	Building Construction 5	Building Construction	3/19/2023	3/17/2023	5	0	RORO Transport
6	Building Construction 6	Building Construction	3/19/2023	3/17/2023	5	0	Booster Transport
7	Building Construction 7	Building Construction	1/20/2023	12/21/2023	5	240	Worker Transport

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Building Construction	5	0.00	8.00	0.00	8.30	80.00	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction 7	5	50.00	0.00	0.00	10.00	6.40	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction 2	5	0.00	40.00	0.00	8.30	80.00	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction 3	5	0.00	36.00	0.00	8.30	80.00	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction 4	5	0.00	2.00	0.00	8.30	80.00	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction 5	5	0.00	1.00	0.00	8.30	8.00	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction 6	5	0.00	120.00	0.00	8.30	80.00	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Building Construction - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	8.0000e-004	0.0199	8.9200e-003	1.1000e-004	3.4700e-003	7.0000e-005	3.5400e-003	1.0000e-003	6.0000e-005	1.0600e-003	0.0000	11.1605	11.1605	6.9000e-004	0.0000	11.1777
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**8.0000e-004**	**0.0199**	**8.9200e-003**	**1.1000e-004**	**3.4700e-003**	**7.0000e-005**	**3.5400e-003**	**1.0000e-003**	**6.0000e-005**	**1.0600e-003**	**0.0000**	**11.1605**	**11.1605**	**6.9000e-004**	**0.0000**	**11.1777**

3.2 Building Construction - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	8.0000e-004	0.0199	8.9200e-003	1.1000e-004	3.4700e-003	7.0000e-005	3.5400e-003	1.0000e-003	6.0000e-005	1.0600e-003	0.0000	11.1605	11.1605	6.9000e-004	0.0000	11.1777
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**8.0000e-004**	**0.0199**	**8.9200e-003**	**1.1000e-004**	**3.4700e-003**	**7.0000e-005**	**3.5400e-003**	**1.0000e-003**	**6.0000e-005**	**1.0600e-003**	**0.0000**	**11.1605**	**11.1605**	**6.9000e-004**	**0.0000**	**11.1777**

3.3 Building Construction 2 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.0000e-003	0.0994	0.0446	5.6000e-004	0.0174	3.3000e-004	0.0177	5.0000e-003	3.1000e-004	5.3200e-003	0.0000	55.8024	55.8024	3.4300e-003	0.0000	55.8883
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**4.0000e-003**	**0.0994**	**0.0446**	**5.6000e-004**	**0.0174**	**3.3000e-004**	**0.0177**	**5.0000e-003**	**3.1000e-004**	**5.3200e-003**	**0.0000**	**55.8024**	**55.8024**	**3.4300e-003**	**0.0000**	**55.8883**

3.3 Building Construction 2 - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.0000e-003	0.0994	0.0446	5.6000e-004	0.0174	3.3000e-004	0.0177	5.0000e-003	3.1000e-004	5.3200e-003	0.0000	55.8024	55.8024	3.4300e-003	0.0000	55.8883
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**4.0000e-003**	**0.0994**	**0.0446**	**5.6000e-004**	**0.0174**	**3.3000e-004**	**0.0177**	**5.0000e-003**	**3.1000e-004**	**5.3200e-003**	**0.0000**	**55.8024**	**55.8024**	**3.4300e-003**	**0.0000**	**55.8883**

3.4 Building Construction 3 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	3.6000e-003	0.0895	0.0401	5.1000e-004	0.0156	2.9000e-004	0.0159	4.5000e-003	2.8000e-004	4.7900e-003	0.0000	50.2222	50.2222	3.0900e-003	0.0000	50.2994
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**3.6000e-003**	**0.0895**	**0.0401**	**5.1000e-004**	**0.0156**	**2.9000e-004**	**0.0159**	**4.5000e-003**	**2.8000e-004**	**4.7900e-003**	**0.0000**	**50.2222**	**50.2222**	**3.0900e-003**	**0.0000**	**50.2994**

3.4 Building Construction 3 - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	3.6000e-003	0.0895	0.0401	5.1000e-004	0.0156	2.9000e-004	0.0159	4.5000e-003	2.8000e-004	4.7900e-003	0.0000	50.2222	50.2222	3.0900e-003	0.0000	50.2994
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**3.6000e-003**	**0.0895**	**0.0401**	**5.1000e-004**	**0.0156**	**2.9000e-004**	**0.0159**	**4.5000e-003**	**2.8000e-004**	**4.7900e-003**	**0.0000**	**50.2222**	**50.2222**	**3.0900e-003**	**0.0000**	**50.2994**

3.5 Building Construction 4 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.0000e-004	4.9700e-003	2.2300e-003	3.0000e-005	8.7000e-004	2.0000e-005	8.8000e-004	2.5000e-004	2.0000e-005	2.7000e-004	0.0000	2.7901	2.7901	1.7000e-004	0.0000	2.7944
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.0000e-004**	**4.9700e-003**	**2.2300e-003**	**3.0000e-005**	**8.7000e-004**	**2.0000e-005**	**8.8000e-004**	**2.5000e-004**	**2.0000e-005**	**2.7000e-004**	**0.0000**	**2.7901**	**2.7901**	**1.7000e-004**	**0.0000**	**2.7944**

3.5 Building Construction 4 - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.0000e-004	4.9700e-003	2.2300e-003	3.0000e-005	8.7000e-004	2.0000e-005	8.8000e-004	2.5000e-004	2.0000e-005	2.7000e-004	0.0000	2.7901	2.7901	1.7000e-004	0.0000	2.7944
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.0000e-004**	**4.9700e-003**	**2.2300e-003**	**3.0000e-005**	**8.7000e-004**	**2.0000e-005**	**8.8000e-004**	**2.5000e-004**	**2.0000e-005**	**2.7000e-004**	**0.0000**	**2.7901**	**2.7901**	**1.7000e-004**	**0.0000**	**2.7944**

3.6 Building Construction 5 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Building Construction 5 - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Building Construction 6 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Building Construction 6 - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Building Construction 7 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0177	0.0136	0.1232	3.6000e-004	0.0446	2.6000e-004	0.0449	0.0119	2.4000e-004	0.0121	0.0000	32.4768	32.4768	8.5000e-004	0.0000	32.4980
Total	**0.0177**	**0.0136**	**0.1232**	**3.6000e-004**	**0.0446**	**2.6000e-004**	**0.0449**	**0.0119**	**2.4000e-004**	**0.0121**	**0.0000**	**32.4768**	**32.4768**	**8.5000e-004**	**0.0000**	**32.4980**

3.8 Building Construction 7 - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0177	0.0136	0.1232	3.6000e-004	0.0446	2.6000e-004	0.0449	0.0119	2.4000e-004	0.0121	0.0000	32.4768	32.4768	8.5000e-004	0.0000	32.4980
Total	**0.0177**	**0.0136**	**0.1232**	**3.6000e-004**	**0.0446**	**2.6000e-004**	**0.0449**	**0.0119**	**2.4000e-004**	**0.0121**	**0.0000**	**32.4768**	**32.4768**	**8.5000e-004**	**0.0000**	**32.4980**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Mitigated	3.9000e-004	1.4600e-003	4.1600e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.1263	1.1263	5.0000e-005	0.0000	1.1277
Unmitigated	3.9000e-004	1.4600e-003	4.1600e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.1263	1.1263	5.0000e-005	0.0000	1.1277

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Heavy Industry	1.50	1.50	1.50	3,192	3,192
Total	1.50	1.50	1.50	3,192	3,192

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Heavy Industry	6.60	5.50	6.40	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Heavy Industry	0.572071	0.027190	0.206810	0.117824	0.018361	0.005136	0.017629	0.020081	0.002790	0.002084	0.006580	0.002569	0.000873

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	2.4495	2.4495	1.1000e-004	2.0000e-005	2.4591
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	2.4495	2.4495	1.1000e-004	2.0000e-005	2.4591
NaturalGas Mitigated	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215
NaturalGas Unmitigated	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	26480	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215
Total		**1.4000e-004**	**1.3000e-003**	**1.0900e-003**	**1.0000e-005**		**1.0000e-004**	**1.0000e-004**		**1.0000e-004**	**1.0000e-004**	**0.0000**	**1.4131**	**1.4131**	**3.0000e-005**	**3.0000e-005**	**1.4215**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	26480	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215
Total		**1.4000e-004**	**1.3000e-003**	**1.0900e-003**	**1.0000e-005**		**1.0000e-004**	**1.0000e-004**		**1.0000e-004**	**1.0000e-004**	**0.0000**	**1.4131**	**1.4131**	**3.0000e-005**	**3.0000e-005**	**1.4215**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	8420	2.4495	1.1000e-004	2.0000e-005	2.4591
Total		**2.4495**	**1.1000e-004**	**2.0000e-005**	**2.4591**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	8420	2.4495	1.1000e-004	2.0000e-005	2.4591
Total		**2.4495**	**1.1000e-004**	**2.0000e-005**	**2.4591**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Unmitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.4458	3.0000e-004	1.8000e-004	0.5073
Unmitigated	0.4458	3.0000e-004	1.8000e-004	0.5073

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	0.23125 / 0	0.4458	3.0000e-004	1.8000e-004	0.5073
Total		**0.4458**	**3.0000e-004**	**1.8000e-004**	**0.5073**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	0.23125 / 0	0.4458	3.0000e-004	1.8000e-004	0.5073
Total		**0.4458**	**3.0000e-004**	**1.8000e-004**	**0.5073**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.2575	0.0128	0.0000	0.5767
Unmitigated	0.2575	0.0128	0.0000	0.5767

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	1.24	0.2575	0.0128	0.0000	0.5767
Total		**0.2575**	**0.0128**	**0.0000**	**0.5767**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	1.24	0.2575	0.0128	0.0000	0.5767
Total		**0.2575**	**0.0128**	**0.0000**	**0.5767**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type
Emergency Generator	1	0	25	367	0.73	Diesel
Emergency Generator	1	0	25	320	0.73	Diesel
Emergency Generator	1	0	50	314	0.73	Diesel
Emergency Generator	3	0	50	779	0.73	Diesel

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

10.1 Stationary Sources

Unmitigated/Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Equipment Type	tons/yr										MT/yr					
Emergency Generator - Diesel (300 - 600 HP)	0.0270	0.0754	0.0688	1.3000e-004		3.9700e-003	3.9700e-003		3.9700e-003	3.9700e-003	0.0000	12.5187	12.5187	1.7600e-003	0.0000	12.5626
Emergency Generator - Diesel (750 - 9999 HP)	0.0959	0.4288	0.2445	4.6000e-004		0.0141	0.0141		0.0141	0.0141	0.0000	44.4962	44.4962	6.2400e-003	0.0000	44.6521
Total	**0.1229**	**0.5042**	**0.3133**	**5.9000e-004**		**0.0181**	**0.0181**		**0.0181**	**0.0181**	**0.0000**	**57.0149**	**57.0149**	**8.0000e-003**	**0.0000**	**57.2147**

11.0 Vegetation

Space X Increased Cadence - Proposed - Ventural County

Ventura County APCD Air District, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Heavy Industry	1.00	1000sqft	0.02	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	31
Climate Zone	4			**Operational Year**	2024
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Space X Increased Cadence - Proposed - Ventural County - Ventura County APCD Air District, Annual

Project Characteristics - 2024 operational

Land Use -

Construction Phase - RP-1 Vendor - 36 total trips

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Trips and VMT - Building Construction is RP-1 Vendor
Building Construction 2 is LN2 Vendor
Building Construction 3 is LOX Vendor
Building Construction 4 is He Vendor
Building Construction 5 is Worker transport

Stationary Sources - Emergency Generators and Fire Pumps -

Table Name	Column Name	Default Value	New Value
tblAreaCoating	Area_EF_Residential_Interior	75	50
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblProjectCharacteristics	OperationalYear	2018	2024
tblSolidWaste	LandfillCaptureGasFlare	94.00	100.00
tblSolidWaste	LandfillNoGasCapture	6.00	0.00
tblTripsAndVMT	VendorTripLength	7.30	45.00
tblTripsAndVMT	VendorTripLength	7.30	45.00
tblTripsAndVMT	VendorTripLength	7.30	45.00
tblTripsAndVMT	VendorTripLength	7.30	45.00
tblTripsAndVMT	VendorVehicleClass		HHDT

tblTripsAndVMT	VendorVehicleClass		HHDT
tblTripsAndVMT	VendorVehicleClass		HHDT
tblTripsAndVMT	VendorVehicleClass		HHDT
tblVehicleEF	HHD	0.54	0.45
tblVehicleEF	HHD	0.13	0.17
tblVehicleEF	HHD	0.06	0.08
tblVehicleEF	HHD	1.59	1.50
tblVehicleEF	HHD	1.03	1.45
tblVehicleEF	HHD	3.36	3.91
tblVehicleEF	HHD	4,052.31	3,739.66
tblVehicleEF	HHD	1,539.89	1,647.87
tblVehicleEF	HHD	10.78	12.15
tblVehicleEF	HHD	0.02	0.02
tblVehicleEF	HHD	13.99	14.25
tblVehicleEF	HHD	1.64	2.50
tblVehicleEF	HHD	19.45	19.37
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	6.1710e-003	9.1950e-003
tblVehicleEF	HHD	9.7000e-005	9.1000e-005
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.7210e-003	8.5860e-003
tblVehicleEF	HHD	5.9040e-003	8.7970e-003
tblVehicleEF	HHD	8.9000e-005	8.3000e-005
tblVehicleEF	HHD	7.2000e-005	1.0400e-004

tblVehicleEF	HHD	4.1500e-003	6.1670e-003
tblVehicleEF	HHD	0.39	0.37
tblVehicleEF	HHD	6.0000e-005	8.1000e-005
tblVehicleEF	HHD	0.08	0.09
tblVehicleEF	HHD	4.0800e-004	6.4700e-004
tblVehicleEF	HHD	0.07	0.09
tblVehicleEF	HHD	0.04	0.03
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.6300e-004	1.8600e-004
tblVehicleEF	HHD	7.2000e-005	1.0400e-004
tblVehicleEF	HHD	4.1500e-003	6.1670e-003
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tblVehicleEF	HHD	6.0000e-005	8.1000e-005
tblVehicleEF	HHD	0.21	0.27
tblVehicleEF	HHD	4.0800e-004	6.4700e-004
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tblVehicleEF	HHD	0.51	0.42
tblVehicleEF	HHD	0.13	0.17
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tblVehicleEF	HHD	1.16	1.09
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tblVehicleEF	HHD	4,293.06	3,961.10
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tblVehicleEF	HHD	10.78	12.15
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tblVehicleEF	HHD	14.44	14.71

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tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
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tblVehicleEF	HHD	8.9000e-005	8.3000e-005
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tblVehicleEF	HHD	0.04	0.03
tblVehicleEF	HHD	0.01	0.01
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tblVehicleEF	HHD	1.1200e-004	1.5700e-004
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tblVehicleEF	HHD	1.0000e-004	1.2300e-004
tblVehicleEF	HHD	0.21	0.27

tblVehicleEF	HHD	3.8800e-004	6.1100e-004
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tblVehicleEF	HHD	0.58	0.48
tblVehicleEF	HHD	0.13	0.17
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tblVehicleEF	HHD	1,539.89	1,647.87
tblVehicleEF	HHD	10.78	12.15
tblVehicleEF	HHD	0.02	0.02
tblVehicleEF	HHD	13.37	13.62
tblVehicleEF	HHD	1.63	2.47
tblVehicleEF	HHD	19.47	19.38
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tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
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tblVehicleEF	HHD	9.7000e-005	9.1000e-005
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.7210e-003	8.5860e-003
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tblVehicleEF	HHD	8.9000e-005	8.3000e-005
tblVehicleEF	HHD	5.1000e-005	7.1000e-005
tblVehicleEF	HHD	4.2990e-003	6.4390e-003

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tblVehicleEF	HHD	4.2000e-005	6.0000e-005
tblVehicleEF	HHD	0.07	0.09
tblVehicleEF	HHD	4.5700e-004	7.1500e-004
tblVehicleEF	HHD	0.07	0.10
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.6500e-004	1.8800e-004
tblVehicleEF	HHD	5.1000e-005	7.1000e-005
tblVehicleEF	HHD	4.2990e-003	6.4390e-003
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tblVehicleEF	HHD	4.2000e-005	6.0000e-005
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tblVehicleEF	LDA	4.3070e-003	5.9100e-003
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tblVehicleEF	LDA	0.99	1.28
tblVehicleEF	LDA	230.49	214.65
tblVehicleEF	LDA	52.48	53.88
tblVehicleEF	LDA	0.60	0.57
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.06	0.08
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tblVehicleEF	LDA	2.2840e-003	2.2910e-003
tblVehicleEF	LDA	1.6730e-003	1.3810e-003

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tblVehicleEF	LDA	0.09	0.10
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	8.7910e-003	8.8560e-003
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.08
tblVehicleEF	LDA	2.3080e-003	2.1490e-003
tblVehicleEF	LDA	5.4100e-004	5.6100e-004
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.09	0.10
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.01	0.01
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.09
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tblVehicleEF	LDA	3.7370e-003	5.2450e-003
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tblVehicleEF	LDA	0.82	1.09
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tblVehicleEF	LDA	52.48	53.88
tblVehicleEF	LDA	0.60	0.57
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.05	0.08
tblVehicleEF	LDA	1.8160e-003	1.4980e-003
tblVehicleEF	LDA	2.2840e-003	2.2910e-003
tblVehicleEF	LDA	1.6730e-003	1.3810e-003

tblVehicleEF	LDA	2.1000e-003	2.1070e-003
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tblVehicleEF	LDA	0.09	0.10
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	9.3360e-003	9.1840e-003
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.05	0.07
tblVehicleEF	LDA	2.4100e-003	2.1990e-003
tblVehicleEF	LDA	5.3800e-004	5.5700e-004
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tblVehicleEF	LDA	0.09	0.10
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.01	0.01
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.06	0.08
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tblVehicleEF	LDA	1.10	1.39
tblVehicleEF	LDA	228.56	214.34
tblVehicleEF	LDA	52.48	53.88
tblVehicleEF	LDA	0.60	0.57
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.06	0.09
tblVehicleEF	LDA	1.8160e-003	1.4980e-003
tblVehicleEF	LDA	2.2840e-003	2.2910e-003
tblVehicleEF	LDA	1.6730e-003	1.3810e-003

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tblVehicleEF	LDA	0.09	0.11
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	8.6280e-003	8.7650e-003
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.08
tblVehicleEF	LDA	2.2880e-003	2.1460e-003
tblVehicleEF	LDA	5.4300e-004	5.6300e-004
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.09	0.11
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.01	0.01
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.07	0.09
tblVehicleEF	LDT1	8.8100e-003	7.1200e-003
tblVehicleEF	LDT1	0.01	0.01
tblVehicleEF	LDT1	1.07	0.85
tblVehicleEF	LDT1	2.79	2.34
tblVehicleEF	LDT1	291.88	260.79
tblVehicleEF	LDT1	67.43	65.38
tblVehicleEF	LDT1	0.04	0.03
tblVehicleEF	LDT1	0.10	0.10
tblVehicleEF	LDT1	0.16	0.14
tblVehicleEF	LDT1	2.4950e-003	1.9340e-003
tblVehicleEF	LDT1	3.2660e-003	2.8280e-003
tblVehicleEF	LDT1	2.2970e-003	1.7840e-003

tblVehicleEF	LDT1	3.0030e-003	2.6000e-003
tblVehicleEF	LDT1	0.10	0.06
tblVehicleEF	LDT1	0.27	0.17
tblVehicleEF	LDT1	0.09	0.05
tblVehicleEF	LDT1	0.02	0.02
tblVehicleEF	LDT1	0.18	0.12
tblVehicleEF	LDT1	0.19	0.15
tblVehicleEF	LDT1	2.9310e-003	2.6170e-003
tblVehicleEF	LDT1	7.2300e-004	6.9400e-004
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tblVehicleEF	LDT1	0.27	0.17
tblVehicleEF	LDT1	0.09	0.05
tblVehicleEF	LDT1	0.03	0.03
tblVehicleEF	LDT1	0.18	0.12
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tblVehicleEF	LDT1	0.09	0.09
tblVehicleEF	LDT1	0.14	0.13
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tblVehicleEF	LDT1	2.2970e-003	1.7840e-003

tblVehicleEF	LDT1	3.0030e-003	2.6000e-003
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tblVehicleEF	LDT1	0.28	0.17
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tblVehicleEF	LDT1	0.02	0.02
tblVehicleEF	LDT1	0.16	0.11
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tblVehicleEF	LDT1	0.28	0.17
tblVehicleEF	LDT1	0.16	0.08
tblVehicleEF	LDT1	0.03	0.03
tblVehicleEF	LDT1	0.16	0.11
tblVehicleEF	LDT1	0.18	0.14
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tblVehicleEF	LDT1	289.54	260.42
tblVehicleEF	LDT1	67.43	65.38
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tblVehicleEF	LDT1	0.11	0.10
tblVehicleEF	LDT1	0.17	0.15
tblVehicleEF	LDT1	2.4950e-003	1.9340e-003
tblVehicleEF	LDT1	3.2660e-003	2.8280e-003
tblVehicleEF	LDT1	2.2970e-003	1.7840e-003

tblVehicleEF	LDT1	3.0030e-003	2.6000e-003
tblVehicleEF	LDT1	0.07	0.04
tblVehicleEF	LDT1	0.30	0.19
tblVehicleEF	LDT1	0.07	0.04
tblVehicleEF	LDT1	0.02	0.02
tblVehicleEF	LDT1	0.22	0.15
tblVehicleEF	LDT1	0.20	0.16
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tblVehicleEF	LDT1	7.2900e-004	6.9800e-004
tblVehicleEF	LDT1	0.07	0.04
tblVehicleEF	LDT1	0.30	0.19
tblVehicleEF	LDT1	0.07	0.04
tblVehicleEF	LDT1	0.03	0.03
tblVehicleEF	LDT1	0.22	0.15
tblVehicleEF	LDT1	0.22	0.17
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tblVehicleEF	LDT2	0.64	0.86
tblVehicleEF	LDT2	1.30	2.36
tblVehicleEF	LDT2	323.19	315.30
tblVehicleEF	LDT2	74.04	78.59
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tblVehicleEF	LDT2	0.06	0.12
tblVehicleEF	LDT2	0.09	0.22
tblVehicleEF	LDT2	1.8330e-003	1.6310e-003
tblVehicleEF	LDT2	2.3570e-003	2.5520e-003
tblVehicleEF	LDT2	1.6860e-003	1.5000e-003

tblVehicleEF	LDT2	2.1680e-003	2.3460e-003
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tblVehicleEF	LDT2	0.10	0.17
tblVehicleEF	LDT2	0.04	0.06
tblVehicleEF	LDT2	0.01	0.02
tblVehicleEF	LDT2	0.06	0.11
tblVehicleEF	LDT2	0.08	0.16
tblVehicleEF	LDT2	3.2360e-003	3.1610e-003
tblVehicleEF	LDT2	7.6200e-004	8.2700e-004
tblVehicleEF	LDT2	0.04	0.06
tblVehicleEF	LDT2	0.10	0.17
tblVehicleEF	LDT2	0.04	0.06
tblVehicleEF	LDT2	0.02	0.03
tblVehicleEF	LDT2	0.06	0.11
tblVehicleEF	LDT2	0.09	0.18
tblVehicleEF	LDT2	4.9900e-003	7.6050e-003
tblVehicleEF	LDT2	5.0060e-003	0.01
tblVehicleEF	LDT2	0.69	0.89
tblVehicleEF	LDT2	1.07	2.00
tblVehicleEF	LDT2	337.16	322.41
tblVehicleEF	LDT2	74.04	78.59
tblVehicleEF	LDT2	0.19	0.21
tblVehicleEF	LDT2	0.05	0.10
tblVehicleEF	LDT2	0.08	0.20
tblVehicleEF	LDT2	1.8330e-003	1.6310e-003
tblVehicleEF	LDT2	2.3570e-003	2.5520e-003
tblVehicleEF	LDT2	1.6860e-003	1.5000e-003

tblVehicleEF	LDT2	2.1680e-003	2.3460e-003
tblVehicleEF	LDT2	0.06	0.08
tblVehicleEF	LDT2	0.10	0.17
tblVehicleEF	LDT2	0.07	0.09
tblVehicleEF	LDT2	0.01	0.02
tblVehicleEF	LDT2	0.05	0.10
tblVehicleEF	LDT2	0.07	0.14
tblVehicleEF	LDT2	3.3770e-003	3.2330e-003
tblVehicleEF	LDT2	7.5800e-004	8.2100e-004
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tblVehicleEF	LDT2	0.10	0.17
tblVehicleEF	LDT2	0.07	0.09
tblVehicleEF	LDT2	0.02	0.03
tblVehicleEF	LDT2	0.05	0.10
tblVehicleEF	LDT2	0.07	0.16
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tblVehicleEF	LDT2	6.2300e-003	0.01
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tblVehicleEF	LDT2	74.04	78.59
tblVehicleEF	LDT2	0.19	0.21
tblVehicleEF	LDT2	0.06	0.12
tblVehicleEF	LDT2	0.10	0.23
tblVehicleEF	LDT2	1.8330e-003	1.6310e-003
tblVehicleEF	LDT2	2.3570e-003	2.5520e-003
tblVehicleEF	LDT2	1.6860e-003	1.5000e-003

tblVehicleEF	LDT2	2.1680e-003	2.3460e-003
tblVehicleEF	LDT2	0.02	0.04
tblVehicleEF	LDT2	0.10	0.18
tblVehicleEF	LDT2	0.03	0.04
tblVehicleEF	LDT2	0.01	0.02
tblVehicleEF	LDT2	0.07	0.14
tblVehicleEF	LDT2	0.08	0.17
tblVehicleEF	LDT2	3.2100e-003	3.1570e-003
tblVehicleEF	LDT2	7.6400e-004	8.3100e-004
tblVehicleEF	LDT2	0.02	0.04
tblVehicleEF	LDT2	0.10	0.18
tblVehicleEF	LDT2	0.03	0.04
tblVehicleEF	LDT2	0.02	0.03
tblVehicleEF	LDT2	0.07	0.14
tblVehicleEF	LDT2	0.09	0.19
tblVehicleEF	LHD1	4.7270e-003	5.4490e-003
tblVehicleEF	LHD1	9.9090e-003	0.02
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.14	0.15
tblVehicleEF	LHD1	0.81	1.35
tblVehicleEF	LHD1	2.31	2.95
tblVehicleEF	LHD1	9.24	9.06
tblVehicleEF	LHD1	588.73	704.54
tblVehicleEF	LHD1	28.63	32.76
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.09	0.08
tblVehicleEF	LHD1	1.63	1.63

tblVehicleEF	LHD1	0.88	1.09
tblVehicleEF	LHD1	9.7800e-004	8.6400e-004
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tblVehicleEF	LHD1	0.01	0.02
tblVehicleEF	LHD1	8.4900e-004	1.0970e-003
tblVehicleEF	LHD1	9.3600e-004	8.2600e-004
tblVehicleEF	LHD1	2.5730e-003	2.4970e-003
tblVehicleEF	LHD1	0.01	0.02
tblVehicleEF	LHD1	7.8100e-004	1.0080e-003
tblVehicleEF	LHD1	2.2500e-003	2.7430e-003
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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.5120e-003	1.6920e-003
tblVehicleEF	LHD1	0.07	0.14
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tblVehicleEF	LHD1	0.23	0.30
tblVehicleEF	LHD1	9.2000e-005	9.1000e-005
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tblVehicleEF	LHD1	3.3000e-004	3.8300e-004
tblVehicleEF	LHD1	2.2500e-003	2.7430e-003
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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.5120e-003	1.6920e-003
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tblVehicleEF	LHD1	0.25	0.33
tblVehicleEF	LHD1	4.7270e-003	5.4490e-003

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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.14	0.15
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tblVehicleEF	LHD1	2.16	2.76
tblVehicleEF	LHD1	9.24	9.06
tblVehicleEF	LHD1	588.73	704.54
tblVehicleEF	LHD1	28.63	32.76
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.09	0.08
tblVehicleEF	LHD1	1.55	1.56
tblVehicleEF	LHD1	0.83	1.02
tblVehicleEF	LHD1	9.7800e-004	8.6400e-004
tblVehicleEF	LHD1	0.01	9.9890e-003
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tblVehicleEF	LHD1	2.5730e-003	2.4970e-003
tblVehicleEF	LHD1	0.01	0.02
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tblVehicleEF	LHD1	3.4900e-003	4.1790e-003
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tblVehicleEF	LHD1	3.4900e-003	4.1790e-003
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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	2.4990e-003	2.5810e-003
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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.14	0.15
tblVehicleEF	LHD1	0.81	1.33
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tblVehicleEF	LHD1	9.24	9.06
tblVehicleEF	LHD1	588.73	704.54
tblVehicleEF	LHD1	28.63	32.76
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.09	0.08
tblVehicleEF	LHD1	1.62	1.61
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tblVehicleEF	LHD1	9.7800e-004	8.6400e-004
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tblVehicleEF	LHD1	8.4900e-004	1.0970e-003

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tblVehicleEF	LHD1	2.5730e-003	2.4970e-003
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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.0630e-003	1.2420e-003
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tblVehicleEF	LHD1	0.36	0.52
tblVehicleEF	LHD1	0.24	0.31
tblVehicleEF	LHD1	9.2000e-005	9.1000e-005
tblVehicleEF	LHD1	5.7640e-003	6.9250e-003
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tblVehicleEF	LHD1	1.5530e-003	1.7600e-003
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tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.0630e-003	1.2420e-003
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tblVehicleEF	LHD2	3.5590e-003	3.5760e-003
tblVehicleEF	LHD2	3.5620e-003	8.9930e-003
tblVehicleEF	LHD2	7.1380e-003	8.7560e-003
tblVehicleEF	LHD2	0.12	0.12
tblVehicleEF	LHD2	0.34	0.68
tblVehicleEF	LHD2	1.15	1.29

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tblVehicleEF	LHD2	0.52	0.57
tblVehicleEF	LHD2	1.1680e-003	1.1990e-003
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tblVehicleEF	LHD2	0.01	0.02
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tblVehicleEF	LHD2	6.8210e-003	8.3490e-003
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tblVehicleEF	LHD2	1.1680e-003	1.1990e-003
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tblVehicleEF	LHD2	2.6720e-003	2.6750e-003
tblVehicleEF	LHD2	9.6360e-003	0.02
tblVehicleEF	LHD2	3.4700e-004	3.9600e-004
tblVehicleEF	LHD2	5.6400e-004	6.1100e-004
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tblVehicleEF	LHD2	4.3400e-004	4.6800e-004
tblVehicleEF	LHD2	0.05	0.13
tblVehicleEF	LHD2	0.08	0.12
tblVehicleEF	LHD2	0.11	0.13

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tblVehicleEF	MCY	3.8160e-003	6.5800e-003
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tblVehicleEF	MCY	0.32	0.33
tblVehicleEF	MCY	2.1940e-003	1.8400e-003
tblVehicleEF	MCY	3.7430e-003	3.8990e-003
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tblVehicleEF	MCY	0.59	0.54
tblVehicleEF	MCY	2.37	2.12
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tblVehicleEF	MCY	6.8600e-004	7.0500e-004
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tblVehicleEF	MCY	0.76	0.87
tblVehicleEF	MCY	0.59	0.54
tblVehicleEF	MCY	2.94	2.60
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tblVehicleEF	MCY	2.37	2.51

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tblVehicleEF	MCY	175.65	160.91
tblVehicleEF	MCY	45.94	47.13
tblVehicleEF	MCY	3.8160e-003	6.5800e-003
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tblVehicleEF	MCY	2.1940e-003	1.8400e-003
tblVehicleEF	MCY	3.7430e-003	3.8990e-003
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tblVehicleEF	MCY	1.58	1.46
tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	1.21	0.98
tblVehicleEF	MCY	2.83	2.49
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tblVehicleEF	MCY	2.03	2.15

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tblVehicleEF	MCY	7.0600e-004	7.2300e-004
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tblVehicleEF	MCY	3.02	2.67
tblVehicleEF	MCY	1.17	0.81
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tblVehicleEF	MDV	2.1690e-003	2.2960e-003
tblVehicleEF	MDV	0.06	0.07
tblVehicleEF	MDV	0.17	0.21
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tblVehicleEF	MDV	0.02	0.03
tblVehicleEF	MDV	0.11	0.14
tblVehicleEF	MDV	0.18	0.27
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tblVehicleEF	MDV	1.0520e-003	1.1060e-003
tblVehicleEF	MDV	0.06	0.07
tblVehicleEF	MDV	0.17	0.21
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tblVehicleEF	MDV	0.03	0.04
tblVehicleEF	MDV	0.11	0.14
tblVehicleEF	MDV	0.20	0.29

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tblVehicleEF	MDV	0.01	0.02
tblVehicleEF	MDV	1.08	1.18
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tblVehicleEF	MDV	0.11	0.12
tblVehicleEF	MDV	0.10	0.16
tblVehicleEF	MDV	0.20	0.34
tblVehicleEF	MDV	1.8700e-003	1.6370e-003
tblVehicleEF	MDV	2.3580e-003	2.4960e-003
tblVehicleEF	MDV	1.7230e-003	1.5090e-003
tblVehicleEF	MDV	2.1690e-003	2.2960e-003
tblVehicleEF	MDV	0.09	0.10
tblVehicleEF	MDV	0.17	0.21
tblVehicleEF	MDV	0.11	0.11
tblVehicleEF	MDV	0.02	0.03
tblVehicleEF	MDV	0.10	0.12
tblVehicleEF	MDV	0.16	0.24
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tblVehicleEF	MDV	1.0440e-003	1.0970e-003
tblVehicleEF	MDV	0.09	0.10
tblVehicleEF	MDV	0.17	0.21
tblVehicleEF	MDV	0.11	0.11
tblVehicleEF	MDV	0.03	0.04
tblVehicleEF	MDV	0.10	0.12
tblVehicleEF	MDV	0.17	0.26

tblVehicleEF	MDV	8.6850e-003	0.01
tblVehicleEF	MDV	0.01	0.02
tblVehicleEF	MDV	0.97	1.13
tblVehicleEF	MDV	2.76	3.79
tblVehicleEF	MDV	441.47	425.45
tblVehicleEF	MDV	100.86	104.46
tblVehicleEF	MDV	0.11	0.12
tblVehicleEF	MDV	0.11	0.18
tblVehicleEF	MDV	0.23	0.38
tblVehicleEF	MDV	1.8700e-003	1.6370e-003
tblVehicleEF	MDV	2.3580e-003	2.4960e-003
tblVehicleEF	MDV	1.7230e-003	1.5090e-003
tblVehicleEF	MDV	2.1690e-003	2.2960e-003
tblVehicleEF	MDV	0.04	0.04
tblVehicleEF	MDV	0.18	0.22
tblVehicleEF	MDV	0.05	0.05
tblVehicleEF	MDV	0.02	0.03
tblVehicleEF	MDV	0.13	0.16
tblVehicleEF	MDV	0.20	0.29
tblVehicleEF	MDV	4.4190e-003	4.2620e-003
tblVehicleEF	MDV	1.0570e-003	1.1120e-003
tblVehicleEF	MDV	0.04	0.04
tblVehicleEF	MDV	0.18	0.22
tblVehicleEF	MDV	0.05	0.05
tblVehicleEF	MDV	0.03	0.04
tblVehicleEF	MDV	0.13	0.16
tblVehicleEF	MDV	0.22	0.31

tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	0.02	0.03
tblVehicleEF	MH	2.02	3.05
tblVehicleEF	MH	5.50	6.69
tblVehicleEF	MH	1,091.02	1,227.69
tblVehicleEF	MH	58.65	60.47
tblVehicleEF	MH	1.2930e-003	8.7300e-004
tblVehicleEF	MH	1.42	1.54
tblVehicleEF	MH	0.83	0.97
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	1.0050e-003	1.2870e-003
tblVehicleEF	MH	3.2300e-003	3.2100e-003
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	9.2400e-004	1.1830e-003
tblVehicleEF	MH	0.86	0.95
tblVehicleEF	MH	0.08	0.09
tblVehicleEF	MH	0.41	0.41
tblVehicleEF	MH	0.08	0.13
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	0.32	0.38
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.8200e-004	7.2100e-004
tblVehicleEF	MH	0.86	0.95
tblVehicleEF	MH	0.08	0.09
tblVehicleEF	MH	0.41	0.41
tblVehicleEF	MH	0.11	0.18

tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	0.35	0.42
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	0.02	0.03
tblVehicleEF	MH	2.09	3.15
tblVehicleEF	MH	5.08	6.25
tblVehicleEF	MH	1,091.02	1,227.69
tblVehicleEF	MH	58.65	60.47
tblVehicleEF	MH	1.2930e-003	8.7300e-004
tblVehicleEF	MH	1.33	1.45
tblVehicleEF	MH	0.78	0.91
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	1.0050e-003	1.2870e-003
tblVehicleEF	MH	3.2300e-003	3.2100e-003
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	9.2400e-004	1.1830e-003
tblVehicleEF	MH	1.28	1.44
tblVehicleEF	MH	0.08	0.09
tblVehicleEF	MH	0.67	0.61
tblVehicleEF	MH	0.08	0.13
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	0.31	0.37
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.7500e-004	7.1400e-004
tblVehicleEF	MH	1.28	1.44
tblVehicleEF	MH	0.08	0.09

tblVehicleEF	MH	0.67	0.61
tblVehicleEF	MH	0.12	0.18
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	0.33	0.40
tblVehicleEF	MH	0.02	0.04
tblVehicleEF	MH	0.02	0.03
tblVehicleEF	MH	1.97	2.99
tblVehicleEF	MH	5.74	6.95
tblVehicleEF	MH	1,091.02	1,227.69
tblVehicleEF	MH	58.65	60.47
tblVehicleEF	MH	1.2930e-003	8.7300e-004
tblVehicleEF	MH	1.42	1.53
tblVehicleEF	MH	0.87	1.00
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	1.0050e-003	1.2870e-003
tblVehicleEF	MH	3.2300e-003	3.2100e-003
tblVehicleEF	MH	0.03	0.03
tblVehicleEF	MH	9.2400e-004	1.1830e-003
tblVehicleEF	MH	0.61	0.61
tblVehicleEF	MH	0.09	0.11
tblVehicleEF	MH	0.29	0.29
tblVehicleEF	MH	0.08	0.13
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	0.33	0.40
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.8700e-004	7.2600e-004

tblVehicleEF	MH	0.61	0.61
tblVehicleEF	MH	0.09	0.11
tblVehicleEF	MH	0.29	0.29
tblVehicleEF	MH	0.11	0.17
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	0.37	0.43
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	2.8490e-003	5.7070e-003
tblVehicleEF	MHD	0.05	0.06
tblVehicleEF	MHD	0.31	0.35
tblVehicleEF	MHD	0.25	0.43
tblVehicleEF	MHD	5.17	6.49
tblVehicleEF	MHD	150.93	147.46
tblVehicleEF	MHD	1,107.40	1,188.06
tblVehicleEF	MHD	53.04	55.68
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.41	0.52
tblVehicleEF	MHD	0.66	1.39
tblVehicleEF	MHD	11.70	11.50
tblVehicleEF	MHD	1.0500e-004	2.9000e-004
tblVehicleEF	MHD	2.8600e-003	5.0260e-003
tblVehicleEF	MHD	7.4800e-004	8.6100e-004
tblVehicleEF	MHD	1.0000e-004	2.7700e-004
tblVehicleEF	MHD	2.7330e-003	4.8030e-003
tblVehicleEF	MHD	6.8800e-004	7.9200e-004
tblVehicleEF	MHD	7.3700e-004	9.5000e-004
tblVehicleEF	MHD	0.04	0.05

tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	5.2800e-004	6.1700e-004
tblVehicleEF	MHD	0.03	0.05
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	0.31	0.39
tblVehicleEF	MHD	1.4510e-003	1.4180e-003
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	6.2100e-004	6.7100e-004
tblVehicleEF	MHD	7.3700e-004	9.5000e-004
tblVehicleEF	MHD	0.04	0.05
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	5.2800e-004	6.1700e-004
tblVehicleEF	MHD	0.04	0.06
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	0.34	0.43
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tblVehicleEF	MHD	2.8970e-003	5.8160e-003
tblVehicleEF	MHD	0.05	0.06
tblVehicleEF	MHD	0.23	0.23
tblVehicleEF	MHD	0.25	0.44
tblVehicleEF	MHD	4.83	6.06
tblVehicleEF	MHD	159.86	156.50
tblVehicleEF	MHD	1,107.40	1,188.06
tblVehicleEF	MHD	53.04	55.68
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.42	0.53
tblVehicleEF	MHD	0.63	1.34

tblVehicleEF	MHD	11.66	11.44
tblVehicleEF	MHD	8.8000e-005	2.4400e-004
tblVehicleEF	MHD	2.8600e-003	5.0260e-003
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tblVehicleEF	MHD	1.1570e-003	1.4630e-003
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tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	8.9400e-004	9.5500e-004
tblVehicleEF	MHD	0.03	0.05
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.29	0.37
tblVehicleEF	MHD	1.5350e-003	1.5030e-003
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	6.1500e-004	6.6300e-004
tblVehicleEF	MHD	1.1570e-003	1.4630e-003
tblVehicleEF	MHD	0.04	0.05
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	8.9400e-004	9.5500e-004
tblVehicleEF	MHD	0.04	0.06
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.32	0.40
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	2.8190e-003	5.6470e-003
tblVehicleEF	MHD	0.05	0.06

tblVehicleEF	MHD	0.43	0.44
tblVehicleEF	MHD	0.25	0.43
tblVehicleEF	MHD	5.42	6.76
tblVehicleEF	MHD	138.57	135.66
tblVehicleEF	MHD	1,107.40	1,188.06
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tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.39	0.49
tblVehicleEF	MHD	0.65	1.37
tblVehicleEF	MHD	11.73	11.53
tblVehicleEF	MHD	1.2800e-004	3.5300e-004
tblVehicleEF	MHD	2.8600e-003	5.0260e-003
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tblVehicleEF	MHD	6.8800e-004	7.9200e-004
tblVehicleEF	MHD	5.0900e-004	6.1100e-004
tblVehicleEF	MHD	0.04	0.06
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	3.6900e-004	4.4800e-004
tblVehicleEF	MHD	0.03	0.05
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	0.32	0.40
tblVehicleEF	MHD	1.3340e-003	1.3070e-003
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	6.2500e-004	6.7500e-004
tblVehicleEF	MHD	5.0900e-004	6.1100e-004

tblVehicleEF	MHD	0.04	0.06
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	3.6900e-004	4.4800e-004
tblVehicleEF	MHD	0.04	0.06
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	0.35	0.44
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tblVehicleEF	OBUS	7.0220e-003	8.6260e-003
tblVehicleEF	OBUS	0.03	0.03
tblVehicleEF	OBUS	0.24	0.24
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tblVehicleEF	OBUS	1.60	3.94
tblVehicleEF	OBUS	6.0000e-006	2.7000e-005
tblVehicleEF	OBUS	1.9110e-003	2.9470e-003
tblVehicleEF	OBUS	9.3300e-004	8.8000e-004
tblVehicleEF	OBUS	6.0000e-006	2.6000e-005
tblVehicleEF	OBUS	1.8040e-003	2.8020e-003
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tblVehicleEF	OBUS	1.2080e-003	1.3850e-003
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tblVehicleEF	OBUS	0.03	0.03
tblVehicleEF	OBUS	7.1000e-004	7.2200e-004
tblVehicleEF	OBUS	0.03	0.05
tblVehicleEF	OBUS	0.06	0.04
tblVehicleEF	OBUS	0.34	0.37
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tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	8.0600e-004	7.4300e-004
tblVehicleEF	OBUS	1.2080e-003	1.3850e-003
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tblVehicleEF	OBUS	0.04	0.04
tblVehicleEF	OBUS	7.1000e-004	7.2200e-004
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tblVehicleEF	OBUS	0.06	0.04
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tblVehicleEF	OBUS	7.2140e-003	8.8350e-003
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tblVehicleEF	OBUS	0.24	0.23
tblVehicleEF	OBUS	0.49	0.61
tblVehicleEF	OBUS	5.17	5.74
tblVehicleEF	OBUS	46.97	140.76
tblVehicleEF	OBUS	1,144.46	1,295.95
tblVehicleEF	OBUS	70.88	63.59
tblVehicleEF	OBUS	1.1820e-003	2.7900e-003
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tblVehicleEF	OBUS	0.40	1.02

tblVehicleEF	OBUS	1.55	3.88
tblVehicleEF	OBUS	5.0000e-006	2.3000e-005
tblVehicleEF	OBUS	1.9110e-003	2.9470e-003
tblVehicleEF	OBUS	9.3300e-004	8.8000e-004
tblVehicleEF	OBUS	5.0000e-006	2.2000e-005
tblVehicleEF	OBUS	1.8040e-003	2.8020e-003
tblVehicleEF	OBUS	8.5800e-004	8.0900e-004
tblVehicleEF	OBUS	1.8210e-003	2.0670e-003
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tblVehicleEF	OBUS	1.64	3.97
tblVehicleEF	OBUS	8.0000e-006	3.3000e-005
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tblVehicleEF	OBUS	0.39	0.42
tblVehicleEF	SBUS	0.84	0.78
tblVehicleEF	SBUS	8.7700e-003	9.8630e-003
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tblVehicleEF	SBUS	6.7040e-003	6.4740e-003
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tblVehicleEF	SBUS	2.6320e-003	2.4950e-003
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tblVehicleEF	SBUS	1,049.12	977.24
tblVehicleEF	SBUS	61.15	66.40
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tblVehicleEF	SBUS	1.1270e-003	3.1200e-004
tblVehicleEF	SBUS	5.4070e-003	5.2220e-003
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tblVehicleEF	SBUS	2.3150e-003	3.9310e-003
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tblVehicleEF	SBUS	0.01	0.02
tblVehicleEF	SBUS	0.33	0.39
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.01	9.4810e-003
tblVehicleEF	SBUS	7.1400e-004	7.7600e-004
tblVehicleEF	SBUS	3.6780e-003	6.5400e-003
tblVehicleEF	SBUS	0.02	0.05
tblVehicleEF	SBUS	1.57	1.50
tblVehicleEF	SBUS	2.3150e-003	3.9310e-003
tblVehicleEF	SBUS	0.11	0.09
tblVehicleEF	SBUS	0.01	0.02

tblVehicleEF	SBUS	0.36	0.43
tblVehicleEF	SBUS	0.84	0.78
tblVehicleEF	SBUS	8.6750e-003	9.7590e-003
tblVehicleEF	SBUS	0.06	0.07
tblVehicleEF	SBUS	9.20	9.03
tblVehicleEF	SBUS	0.52	0.59
tblVehicleEF	SBUS	8.53	8.54
tblVehicleEF	SBUS	994.62	996.70
tblVehicleEF	SBUS	1,049.12	977.24
tblVehicleEF	SBUS	61.15	66.40
tblVehicleEF	SBUS	3.8900e-004	2.5690e-003
tblVehicleEF	SBUS	7.13	6.89
tblVehicleEF	SBUS	3.40	2.75
tblVehicleEF	SBUS	10.89	10.61
tblVehicleEF	SBUS	8.1580e-003	7.8780e-003
tblVehicleEF	SBUS	0.01	9.9780e-003
tblVehicleEF	SBUS	0.02	0.01
tblVehicleEF	SBUS	1.1270e-003	3.1200e-004
tblVehicleEF	SBUS	7.8050e-003	7.5370e-003
tblVehicleEF	SBUS	2.6320e-003	2.4950e-003
tblVehicleEF	SBUS	0.02	0.01
tblVehicleEF	SBUS	1.0360e-003	2.8600e-004
tblVehicleEF	SBUS	1.7320e-003	3.2410e-003
tblVehicleEF	SBUS	0.02	0.05
tblVehicleEF	SBUS	1.09	1.04
tblVehicleEF	SBUS	9.5400e-004	2.0740e-003
tblVehicleEF	SBUS	0.09	0.08

tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	0.41	0.46
tblVehicleEF	SBUS	9.8040e-003	9.8310e-003
tblVehicleEF	SBUS	0.01	9.4810e-003
tblVehicleEF	SBUS	7.5800e-004	8.1200e-004
tblVehicleEF	SBUS	1.7320e-003	3.2410e-003
tblVehicleEF	SBUS	0.02	0.05
tblVehicleEF	SBUS	1.58	1.51
tblVehicleEF	SBUS	9.5400e-004	2.0740e-003
tblVehicleEF	SBUS	0.10	0.09
tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	0.44	0.51
tblVehicleEF	UBUS	1.62	0.24
tblVehicleEF	UBUS	0.05	0.06
tblVehicleEF	UBUS	6.70	4.44
tblVehicleEF	UBUS	9.37	9.77
tblVehicleEF	UBUS	1,785.78	2,045.24
tblVehicleEF	UBUS	131.72	112.15
tblVehicleEF	UBUS	1.0400e-003	2.0840e-003
tblVehicleEF	UBUS	3.03	6.94
tblVehicleEF	UBUS	12.96	14.53
tblVehicleEF	UBUS	0.53	0.58
tblVehicleEF	UBUS	0.03	0.14
tblVehicleEF	UBUS	1.2850e-003	1.0310e-003
tblVehicleEF	UBUS	0.23	0.25
tblVehicleEF	UBUS	0.03	0.13
tblVehicleEF	UBUS	1.1820e-003	9.4800e-004

tblVehicleEF	UBUS	2.2480e-003	3.2620e-003
tblVehicleEF	UBUS	0.04	0.07
tblVehicleEF	UBUS	1.7390e-003	2.1400e-003
tblVehicleEF	UBUS	0.27	0.40
tblVehicleEF	UBUS	9.8670e-003	0.01
tblVehicleEF	UBUS	0.73	0.78
tblVehicleEF	UBUS	8.3290e-003	0.02
tblVehicleEF	UBUS	1.4860e-003	1.2990e-003
tblVehicleEF	UBUS	2.2480e-003	3.2620e-003
tblVehicleEF	UBUS	0.04	0.07
tblVehicleEF	UBUS	1.7390e-003	2.1400e-003
tblVehicleEF	UBUS	1.93	0.67
tblVehicleEF	UBUS	9.8670e-003	0.01
tblVehicleEF	UBUS	0.80	0.85
tblVehicleEF	UBUS	1.62	0.24
tblVehicleEF	UBUS	0.05	0.05
tblVehicleEF	UBUS	6.72	4.49
tblVehicleEF	UBUS	7.91	8.30
tblVehicleEF	UBUS	1,785.78	2,045.24
tblVehicleEF	UBUS	131.72	112.15
tblVehicleEF	UBUS	1.0400e-003	2.0840e-003
tblVehicleEF	UBUS	2.88	6.67
tblVehicleEF	UBUS	12.88	14.45
tblVehicleEF	UBUS	0.53	0.58
tblVehicleEF	UBUS	0.03	0.14
tblVehicleEF	UBUS	1.2850e-003	1.0310e-003
tblVehicleEF	UBUS	0.23	0.25

tblVehicleEF	UBUS	0.03	0.13
tblVehicleEF	UBUS	1.1820e-003	9.4800e-004
tblVehicleEF	UBUS	3.1800e-003	4.8690e-003
tblVehicleEF	UBUS	0.04	0.07
tblVehicleEF	UBUS	3.0000e-003	3.1540e-003
tblVehicleEF	UBUS	0.28	0.40
tblVehicleEF	UBUS	8.6570e-003	0.01
tblVehicleEF	UBUS	0.66	0.70
tblVehicleEF	UBUS	8.3300e-003	0.02
tblVehicleEF	UBUS	1.4610e-003	1.2730e-003
tblVehicleEF	UBUS	3.1800e-003	4.8690e-003
tblVehicleEF	UBUS	0.04	0.07
tblVehicleEF	UBUS	3.0000e-003	3.1540e-003
tblVehicleEF	UBUS	1.93	0.68
tblVehicleEF	UBUS	8.6570e-003	0.01
tblVehicleEF	UBUS	0.72	0.77
tblVehicleEF	UBUS	1.62	0.24
tblVehicleEF	UBUS	0.06	0.06
tblVehicleEF	UBUS	6.68	4.42
tblVehicleEF	UBUS	10.35	10.66
tblVehicleEF	UBUS	1,785.78	2,045.24
tblVehicleEF	UBUS	131.72	112.15
tblVehicleEF	UBUS	1.0400e-003	2.0840e-003
tblVehicleEF	UBUS	3.01	6.84
tblVehicleEF	UBUS	13.01	14.58
tblVehicleEF	UBUS	0.53	0.58
tblVehicleEF	UBUS	0.03	0.14

tblVehicleEF	UBUS	1.2850e-003	1.0310e-003
tblVehicleEF	UBUS	0.23	0.25
tblVehicleEF	UBUS	0.03	0.13
tblVehicleEF	UBUS	1.1820e-003	9.4800e-004
tblVehicleEF	UBUS	1.7130e-003	2.2510e-003
tblVehicleEF	UBUS	0.04	0.08
tblVehicleEF	UBUS	1.2070e-003	1.5620e-003
tblVehicleEF	UBUS	0.27	0.39
tblVehicleEF	UBUS	0.01	0.02
tblVehicleEF	UBUS	0.77	0.82
tblVehicleEF	UBUS	8.3290e-003	0.02
tblVehicleEF	UBUS	1.5030e-003	1.3140e-003
tblVehicleEF	UBUS	1.7130e-003	2.2510e-003
tblVehicleEF	UBUS	0.04	0.08
tblVehicleEF	UBUS	1.2070e-003	1.5620e-003
tblVehicleEF	UBUS	1.93	0.67
tblVehicleEF	UBUS	0.01	0.02
tblVehicleEF	UBUS	0.85	0.90
tblVehicleTrips	CC_TL	7.30	5.50
tblVehicleTrips	CNW_TL	7.30	6.40
tblVehicleTrips	CW_TL	9.50	6.60

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	4.4100e-003	0.1251	0.0571	7.6000e-004	0.0199	3.4000e-004	0.0202	5.4600e-003	3.2000e-004	5.7800e-003	0.0000	76.2512	76.2512	6.7100e-003	0.0000	76.4189
Maximum	**4.4100e-003**	**0.1251**	**0.0571**	**7.6000e-004**	**0.0199**	**3.4000e-004**	**0.0202**	**5.4600e-003**	**3.2000e-004**	**5.7800e-003**	**0.0000**	**76.2512**	**76.2512**	**6.7100e-003**	**0.0000**	**76.4189**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	4.4100e-003	0.1251	0.0571	7.6000e-004	0.0199	3.4000e-004	0.0202	5.4600e-003	3.2000e-004	5.7800e-003	0.0000	76.2512	76.2512	6.7100e-003	0.0000	76.4189
Maximum	**4.4100e-003**	**0.1251**	**0.0571**	**7.6000e-004**	**0.0199**	**3.4000e-004**	**0.0202**	**5.4600e-003**	**3.2000e-004**	**5.7800e-003**	**0.0000**	**76.2512**	**76.2512**	**6.7100e-003**	**0.0000**	**76.4189**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**1-1-2023**	**3-31-2023**	0.2471	0.2471
		Highest	0.2471	0.2471

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	3.8626	3.8626	1.4000e-004	5.0000e-005	3.8805
Mobile	3.5000e-004	1.3200e-003	3.8500e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0915	1.0915	4.0000e-005	0.0000	1.0926
Waste						0.0000	0.0000		0.0000	0.0000	0.2575	0.0000	0.2575	0.0128	0.0000	0.5767
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.8760	0.9493	7.5700e-003	1.9000e-004	1.1942
Total	**5.5600e-003**	**2.6200e-003**	**4.9500e-003**	**2.0000e-005**	**1.2100e-003**	**1.1000e-004**	**1.3200e-003**	**3.2000e-004**	**1.1000e-004**	**4.3000e-004**	**0.3309**	**5.8300**	**6.1609**	**0.0205**	**2.4000e-004**	**6.7440**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	3.8626	3.8626	1.4000e-004	5.0000e-005	3.8805
Mobile	3.5000e-004	1.3200e-003	3.8500e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0915	1.0915	4.0000e-005	0.0000	1.0926
Waste						0.0000	0.0000		0.0000	0.0000	0.2575	0.0000	0.2575	0.0128	0.0000	0.5767
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.8760	0.9493	7.5700e-003	1.9000e-004	1.1942
Total	**5.5600e-003**	**2.6200e-003**	**4.9500e-003**	**2.0000e-005**	**1.2100e-003**	**1.1000e-004**	**1.3200e-003**	**3.2000e-004**	**1.1000e-004**	**4.3000e-004**	**0.3309**	**5.8300**	**6.1609**	**0.0205**	**2.4000e-004**	**6.7440**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Building Construction	Building Construction	1/1/2023	1/17/2023	5	12	Vendor (RP-1)
2	Building Construction 2	Building Construction	1/18/2023	2/2/2023	5	12	Vendor (LN2)
3	Building Construction 3	Building Construction	2/3/2023	2/20/2023	5	12	Vendor (LOX)
4	Building Construction 4	Building Construction	2/21/2023	3/8/2023	5	12	Vendor (He)

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

<u>OffRoad Equipment</u>

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor

<u>Trips and VMT</u>

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Building Construction	0		8.00	0.00	10.80	45.00			HHDT	
Building Construction 2	0		40.00	0.00	10.80	45.00			HHDT	
Building Construction 3	0		36.00	0.00	10.80	45.00			HHDT	
Building Construction 4	0		2.00	0.00	10.80	45.00			HHDT	

3.1 Mitigation Measures Construction

3.2 Building Construction - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.1000e-004	0.0116	5.3100e-003	7.0000e-005	1.8500e-003	3.0000e-005	1.8800e-003	5.1000e-004	3.0000e-005	5.4000e-004	0.0000	7.0931	7.0931	6.2000e-004	0.0000	7.1087
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**4.1000e-004**	**0.0116**	**5.3100e-003**	**7.0000e-005**	**1.8500e-003**	**3.0000e-005**	**1.8800e-003**	**5.1000e-004**	**3.0000e-005**	**5.4000e-004**	**0.0000**	**7.0931**	**7.0931**	**6.2000e-004**	**0.0000**	**7.1087**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.1000e-004	0.0116	5.3100e-003	7.0000e-005	1.8500e-003	3.0000e-005	1.8800e-003	5.1000e-004	3.0000e-005	5.4000e-004	0.0000	7.0931	7.0931	6.2000e-004	0.0000	7.1087
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**4.1000e-004**	**0.0116**	**5.3100e-003**	**7.0000e-005**	**1.8500e-003**	**3.0000e-005**	**1.8800e-003**	**5.1000e-004**	**3.0000e-005**	**5.4000e-004**	**0.0000**	**7.0931**	**7.0931**	**6.2000e-004**	**0.0000**	**7.1087**

3.3 Building Construction 2 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.0500e-003	0.0582	0.0265	3.5000e-004	9.2500e-003	1.6000e-004	9.4100e-003	2.5400e-003	1.5000e-004	2.6900e-003	0.0000	35.4657	35.4657	3.1200e-003	0.0000	35.5437
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.0500e-003**	**0.0582**	**0.0265**	**3.5000e-004**	**9.2500e-003**	**1.6000e-004**	**9.4100e-003**	**2.5400e-003**	**1.5000e-004**	**2.6900e-003**	**0.0000**	**35.4657**	**35.4657**	**3.1200e-003**	**0.0000**	**35.5437**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.0500e-003	0.0582	0.0265	3.5000e-004	9.2500e-003	1.6000e-004	9.4100e-003	2.5400e-003	1.5000e-004	2.6900e-003	0.0000	35.4657	35.4657	3.1200e-003	0.0000	35.5437
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.0500e-003**	**0.0582**	**0.0265**	**3.5000e-004**	**9.2500e-003**	**1.6000e-004**	**9.4100e-003**	**2.5400e-003**	**1.5000e-004**	**2.6900e-003**	**0.0000**	**35.4657**	**35.4657**	**3.1200e-003**	**0.0000**	**35.5437**

3.4 Building Construction 3 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.8500e-003	0.0524	0.0239	3.2000e-004	8.3300e-003	1.4000e-004	8.4700e-003	2.2800e-003	1.3000e-004	2.4200e-003	0.0000	31.9191	31.9191	2.8100e-003	0.0000	31.9893
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.8500e-003**	**0.0524**	**0.0239**	**3.2000e-004**	**8.3300e-003**	**1.4000e-004**	**8.4700e-003**	**2.2800e-003**	**1.3000e-004**	**2.4200e-003**	**0.0000**	**31.9191**	**31.9191**	**2.8100e-003**	**0.0000**	**31.9893**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.8500e-003	0.0524	0.0239	3.2000e-004	8.3300e-003	1.4000e-004	8.4700e-003	2.2800e-003	1.3000e-004	2.4200e-003	0.0000	31.9191	31.9191	2.8100e-003	0.0000	31.9893
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.8500e-003**	**0.0524**	**0.0239**	**3.2000e-004**	**8.3300e-003**	**1.4000e-004**	**8.4700e-003**	**2.2800e-003**	**1.3000e-004**	**2.4200e-003**	**0.0000**	**31.9191**	**31.9191**	**2.8100e-003**	**0.0000**	**31.9893**

3.5 Building Construction 4 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0000e-004	2.9100e-003	1.3300e-003	2.0000e-005	4.6000e-004	1.0000e-005	4.7000e-004	1.3000e-004	1.0000e-005	1.3000e-004	0.0000	1.7733	1.7733	1.6000e-004	0.0000	1.7772
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.0000e-004**	**2.9100e-003**	**1.3300e-003**	**2.0000e-005**	**4.6000e-004**	**1.0000e-005**	**4.7000e-004**	**1.3000e-004**	**1.0000e-005**	**1.3000e-004**	**0.0000**	**1.7733**	**1.7733**	**1.6000e-004**	**0.0000**	**1.7772**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.0000e-004	2.9100e-003	1.3300e-003	2.0000e-005	4.6000e-004	1.0000e-005	4.7000e-004	1.3000e-004	1.0000e-005	1.3000e-004	0.0000	1.7733	1.7733	1.6000e-004	0.0000	1.7772
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.0000e-004**	**2.9100e-003**	**1.3300e-003**	**2.0000e-005**	**4.6000e-004**	**1.0000e-005**	**4.7000e-004**	**1.3000e-004**	**1.0000e-005**	**1.3000e-004**	**0.0000**	**1.7733**	**1.7733**	**1.6000e-004**	**0.0000**	**1.7772**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	3.5000e-004	1.3200e-003	3.8500e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0915	1.0915	4.0000e-005	0.0000	1.0926
Unmitigated	3.5000e-004	1.3200e-003	3.8500e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0915	1.0915	4.0000e-005	0.0000	1.0926

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Heavy Industry	1.50	1.50	1.50	3,192	3,192
Total	1.50	1.50	1.50	3,192	3,192

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Heavy Industry	6.60	5.50	6.40	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Heavy Industry	0.597457	0.040465	0.187858	0.105115	0.017041	0.006067	0.020072	0.018206	0.001182	0.001040	0.003816	0.000389	0.001293

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	2.4495	2.4495	1.1000e-004	2.0000e-005	2.4591
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	2.4495	2.4495	1.1000e-004	2.0000e-005	2.4591
NaturalGas Mitigated	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215
NaturalGas Unmitigated	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	26480	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215
Total		**1.4000e-004**	**1.3000e-003**	**1.0900e-003**	**1.0000e-005**		**1.0000e-004**	**1.0000e-004**		**1.0000e-004**	**1.0000e-004**	**0.0000**	**1.4131**	**1.4131**	**3.0000e-005**	**3.0000e-005**	**1.4215**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	26480	1.4000e-004	1.3000e-003	1.0900e-003	1.0000e-005		1.0000e-004	1.0000e-004		1.0000e-004	1.0000e-004	0.0000	1.4131	1.4131	3.0000e-005	3.0000e-005	1.4215
Total		**1.4000e-004**	**1.3000e-003**	**1.0900e-003**	**1.0000e-005**		**1.0000e-004**	**1.0000e-004**		**1.0000e-004**	**1.0000e-004**	**0.0000**	**1.4131**	**1.4131**	**3.0000e-005**	**3.0000e-005**	**1.4215**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	8420	2.4495	1.1000e-004	2.0000e-005	2.4591
Total		**2.4495**	**1.1000e-004**	**2.0000e-005**	**2.4591**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	8420	2.4495	1.1000e-004	2.0000e-005	2.4591
Total		**2.4495**	**1.1000e-004**	**2.0000e-005**	**2.4591**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Unmitigated	5.0700e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.1600e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.9100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**5.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.9493	7.5700e-003	1.9000e-004	1.1942
Unmitigated	0.9493	7.5700e-003	1.9000e-004	1.1942

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	0.23125 / 0	0.9493	7.5700e-003	1.9000e-004	1.1942
Total		**0.9493**	**7.5700e-003**	**1.9000e-004**	**1.1942**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	0.23125 / 0	0.9493	7.5700e-003	1.9000e-004	1.1942
Total		**0.9493**	**7.5700e-003**	**1.9000e-004**	**1.1942**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.2575	0.0128	0.0000	0.5767
Unmitigated	0.2575	0.0128	0.0000	0.5767

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	1.24	0.2575	0.0128	0.0000	0.5767
Total		**0.2575**	**0.0128**	**0.0000**	**0.5767**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	1.24	0.2575	0.0128	0.0000	0.5767
Total		**0.2575**	**0.0128**	**0.0000**	**0.5767**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Space X Increased Cadence - LA - Proposed

South Coast AQMD Air District, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Heavy Industry	1.00	1000sqft	0.02	1,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	31
Climate Zone	8			**Operational Year**	2024
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	702.44	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - South Coast

Land Use -

Construction Phase - 12 events for baseline

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Off-road Equipment -

Trips and VMT - travel through LA County

Space X Increased Cadence - LA - Proposed - South Coast AQMD Air District, Annual

Table Name	Column Name	Default Value	New Value
tblAreaCoating	Area_EF_Nonresidential_Exterior	250	100
tblAreaCoating	Area_EF_Nonresidential_Interior	250	100
tblAreaCoating	Area_EF_Parking	250	100
tblAreaCoating	Area_EF_Residential_Exterior	100	50
tblAreaCoating	Area_EF_Residential_Interior	75	50
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	NumDays	100.00	12.00
tblConstructionPhase	PhaseEndDate	2/20/2023	1/17/2023
tblConstructionPhase	PhaseEndDate	4/11/2023	3/8/2023
tblConstructionPhase	PhaseEndDate	5/31/2023	4/27/2023
tblConstructionPhase	PhaseEndDate	7/20/2023	6/16/2023
tblConsumerProducts	ROG_EF	2.14E-05	1.98E-05
tblLandscapeEquipment	NumberSummerDays	180	250
tblProjectCharacteristics	OperationalYear	2018	2024
tblTripsAndVMT	HaulingTripNumber	0.00	48.00
tblTripsAndVMT	HaulingTripNumber	0.00	12.00
tblTripsAndVMT	HaulingTripNumber	0.00	12.00
tblTripsAndVMT	HaulingTripNumber	0.00	12.00
tblTripsAndVMT	VendorTripLength	7.30	180.00
tblTripsAndVMT	VendorTripLength	7.30	180.00
tblTripsAndVMT	VendorTripLength	7.30	180.00
tblTripsAndVMT	VendorTripLength	7.30	180.00
tblTripsAndVMT	VendorVehicleClass		HHDT
tblTripsAndVMT	VendorVehicleClass		HHDT

Space X Increased Cadence - LA - Proposed - South Coast AQMD Air District, Annual

tblTripsAndVMT	VendorVehicleClass		HHDT
tblTripsAndVMT	VendorVehicleClass		HHDT
tblVehicleEF	HHD	0.54	0.53
tblVehicleEF	HHD	0.13	0.08
tblVehicleEF	HHD	0.06	0.07
tblVehicleEF	HHD	1.59	1.65
tblVehicleEF	HHD	1.03	0.91
tblVehicleEF	HHD	3.36	2.85
tblVehicleEF	HHD	4,052.31	4,619.90
tblVehicleEF	HHD	1,539.89	1,526.07
tblVehicleEF	HHD	10.78	9.26
tblVehicleEF	HHD	0.02	0.04
tblVehicleEF	HHD	13.99	14.31
tblVehicleEF	HHD	1.64	1.78
tblVehicleEF	HHD	19.45	19.67
tblVehicleEF	HHD	0.01	8.0440e-003
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.04
tblVehicleEF	HHD	6.1710e-003	5.9390e-003
tblVehicleEF	HHD	9.7000e-005	8.1000e-005
tblVehicleEF	HHD	0.01	7.6960e-003
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.7210e-003	8.8170e-003
tblVehicleEF	HHD	5.9040e-003	5.6820e-003
tblVehicleEF	HHD	8.9000e-005	7.4000e-005
tblVehicleEF	HHD	7.2000e-005	9.5000e-005
tblVehicleEF	HHD	4.1500e-003	3.8210e-003

tblVehicleEF	HHD	0.39	0.42
tblVehicleEF	HHD	6.0000e-005	6.9000e-005
tblVehicleEF	HHD	0.08	0.08
tblVehicleEF	HHD	4.0800e-004	3.0200e-004
tblVehicleEF	HHD	0.07	0.06
tblVehicleEF	HHD	0.04	0.04
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.6300e-004	1.3900e-004
tblVehicleEF	HHD	7.2000e-005	9.5000e-005
tblVehicleEF	HHD	4.1500e-003	3.8210e-003
tblVehicleEF	HHD	0.47	0.50
tblVehicleEF	HHD	6.0000e-005	6.9000e-005
tblVehicleEF	HHD	0.21	0.17
tblVehicleEF	HHD	4.0800e-004	3.0200e-004
tblVehicleEF	HHD	0.08	0.07
tblVehicleEF	HHD	0.51	0.50
tblVehicleEF	HHD	0.13	0.08
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	1.16	1.20
tblVehicleEF	HHD	1.04	0.91
tblVehicleEF	HHD	3.14	2.71
tblVehicleEF	HHD	4,293.06	4,894.37
tblVehicleEF	HHD	1,539.89	1,526.07
tblVehicleEF	HHD	10.78	9.26
tblVehicleEF	HHD	0.02	0.04
tblVehicleEF	HHD	14.44	14.77
tblVehicleEF	HHD	1.56	1.68

tblVehicleEF	HHD	19.44	19.66
tblVehicleEF	HHD	0.01	6.7820e-003
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.04
tblVehicleEF	HHD	6.1710e-003	5.9390e-003
tblVehicleEF	HHD	9.7000e-005	8.1000e-005
tblVehicleEF	HHD	9.8140e-003	6.4880e-003
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.7210e-003	8.8170e-003
tblVehicleEF	HHD	5.9040e-003	5.6820e-003
tblVehicleEF	HHD	8.9000e-005	7.4000e-005
tblVehicleEF	HHD	1.1200e-004	1.5200e-004
tblVehicleEF	HHD	4.2510e-003	3.9920e-003
tblVehicleEF	HHD	0.37	0.40
tblVehicleEF	HHD	1.0000e-004	1.0400e-004
tblVehicleEF	HHD	0.08	0.08
tblVehicleEF	HHD	3.8800e-004	2.9500e-004
tblVehicleEF	HHD	0.07	0.06
tblVehicleEF	HHD	0.04	0.05
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.5900e-004	1.3700e-004
tblVehicleEF	HHD	1.1200e-004	1.5200e-004
tblVehicleEF	HHD	4.2510e-003	3.9920e-003
tblVehicleEF	HHD	0.44	0.47
tblVehicleEF	HHD	1.0000e-004	1.0400e-004
tblVehicleEF	HHD	0.21	0.17
tblVehicleEF	HHD	3.8800e-004	2.9500e-004

tblVehicleEF	HHD	0.07	0.07
tblVehicleEF	HHD	0.58	0.57
tblVehicleEF	HHD	0.13	0.08
tblVehicleEF	HHD	0.07	0.07
tblVehicleEF	HHD	2.19	2.28
tblVehicleEF	HHD	1.03	0.91
tblVehicleEF	HHD	3.52	2.87
tblVehicleEF	HHD	3,719.84	4,240.87
tblVehicleEF	HHD	1,539.89	1,526.07
tblVehicleEF	HHD	10.78	9.26
tblVehicleEF	HHD	0.02	0.04
tblVehicleEF	HHD	13.37	13.67
tblVehicleEF	HHD	1.63	1.75
tblVehicleEF	HHD	19.47	19.68
tblVehicleEF	HHD	0.01	9.7870e-003
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.04
tblVehicleEF	HHD	6.1710e-003	5.9390e-003
tblVehicleEF	HHD	9.7000e-005	8.1000e-005
tblVehicleEF	HHD	0.01	9.3640e-003
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.7210e-003	8.8170e-003
tblVehicleEF	HHD	5.9040e-003	5.6820e-003
tblVehicleEF	HHD	8.9000e-005	7.4000e-005
tblVehicleEF	HHD	5.1000e-005	8.7000e-005
tblVehicleEF	HHD	4.2990e-003	4.0380e-003
tblVehicleEF	HHD	0.42	0.45

tblVehicleEF	HHD	4.2000e-005	6.5000e-005
tblVehicleEF	HHD	0.07	0.08
tblVehicleEF	HHD	4.5700e-004	3.2900e-004
tblVehicleEF	HHD	0.07	0.06
tblVehicleEF	HHD	0.03	0.04
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.6500e-004	1.4000e-004
tblVehicleEF	HHD	5.1000e-005	8.7000e-005
tblVehicleEF	HHD	4.2990e-003	4.0380e-003
tblVehicleEF	HHD	0.50	0.54
tblVehicleEF	HHD	4.2000e-005	6.5000e-005
tblVehicleEF	HHD	0.21	0.17
tblVehicleEF	HHD	4.5700e-004	3.2900e-004
tblVehicleEF	HHD	0.08	0.07
tblVehicleEF	LDA	3.4860e-003	3.9020e-003
tblVehicleEF	LDA	4.3070e-003	3.9350e-003
tblVehicleEF	LDA	0.49	0.54
tblVehicleEF	LDA	0.99	0.91
tblVehicleEF	LDA	230.49	243.88
tblVehicleEF	LDA	52.48	52.52
tblVehicleEF	LDA	0.60	0.55
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.05
tblVehicleEF	LDA	1.8160e-003	1.9240e-003
tblVehicleEF	LDA	2.2840e-003	2.2240e-003
tblVehicleEF	LDA	1.6730e-003	1.7730e-003
tblVehicleEF	LDA	2.1000e-003	2.0440e-003

tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.09	0.09
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	8.7910e-003	9.8200e-003
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.05
tblVehicleEF	LDA	2.3080e-003	2.4420e-003
tblVehicleEF	LDA	5.4100e-004	5.4000e-004
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.09	0.09
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.01	0.01
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.06
tblVehicleEF	LDA	3.7060e-003	4.1870e-003
tblVehicleEF	LDA	3.7370e-003	3.4920e-003
tblVehicleEF	LDA	0.54	0.60
tblVehicleEF	LDA	0.82	0.78
tblVehicleEF	LDA	240.64	256.98
tblVehicleEF	LDA	52.48	52.52
tblVehicleEF	LDA	0.60	0.55
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.05	0.05
tblVehicleEF	LDA	1.8160e-003	1.9240e-003
tblVehicleEF	LDA	2.2840e-003	2.2240e-003
tblVehicleEF	LDA	1.6730e-003	1.7730e-003
tblVehicleEF	LDA	2.1000e-003	2.0440e-003

tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.09	0.09
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	9.3360e-003	0.01
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.05	0.05
tblVehicleEF	LDA	2.4100e-003	2.5740e-003
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.09	0.09
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.01	0.02
tblVehicleEF	LDA	0.03	0.03
tblVehicleEF	LDA	0.06	0.05
tblVehicleEF	LDA	3.4200e-003	3.8180e-003
tblVehicleEF	LDA	4.6520e-003	4.0250e-003
tblVehicleEF	LDA	0.49	0.52
tblVehicleEF	LDA	1.10	0.94
tblVehicleEF	LDA	228.56	239.64
tblVehicleEF	LDA	52.48	52.52
tblVehicleEF	LDA	0.60	0.55
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.05
tblVehicleEF	LDA	1.8160e-003	1.9240e-003
tblVehicleEF	LDA	2.2840e-003	2.2240e-003
tblVehicleEF	LDA	1.6730e-003	1.7730e-003
tblVehicleEF	LDA	2.1000e-003	2.0440e-003
tblVehicleEF	LDA	0.02	0.03

tblVehicleEF	LDA	0.09	0.09
tblVehicleEF	LDA	0.02	0.03
tblVehicleEF	LDA	8.6280e-003	9.6110e-003
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.06	0.05
tblVehicleEF	LDA	2.2880e-003	2.3990e-003
tblVehicleEF	LDA	5.4300e-004	5.4100e-004
tblVehicleEF	LDA	0.02	0.03
tblVehicleEF	LDA	0.09	0.09
tblVehicleEF	LDA	0.02	0.03
tblVehicleEF	LDA	0.01	0.01
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	0.07	0.06
tblVehicleEF	LDT1	8.8100e-003	0.01
tblVehicleEF	LDT1	0.01	0.01
tblVehicleEF	LDT1	1.07	1.25
tblVehicleEF	LDT1	2.79	2.25
tblVehicleEF	LDT1	291.88	310.15
tblVehicleEF	LDT1	67.43	65.72
tblVehicleEF	LDT1	0.04	0.04
tblVehicleEF	LDT1	0.10	0.11
tblVehicleEF	LDT1	0.16	0.13
tblVehicleEF	LDT1	2.4950e-003	2.8790e-003
tblVehicleEF	LDT1	3.2660e-003	3.1270e-003
tblVehicleEF	LDT1	2.2970e-003	2.6500e-003
tblVehicleEF	LDT1	3.0030e-003	2.8760e-003
tblVehicleEF	LDT1	0.10	0.12

tblVehicleEF	LDT1	0.27	0.24
tblVehicleEF	LDT1	0.09	0.10
tblVehicleEF	LDT1	0.02	0.03
tblVehicleEF	LDT1	0.18	0.15
tblVehicleEF	LDT1	0.19	0.15
tblVehicleEF	LDT1	2.9310e-003	3.1170e-003
tblVehicleEF	LDT1	7.2300e-004	6.9600e-004
tblVehicleEF	LDT1	0.10	0.12
tblVehicleEF	LDT1	0.27	0.24
tblVehicleEF	LDT1	0.09	0.10
tblVehicleEF	LDT1	0.03	0.04
tblVehicleEF	LDT1	0.18	0.15
tblVehicleEF	LDT1	0.21	0.16
tblVehicleEF	LDT1	9.2980e-003	0.01
tblVehicleEF	LDT1	0.01	9.8640e-003
tblVehicleEF	LDT1	1.15	1.38
tblVehicleEF	LDT1	2.28	1.92
tblVehicleEF	LDT1	304.24	325.67
tblVehicleEF	LDT1	67.43	65.72
tblVehicleEF	LDT1	0.04	0.04
tblVehicleEF	LDT1	0.09	0.10
tblVehicleEF	LDT1	0.14	0.12
tblVehicleEF	LDT1	2.4950e-003	2.8790e-003
tblVehicleEF	LDT1	3.2660e-003	3.1270e-003
tblVehicleEF	LDT1	2.2970e-003	2.6500e-003
tblVehicleEF	LDT1	3.0030e-003	2.8760e-003
tblVehicleEF	LDT1	0.17	0.19

tblVehicleEF	LDT1	0.28	0.25
tblVehicleEF	LDT1	0.16	0.14
tblVehicleEF	LDT1	0.02	0.03
tblVehicleEF	LDT1	0.16	0.15
tblVehicleEF	LDT1	0.16	0.13
tblVehicleEF	LDT1	3.0560e-003	3.2730e-003
tblVehicleEF	LDT1	7.1400e-004	6.9100e-004
tblVehicleEF	LDT1	0.17	0.19
tblVehicleEF	LDT1	0.28	0.25
tblVehicleEF	LDT1	0.16	0.14
tblVehicleEF	LDT1	0.03	0.04
tblVehicleEF	LDT1	0.16	0.15
tblVehicleEF	LDT1	0.18	0.15
tblVehicleEF	LDT1	8.6710e-003	0.01
tblVehicleEF	LDT1	0.02	0.01
tblVehicleEF	LDT1	1.06	1.21
tblVehicleEF	LDT1	3.10	2.32
tblVehicleEF	LDT1	289.54	304.96
tblVehicleEF	LDT1	67.43	65.72
tblVehicleEF	LDT1	0.04	0.04
tblVehicleEF	LDT1	0.11	0.11
tblVehicleEF	LDT1	0.17	0.13
tblVehicleEF	LDT1	2.4950e-003	2.8790e-003
tblVehicleEF	LDT1	3.2660e-003	3.1270e-003
tblVehicleEF	LDT1	2.2970e-003	2.6500e-003
tblVehicleEF	LDT1	3.0030e-003	2.8760e-003
tblVehicleEF	LDT1	0.07	0.12

tblVehicleEF	LDT1	0.30	0.26
tblVehicleEF	LDT1	0.07	0.09
tblVehicleEF	LDT1	0.02	0.03
tblVehicleEF	LDT1	0.22	0.18
tblVehicleEF	LDT1	0.20	0.15
tblVehicleEF	LDT1	2.9070e-003	3.0640e-003
tblVehicleEF	LDT1	7.2900e-004	6.9700e-004
tblVehicleEF	LDT1	0.07	0.12
tblVehicleEF	LDT1	0.30	0.26
tblVehicleEF	LDT1	0.07	0.09
tblVehicleEF	LDT1	0.03	0.04
tblVehicleEF	LDT1	0.22	0.18
tblVehicleEF	LDT1	0.22	0.17
tblVehicleEF	LDT2	4.6970e-003	5.5430e-003
tblVehicleEF	LDT2	5.7680e-003	5.0880e-003
tblVehicleEF	LDT2	0.64	0.72
tblVehicleEF	LDT2	1.30	1.15
tblVehicleEF	LDT2	323.19	344.86
tblVehicleEF	LDT2	74.04	73.12
tblVehicleEF	LDT2	0.19	0.20
tblVehicleEF	LDT2	0.06	0.06
tblVehicleEF	LDT2	0.09	0.08
tblVehicleEF	LDT2	1.8330e-003	2.0170e-003
tblVehicleEF	LDT2	2.3570e-003	2.3800e-003
tblVehicleEF	LDT2	1.6860e-003	1.8550e-003
tblVehicleEF	LDT2	2.1680e-003	2.1880e-003
tblVehicleEF	LDT2	0.04	0.04

tblVehicleEF	LDT2	0.10	0.09
tblVehicleEF	LDT2	0.04	0.04
tblVehicleEF	LDT2	0.01	0.01
tblVehicleEF	LDT2	0.06	0.06
tblVehicleEF	LDT2	0.08	0.07
tblVehicleEF	LDT2	3.2360e-003	3.4540e-003
tblVehicleEF	LDT2	7.6200e-004	7.5000e-004
tblVehicleEF	LDT2	0.04	0.04
tblVehicleEF	LDT2	0.10	0.09
tblVehicleEF	LDT2	0.04	0.04
tblVehicleEF	LDT2	0.02	0.02
tblVehicleEF	LDT2	0.06	0.06
tblVehicleEF	LDT2	0.09	0.08
tblVehicleEF	LDT2	4.9900e-003	5.9380e-003
tblVehicleEF	LDT2	5.0060e-003	4.5160e-003
tblVehicleEF	LDT2	0.69	0.80
tblVehicleEF	LDT2	1.07	0.99
tblVehicleEF	LDT2	337.16	362.72
tblVehicleEF	LDT2	74.04	73.12
tblVehicleEF	LDT2	0.19	0.20
tblVehicleEF	LDT2	0.05	0.06
tblVehicleEF	LDT2	0.08	0.08
tblVehicleEF	LDT2	1.8330e-003	2.0170e-003
tblVehicleEF	LDT2	2.3570e-003	2.3800e-003
tblVehicleEF	LDT2	1.6860e-003	1.8550e-003
tblVehicleEF	LDT2	2.1680e-003	2.1880e-003
tblVehicleEF	LDT2	0.06	0.07

tblVehicleEF	LDT2	0.10	0.10
tblVehicleEF	LDT2	0.07	0.06
tblVehicleEF	LDT2	0.01	0.01
tblVehicleEF	LDT2	0.05	0.05
tblVehicleEF	LDT2	0.07	0.06
tblVehicleEF	LDT2	3.3770e-003	3.6340e-003
tblVehicleEF	LDT2	7.5800e-004	7.4700e-004
tblVehicleEF	LDT2	0.06	0.07
tblVehicleEF	LDT2	0.10	0.10
tblVehicleEF	LDT2	0.07	0.06
tblVehicleEF	LDT2	0.02	0.02
tblVehicleEF	LDT2	0.05	0.05
tblVehicleEF	LDT2	0.07	0.07
tblVehicleEF	LDT2	4.6090e-003	5.4230e-003
tblVehicleEF	LDT2	6.2300e-003	5.2070e-003
tblVehicleEF	LDT2	0.63	0.69
tblVehicleEF	LDT2	1.44	1.18
tblVehicleEF	LDT2	320.55	338.93
tblVehicleEF	LDT2	74.04	73.12
tblVehicleEF	LDT2	0.19	0.20
tblVehicleEF	LDT2	0.06	0.06
tblVehicleEF	LDT2	0.10	0.08
tblVehicleEF	LDT2	1.8330e-003	2.0170e-003
tblVehicleEF	LDT2	2.3570e-003	2.3800e-003
tblVehicleEF	LDT2	1.6860e-003	1.8550e-003
tblVehicleEF	LDT2	2.1680e-003	2.1880e-003
tblVehicleEF	LDT2	0.02	0.04

tblVehicleEF	LDT2	0.10	0.10
tblVehicleEF	LDT2	0.03	0.04
tblVehicleEF	LDT2	0.01	0.01
tblVehicleEF	LDT2	0.07	0.07
tblVehicleEF	LDT2	0.08	0.07
tblVehicleEF	LDT2	3.2100e-003	3.3940e-003
tblVehicleEF	LDT2	7.6400e-004	7.5100e-004
tblVehicleEF	LDT2	0.02	0.04
tblVehicleEF	LDT2	0.10	0.10
tblVehicleEF	LDT2	0.03	0.04
tblVehicleEF	LDT2	0.02	0.02
tblVehicleEF	LDT2	0.07	0.07
tblVehicleEF	LDT2	0.09	0.08
tblVehicleEF	LHD1	4.7270e-003	4.9470e-003
tblVehicleEF	LHD1	9.9090e-003	8.6670e-003
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.14	0.14
tblVehicleEF	LHD1	0.81	0.66
tblVehicleEF	LHD1	2.31	2.24
tblVehicleEF	LHD1	9.24	9.02
tblVehicleEF	LHD1	588.73	588.59
tblVehicleEF	LHD1	28.63	30.53
tblVehicleEF	LHD1	0.02	0.01
tblVehicleEF	LHD1	0.09	0.07
tblVehicleEF	LHD1	1.63	0.99
tblVehicleEF	LHD1	0.88	0.89
tblVehicleEF	LHD1	9.7800e-004	8.6500e-004

tblVehicleEF	LHD1	0.01	0.01
tblVehicleEF	LHD1	0.01	9.4630e-003
tblVehicleEF	LHD1	8.4900e-004	8.3900e-004
tblVehicleEF	LHD1	9.3600e-004	8.2800e-004
tblVehicleEF	LHD1	2.5730e-003	2.5560e-003
tblVehicleEF	LHD1	0.01	9.0310e-003
tblVehicleEF	LHD1	7.8100e-004	7.7100e-004
tblVehicleEF	LHD1	2.2500e-003	2.8770e-003
tblVehicleEF	LHD1	0.10	0.09
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.5120e-003	1.7250e-003
tblVehicleEF	LHD1	0.07	0.06
tblVehicleEF	LHD1	0.32	0.29
tblVehicleEF	LHD1	0.23	0.22
tblVehicleEF	LHD1	9.2000e-005	9.0000e-005
tblVehicleEF	LHD1	5.7640e-003	5.7680e-003
tblVehicleEF	LHD1	3.3000e-004	3.4700e-004
tblVehicleEF	LHD1	2.2500e-003	2.8770e-003
tblVehicleEF	LHD1	0.10	0.09
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.5120e-003	1.7250e-003
tblVehicleEF	LHD1	0.09	0.07
tblVehicleEF	LHD1	0.32	0.29
tblVehicleEF	LHD1	0.25	0.24
tblVehicleEF	LHD1	4.7270e-003	4.9470e-003
tblVehicleEF	LHD1	0.01	8.8390e-003
tblVehicleEF	LHD1	0.02	0.02

tblVehicleEF	LHD1	0.14	0.14
tblVehicleEF	LHD1	0.83	0.67
tblVehicleEF	LHD1	2.16	2.14
tblVehicleEF	LHD1	9.24	9.02
tblVehicleEF	LHD1	588.73	588.59
tblVehicleEF	LHD1	28.63	30.53
tblVehicleEF	LHD1	0.02	0.01
tblVehicleEF	LHD1	0.09	0.07
tblVehicleEF	LHD1	1.55	0.93
tblVehicleEF	LHD1	0.83	0.85
tblVehicleEF	LHD1	9.7800e-004	8.6500e-004
tblVehicleEF	LHD1	0.01	0.01
tblVehicleEF	LHD1	0.01	9.4630e-003
tblVehicleEF	LHD1	8.4900e-004	8.3900e-004
tblVehicleEF	LHD1	9.3600e-004	8.2800e-004
tblVehicleEF	LHD1	2.5730e-003	2.5560e-003
tblVehicleEF	LHD1	0.01	9.0310e-003
tblVehicleEF	LHD1	7.8100e-004	7.7100e-004
tblVehicleEF	LHD1	3.4900e-003	4.4820e-003
tblVehicleEF	LHD1	0.10	0.10
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	2.4990e-003	2.5750e-003
tblVehicleEF	LHD1	0.07	0.06
tblVehicleEF	LHD1	0.31	0.28
tblVehicleEF	LHD1	0.22	0.21
tblVehicleEF	LHD1	9.2000e-005	9.0000e-005
tblVehicleEF	LHD1	5.7650e-003	5.7680e-003

tblVehicleEF	LHD1	3.2700e-004	3.4500e-004
tblVehicleEF	LHD1	3.4900e-003	4.4820e-003
tblVehicleEF	LHD1	0.10	0.10
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	2.4990e-003	2.5750e-003
tblVehicleEF	LHD1	0.09	0.07
tblVehicleEF	LHD1	0.31	0.28
tblVehicleEF	LHD1	0.24	0.23
tblVehicleEF	LHD1	4.7270e-003	4.9470e-003
tblVehicleEF	LHD1	9.7510e-003	8.6290e-003
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	0.14	0.14
tblVehicleEF	LHD1	0.81	0.66
tblVehicleEF	LHD1	2.41	2.25
tblVehicleEF	LHD1	9.24	9.02
tblVehicleEF	LHD1	588.73	588.59
tblVehicleEF	LHD1	28.63	30.53
tblVehicleEF	LHD1	0.02	0.01
tblVehicleEF	LHD1	0.09	0.07
tblVehicleEF	LHD1	1.62	0.97
tblVehicleEF	LHD1	0.92	0.90
tblVehicleEF	LHD1	9.7800e-004	8.6500e-004
tblVehicleEF	LHD1	0.01	0.01
tblVehicleEF	LHD1	0.01	9.4630e-003
tblVehicleEF	LHD1	8.4900e-004	8.3900e-004
tblVehicleEF	LHD1	9.3600e-004	8.2800e-004
tblVehicleEF	LHD1	2.5730e-003	2.5560e-003

tblVehicleEF	LHD1	0.01	9.0310e-003
tblVehicleEF	LHD1	7.8100e-004	7.7100e-004
tblVehicleEF	LHD1	1.5530e-003	2.8880e-003
tblVehicleEF	LHD1	0.11	0.11
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.0630e-003	1.6860e-003
tblVehicleEF	LHD1	0.07	0.06
tblVehicleEF	LHD1	0.36	0.31
tblVehicleEF	LHD1	0.24	0.22
tblVehicleEF	LHD1	9.2000e-005	9.0000e-005
tblVehicleEF	LHD1	5.7640e-003	5.7670e-003
tblVehicleEF	LHD1	3.3100e-004	3.4700e-004
tblVehicleEF	LHD1	1.5530e-003	2.8880e-003
tblVehicleEF	LHD1	0.11	0.11
tblVehicleEF	LHD1	0.02	0.02
tblVehicleEF	LHD1	1.0630e-003	1.6860e-003
tblVehicleEF	LHD1	0.09	0.07
tblVehicleEF	LHD1	0.36	0.31
tblVehicleEF	LHD1	0.26	0.24
tblVehicleEF	LHD2	3.5590e-003	3.4800e-003
tblVehicleEF	LHD2	3.5620e-003	3.3370e-003
tblVehicleEF	LHD2	7.1380e-003	6.5210e-003
tblVehicleEF	LHD2	0.12	0.12
tblVehicleEF	LHD2	0.34	0.29
tblVehicleEF	LHD2	1.15	1.13
tblVehicleEF	LHD2	13.85	13.69
tblVehicleEF	LHD2	605.33	603.39

tblVehicleEF	LHD2	25.90	25.70
tblVehicleEF	LHD2	6.0670e-003	5.8060e-003
tblVehicleEF	LHD2	0.10	0.09
tblVehicleEF	LHD2	0.90	0.58
tblVehicleEF	LHD2	0.52	0.46
tblVehicleEF	LHD2	1.1680e-003	1.1460e-003
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	0.01	8.5600e-003
tblVehicleEF	LHD2	3.7700e-004	4.0500e-004
tblVehicleEF	LHD2	1.1170e-003	1.0960e-003
tblVehicleEF	LHD2	2.6720e-003	2.6750e-003
tblVehicleEF	LHD2	9.6360e-003	8.1770e-003
tblVehicleEF	LHD2	3.4700e-004	3.7200e-004
tblVehicleEF	LHD2	8.0300e-004	9.9200e-004
tblVehicleEF	LHD2	0.03	0.03
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	6.0900e-004	6.5300e-004
tblVehicleEF	LHD2	0.05	0.04
tblVehicleEF	LHD2	0.07	0.07
tblVehicleEF	LHD2	0.10	0.09
tblVehicleEF	LHD2	1.3500e-004	1.3400e-004
tblVehicleEF	LHD2	5.8930e-003	5.8730e-003
tblVehicleEF	LHD2	2.8000e-004	2.7700e-004
tblVehicleEF	LHD2	8.0300e-004	9.9200e-004
tblVehicleEF	LHD2	0.03	0.03
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	6.0900e-004	6.5300e-004

tblVehicleEF	LHD2	0.05	0.05
tblVehicleEF	LHD2	0.07	0.07
tblVehicleEF	LHD2	0.11	0.10
tblVehicleEF	LHD2	3.5590e-003	3.4800e-003
tblVehicleEF	LHD2	3.6090e-003	3.3730e-003
tblVehicleEF	LHD2	6.8210e-003	6.3110e-003
tblVehicleEF	LHD2	0.12	0.12
tblVehicleEF	LHD2	0.35	0.29
tblVehicleEF	LHD2	1.09	1.09
tblVehicleEF	LHD2	13.85	13.69
tblVehicleEF	LHD2	605.33	603.39
tblVehicleEF	LHD2	25.90	25.70
tblVehicleEF	LHD2	6.0670e-003	5.8060e-003
tblVehicleEF	LHD2	0.10	0.09
tblVehicleEF	LHD2	0.86	0.54
tblVehicleEF	LHD2	0.49	0.45
tblVehicleEF	LHD2	1.1680e-003	1.1460e-003
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	0.01	8.5600e-003
tblVehicleEF	LHD2	3.7700e-004	4.0500e-004
tblVehicleEF	LHD2	1.1170e-003	1.0960e-003
tblVehicleEF	LHD2	2.6720e-003	2.6750e-003
tblVehicleEF	LHD2	9.6360e-003	8.1770e-003
tblVehicleEF	LHD2	3.4700e-004	3.7200e-004
tblVehicleEF	LHD2	1.2400e-003	1.5430e-003
tblVehicleEF	LHD2	0.03	0.03
tblVehicleEF	LHD2	0.01	0.01

tblVehicleEF	LHD2	1.0000e-003	9.6300e-004
tblVehicleEF	LHD2	0.05	0.04
tblVehicleEF	LHD2	0.07	0.07
tblVehicleEF	LHD2	0.09	0.09
tblVehicleEF	LHD2	1.3500e-004	1.3400e-004
tblVehicleEF	LHD2	5.8930e-003	5.8730e-003
tblVehicleEF	LHD2	2.7900e-004	2.7600e-004
tblVehicleEF	LHD2	1.2400e-003	1.5430e-003
tblVehicleEF	LHD2	0.03	0.03
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	1.0000e-003	9.6300e-004
tblVehicleEF	LHD2	0.05	0.05
tblVehicleEF	LHD2	0.07	0.07
tblVehicleEF	LHD2	0.10	0.09
tblVehicleEF	LHD2	3.5590e-003	3.4800e-003
tblVehicleEF	LHD2	3.5320e-003	3.3280e-003
tblVehicleEF	LHD2	7.3580e-003	6.5580e-003
tblVehicleEF	LHD2	0.12	0.12
tblVehicleEF	LHD2	0.34	0.29
tblVehicleEF	LHD2	1.20	1.14
tblVehicleEF	LHD2	13.85	13.69
tblVehicleEF	LHD2	605.33	603.39
tblVehicleEF	LHD2	25.90	25.70
tblVehicleEF	LHD2	6.0670e-003	5.8060e-003
tblVehicleEF	LHD2	0.10	0.09
tblVehicleEF	LHD2	0.89	0.57
tblVehicleEF	LHD2	0.54	0.46

tblVehicleEF	LHD2	1.1680e-003	1.1460e-003
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	0.01	8.5600e-003
tblVehicleEF	LHD2	3.7700e-004	4.0500e-004
tblVehicleEF	LHD2	1.1170e-003	1.0960e-003
tblVehicleEF	LHD2	2.6720e-003	2.6750e-003
tblVehicleEF	LHD2	9.6360e-003	8.1770e-003
tblVehicleEF	LHD2	3.4700e-004	3.7200e-004
tblVehicleEF	LHD2	5.6400e-004	9.5400e-004
tblVehicleEF	LHD2	0.04	0.03
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	4.3400e-004	6.2500e-004
tblVehicleEF	LHD2	0.05	0.04
tblVehicleEF	LHD2	0.08	0.07
tblVehicleEF	LHD2	0.10	0.09
tblVehicleEF	LHD2	1.3500e-004	1.3400e-004
tblVehicleEF	LHD2	5.8930e-003	5.8730e-003
tblVehicleEF	LHD2	2.8100e-004	2.7700e-004
tblVehicleEF	LHD2	5.6400e-004	9.5400e-004
tblVehicleEF	LHD2	0.04	0.03
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	4.3400e-004	6.2500e-004
tblVehicleEF	LHD2	0.05	0.05
tblVehicleEF	LHD2	0.08	0.07
tblVehicleEF	LHD2	0.11	0.10
tblVehicleEF	MCY	0.48	0.52
tblVehicleEF	MCY	0.16	0.15

tblVehicleEF	MCY	19.09	18.43
tblVehicleEF	MCY	9.94	9.68
tblVehicleEF	MCY	175.65	184.66
tblVehicleEF	MCY	45.94	44.08
tblVehicleEF	MCY	3.8160e-003	4.8910e-003
tblVehicleEF	MCY	1.14	1.13
tblVehicleEF	MCY	0.32	0.31
tblVehicleEF	MCY	2.1940e-003	2.3730e-003
tblVehicleEF	MCY	3.7430e-003	3.4400e-003
tblVehicleEF	MCY	2.0510e-003	2.2150e-003
tblVehicleEF	MCY	3.5270e-003	3.2290e-003
tblVehicleEF	MCY	0.91	1.17
tblVehicleEF	MCY	0.76	0.65
tblVehicleEF	MCY	0.59	0.69
tblVehicleEF	MCY	2.37	2.47
tblVehicleEF	MCY	1.00	0.57
tblVehicleEF	MCY	2.18	2.03
tblVehicleEF	MCY	2.1390e-003	2.2230e-003
tblVehicleEF	MCY	6.8600e-004	6.5900e-004
tblVehicleEF	MCY	0.91	1.17
tblVehicleEF	MCY	0.76	0.65
tblVehicleEF	MCY	0.59	0.69
tblVehicleEF	MCY	2.94	3.08
tblVehicleEF	MCY	1.00	0.57
tblVehicleEF	MCY	2.37	2.21
tblVehicleEF	MCY	0.46	0.51
tblVehicleEF	MCY	0.14	0.13

tblVehicleEF	MCY	17.90	17.99
tblVehicleEF	MCY	8.81	8.88
tblVehicleEF	MCY	175.65	184.66
tblVehicleEF	MCY	45.94	44.08
tblVehicleEF	MCY	3.8160e-003	4.8910e-003
tblVehicleEF	MCY	1.01	0.98
tblVehicleEF	MCY	0.30	0.29
tblVehicleEF	MCY	2.1940e-003	2.3730e-003
tblVehicleEF	MCY	3.7430e-003	3.4400e-003
tblVehicleEF	MCY	2.0510e-003	2.2150e-003
tblVehicleEF	MCY	3.5270e-003	3.2290e-003
tblVehicleEF	MCY	1.58	1.96
tblVehicleEF	MCY	0.83	0.77
tblVehicleEF	MCY	1.21	1.22
tblVehicleEF	MCY	2.29	2.42
tblVehicleEF	MCY	0.92	0.54
tblVehicleEF	MCY	1.87	1.81
tblVehicleEF	MCY	2.1170e-003	2.2140e-003
tblVehicleEF	MCY	6.5800e-004	6.3900e-004
tblVehicleEF	MCY	1.58	1.96
tblVehicleEF	MCY	0.83	0.77
tblVehicleEF	MCY	1.21	1.22
tblVehicleEF	MCY	2.83	3.02
tblVehicleEF	MCY	0.92	0.54
tblVehicleEF	MCY	2.03	1.98
tblVehicleEF	MCY	0.49	0.52
tblVehicleEF	MCY	0.18	0.15

tblVehicleEF	MCY	20.09	18.45
tblVehicleEF	MCY	10.76	9.79
tblVehicleEF	MCY	175.65	184.66
tblVehicleEF	MCY	45.94	44.08
tblVehicleEF	MCY	3.8160e-003	4.8910e-003
tblVehicleEF	MCY	1.16	1.10
tblVehicleEF	MCY	0.33	0.31
tblVehicleEF	MCY	2.1940e-003	2.3730e-003
tblVehicleEF	MCY	3.7430e-003	3.4400e-003
tblVehicleEF	MCY	2.0510e-003	2.2150e-003
tblVehicleEF	MCY	3.5270e-003	3.2290e-003
tblVehicleEF	MCY	0.58	1.25
tblVehicleEF	MCY	0.96	0.83
tblVehicleEF	MCY	0.35	0.65
tblVehicleEF	MCY	2.44	2.48
tblVehicleEF	MCY	1.17	0.66
tblVehicleEF	MCY	2.40	2.06
tblVehicleEF	MCY	2.1570e-003	2.2230e-003
tblVehicleEF	MCY	7.0600e-004	6.6100e-004
tblVehicleEF	MCY	0.58	1.25
tblVehicleEF	MCY	0.96	0.83
tblVehicleEF	MCY	0.35	0.65
tblVehicleEF	MCY	3.02	3.09
tblVehicleEF	MCY	1.17	0.66
tblVehicleEF	MCY	2.61	2.24
tblVehicleEF	MDV	8.8370e-003	9.9650e-003
tblVehicleEF	MDV	0.01	0.01

tblVehicleEF	MDV	0.99	1.07
tblVehicleEF	MDV	2.49	2.07
tblVehicleEF	MDV	445.01	469.02
tblVehicleEF	MDV	100.86	98.01
tblVehicleEF	MDV	0.11	0.12
tblVehicleEF	MDV	0.11	0.11
tblVehicleEF	MDV	0.22	0.18
tblVehicleEF	MDV	1.8700e-003	2.0810e-003
tblVehicleEF	MDV	2.3580e-003	2.3810e-003
tblVehicleEF	MDV	1.7230e-003	1.9170e-003
tblVehicleEF	MDV	2.1690e-003	2.1900e-003
tblVehicleEF	MDV	0.06	0.07
tblVehicleEF	MDV	0.17	0.15
tblVehicleEF	MDV	0.07	0.07
tblVehicleEF	MDV	0.02	0.02
tblVehicleEF	MDV	0.11	0.09
tblVehicleEF	MDV	0.18	0.15
tblVehicleEF	MDV	4.4550e-003	4.6950e-003
tblVehicleEF	MDV	1.0520e-003	1.0160e-003
tblVehicleEF	MDV	0.06	0.07
tblVehicleEF	MDV	0.17	0.15
tblVehicleEF	MDV	0.07	0.07
tblVehicleEF	MDV	0.03	0.04
tblVehicleEF	MDV	0.11	0.09
tblVehicleEF	MDV	0.20	0.17
tblVehicleEF	MDV	9.3650e-003	0.01
tblVehicleEF	MDV	0.01	9.9740e-003

tblVehicleEF	MDV	1.08	1.20
tblVehicleEF	MDV	2.05	1.78
tblVehicleEF	MDV	463.68	493.01
tblVehicleEF	MDV	100.86	98.01
tblVehicleEF	MDV	0.11	0.12
tblVehicleEF	MDV	0.10	0.10
tblVehicleEF	MDV	0.20	0.17
tblVehicleEF	MDV	1.8700e-003	2.0810e-003
tblVehicleEF	MDV	2.3580e-003	2.3810e-003
tblVehicleEF	MDV	1.7230e-003	1.9170e-003
tblVehicleEF	MDV	2.1690e-003	2.1900e-003
tblVehicleEF	MDV	0.09	0.11
tblVehicleEF	MDV	0.17	0.16
tblVehicleEF	MDV	0.11	0.10
tblVehicleEF	MDV	0.02	0.03
tblVehicleEF	MDV	0.10	0.08
tblVehicleEF	MDV	0.16	0.13
tblVehicleEF	MDV	4.6420e-003	4.9370e-003
tblVehicleEF	MDV	1.0440e-003	1.0110e-003
tblVehicleEF	MDV	0.09	0.11
tblVehicleEF	MDV	0.17	0.16
tblVehicleEF	MDV	0.11	0.10
tblVehicleEF	MDV	0.03	0.04
tblVehicleEF	MDV	0.10	0.08
tblVehicleEF	MDV	0.17	0.15
tblVehicleEF	MDV	8.6850e-003	9.7490e-003
tblVehicleEF	MDV	0.01	0.01

tblVehicleEF	MDV	0.97	1.03
tblVehicleEF	MDV	2.76	2.13
tblVehicleEF	MDV	441.47	461.13
tblVehicleEF	MDV	100.86	98.01
tblVehicleEF	MDV	0.11	0.12
tblVehicleEF	MDV	0.11	0.11
tblVehicleEF	MDV	0.23	0.18
tblVehicleEF	MDV	1.8700e-003	2.0810e-003
tblVehicleEF	MDV	2.3580e-003	2.3810e-003
tblVehicleEF	MDV	1.7230e-003	1.9170e-003
tblVehicleEF	MDV	2.1690e-003	2.1900e-003
tblVehicleEF	MDV	0.04	0.06
tblVehicleEF	MDV	0.18	0.16
tblVehicleEF	MDV	0.05	0.07
tblVehicleEF	MDV	0.02	0.02
tblVehicleEF	MDV	0.13	0.10
tblVehicleEF	MDV	0.20	0.16
tblVehicleEF	MDV	4.4190e-003	4.6160e-003
tblVehicleEF	MDV	1.0570e-003	1.0170e-003
tblVehicleEF	MDV	0.04	0.06
tblVehicleEF	MDV	0.18	0.16
tblVehicleEF	MDV	0.05	0.07
tblVehicleEF	MDV	0.03	0.04
tblVehicleEF	MDV	0.13	0.10
tblVehicleEF	MDV	0.22	0.17
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.02	0.02

tblVehicleEF	MH	2.02	1.45
tblVehicleEF	MH	5.50	4.77
tblVehicleEF	MH	1,091.02	1,101.62
tblVehicleEF	MH	58.65	58.33
tblVehicleEF	MH	1.2930e-003	8.4500e-004
tblVehicleEF	MH	1.42	1.06
tblVehicleEF	MH	0.83	0.71
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	1.0050e-003	9.5800e-004
tblVehicleEF	MH	3.2300e-003	3.2210e-003
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	9.2400e-004	8.8100e-004
tblVehicleEF	MH	0.86	0.87
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.41	0.36
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.32	0.28
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.8200e-004	6.6600e-004
tblVehicleEF	MH	0.86	0.87
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.41	0.36
tblVehicleEF	MH	0.11	0.08
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.35	0.30

tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	2.09	1.49
tblVehicleEF	MH	5.08	4.49
tblVehicleEF	MH	1,091.02	1,101.62
tblVehicleEF	MH	58.65	58.33
tblVehicleEF	MH	1.2930e-003	8.4500e-004
tblVehicleEF	MH	1.33	0.98
tblVehicleEF	MH	0.78	0.68
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	1.0050e-003	9.5800e-004
tblVehicleEF	MH	3.2300e-003	3.2210e-003
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	9.2400e-004	8.8100e-004
tblVehicleEF	MH	1.28	1.34
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.67	0.55
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.31	0.27
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.7500e-004	6.6100e-004
tblVehicleEF	MH	1.28	1.34
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.67	0.55
tblVehicleEF	MH	0.12	0.09

tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.33	0.29
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	1.97	1.44
tblVehicleEF	MH	5.74	4.81
tblVehicleEF	MH	1,091.02	1,101.62
tblVehicleEF	MH	58.65	58.33
tblVehicleEF	MH	1.2930e-003	8.4500e-004
tblVehicleEF	MH	1.42	1.04
tblVehicleEF	MH	0.87	0.72
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	1.0050e-003	9.5800e-004
tblVehicleEF	MH	3.2300e-003	3.2210e-003
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	9.2400e-004	8.8100e-004
tblVehicleEF	MH	0.61	0.94
tblVehicleEF	MH	0.09	0.07
tblVehicleEF	MH	0.29	0.36
tblVehicleEF	MH	0.08	0.06
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.33	0.28
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.8700e-004	6.6700e-004
tblVehicleEF	MH	0.61	0.94
tblVehicleEF	MH	0.09	0.07

tblVehicleEF	MH	0.29	0.36
tblVehicleEF	MH	0.11	0.08
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.37	0.31
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	2.8490e-003	3.0460e-003
tblVehicleEF	MHD	0.05	0.04
tblVehicleEF	MHD	0.31	0.33
tblVehicleEF	MHD	0.25	0.26
tblVehicleEF	MHD	5.17	4.83
tblVehicleEF	MHD	150.93	140.32
tblVehicleEF	MHD	1,107.40	1,125.35
tblVehicleEF	MHD	53.04	57.93
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.41	0.37
tblVehicleEF	MHD	0.66	0.70
tblVehicleEF	MHD	11.70	10.75
tblVehicleEF	MHD	1.0500e-004	9.0000e-005
tblVehicleEF	MHD	2.8600e-003	2.8360e-003
tblVehicleEF	MHD	7.4800e-004	7.3800e-004
tblVehicleEF	MHD	1.0000e-004	8.6000e-005
tblVehicleEF	MHD	2.7330e-003	2.7090e-003
tblVehicleEF	MHD	6.8800e-004	6.7800e-004
tblVehicleEF	MHD	7.3700e-004	1.0090e-003
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	5.2800e-004	6.5700e-004

tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.31	0.30
tblVehicleEF	MHD	1.4510e-003	1.3500e-003
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	6.2100e-004	6.6400e-004
tblVehicleEF	MHD	7.3700e-004	1.0090e-003
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	5.2800e-004	6.5700e-004
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.34	0.33
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	2.8970e-003	3.0830e-003
tblVehicleEF	MHD	0.05	0.04
tblVehicleEF	MHD	0.23	0.24
tblVehicleEF	MHD	0.25	0.26
tblVehicleEF	MHD	4.83	4.60
tblVehicleEF	MHD	159.86	148.62
tblVehicleEF	MHD	1,107.40	1,125.35
tblVehicleEF	MHD	53.04	57.93
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.42	0.38
tblVehicleEF	MHD	0.63	0.66
tblVehicleEF	MHD	11.66	10.72
tblVehicleEF	MHD	8.8000e-005	7.6000e-005

tblVehicleEF	MHD	2.8600e-003	2.8360e-003
tblVehicleEF	MHD	7.4800e-004	7.3800e-004
tblVehicleEF	MHD	8.5000e-005	7.3000e-005
tblVehicleEF	MHD	2.7330e-003	2.7090e-003
tblVehicleEF	MHD	6.8800e-004	6.7800e-004
tblVehicleEF	MHD	1.1570e-003	1.5740e-003
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	8.9400e-004	9.7500e-004
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.29	0.29
tblVehicleEF	MHD	1.5350e-003	1.4290e-003
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	6.1500e-004	6.6000e-004
tblVehicleEF	MHD	1.1570e-003	1.5740e-003
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	8.9400e-004	9.7500e-004
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.32	0.31
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	2.8190e-003	3.0340e-003
tblVehicleEF	MHD	0.05	0.04
tblVehicleEF	MHD	0.43	0.46
tblVehicleEF	MHD	0.25	0.26

tblVehicleEF	MHD	5.42	4.88
tblVehicleEF	MHD	138.57	128.84
tblVehicleEF	MHD	1,107.40	1,125.35
tblVehicleEF	MHD	53.04	57.93
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.39	0.35
tblVehicleEF	MHD	0.65	0.69
tblVehicleEF	MHD	11.73	10.76
tblVehicleEF	MHD	1.2800e-004	1.1000e-004
tblVehicleEF	MHD	2.8600e-003	2.8360e-003
tblVehicleEF	MHD	7.4800e-004	7.3800e-004
tblVehicleEF	MHD	1.2200e-004	1.0500e-004
tblVehicleEF	MHD	2.7330e-003	2.7090e-003
tblVehicleEF	MHD	6.8800e-004	6.7800e-004
tblVehicleEF	MHD	5.0900e-004	9.7000e-004
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	3.6900e-004	6.2700e-004
tblVehicleEF	MHD	0.03	0.03
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.32	0.30
tblVehicleEF	MHD	1.3340e-003	1.2420e-003
tblVehicleEF	MHD	0.01	0.01
tblVehicleEF	MHD	6.2500e-004	6.6500e-004
tblVehicleEF	MHD	5.0900e-004	9.7000e-004
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.03	0.04

tblVehicleEF	MHD	3.6900e-004	6.2700e-004
tblVehicleEF	MHD	0.04	0.04
tblVehicleEF	MHD	0.02	0.02
tblVehicleEF	MHD	0.35	0.33
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.0220e-003	5.4430e-003
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.24	0.25
tblVehicleEF	OBUS	0.48	0.40
tblVehicleEF	OBUS	5.58	4.97
tblVehicleEF	OBUS	45.31	92.73
tblVehicleEF	OBUS	1,144.46	1,224.67
tblVehicleEF	OBUS	70.88	68.08
tblVehicleEF	OBUS	1.1820e-003	2.1340e-003
tblVehicleEF	OBUS	0.07	0.19
tblVehicleEF	OBUS	0.43	0.65
tblVehicleEF	OBUS	1.60	2.31
tblVehicleEF	OBUS	6.0000e-006	1.8000e-005
tblVehicleEF	OBUS	1.9110e-003	2.6120e-003
tblVehicleEF	OBUS	9.3300e-004	8.6800e-004
tblVehicleEF	OBUS	6.0000e-006	1.7000e-005
tblVehicleEF	OBUS	1.8040e-003	2.4820e-003
tblVehicleEF	OBUS	8.5800e-004	7.9800e-004
tblVehicleEF	OBUS	1.2080e-003	1.4730e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.03
tblVehicleEF	OBUS	7.1000e-004	7.7700e-004

tblVehicleEF	OBUS	0.03	0.04
tblVehicleEF	OBUS	0.06	0.04
tblVehicleEF	OBUS	0.34	0.31
tblVehicleEF	OBUS	4.4500e-004	8.9700e-004
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	8.0600e-004	7.6800e-004
tblVehicleEF	OBUS	1.2080e-003	1.4730e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.04	0.05
tblVehicleEF	OBUS	7.1000e-004	7.7700e-004
tblVehicleEF	OBUS	0.04	0.05
tblVehicleEF	OBUS	0.06	0.04
tblVehicleEF	OBUS	0.38	0.34
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.2140e-003	5.5370e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.24	0.24
tblVehicleEF	OBUS	0.49	0.41
tblVehicleEF	OBUS	5.17	4.69
tblVehicleEF	OBUS	46.97	97.25
tblVehicleEF	OBUS	1,144.46	1,224.67
tblVehicleEF	OBUS	70.88	68.08
tblVehicleEF	OBUS	1.1820e-003	2.1340e-003
tblVehicleEF	OBUS	0.08	0.20
tblVehicleEF	OBUS	0.40	0.61
tblVehicleEF	OBUS	1.55	2.28
tblVehicleEF	OBUS	5.0000e-006	1.5000e-005

tblVehicleEF	OBUS	1.9110e-003	2.6120e-003
tblVehicleEF	OBUS	9.3300e-004	8.6800e-004
tblVehicleEF	OBUS	5.0000e-006	1.4000e-005
tblVehicleEF	OBUS	1.8040e-003	2.4820e-003
tblVehicleEF	OBUS	8.5800e-004	7.9800e-004
tblVehicleEF	OBUS	1.8210e-003	2.2360e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.03
tblVehicleEF	OBUS	1.1920e-003	1.1520e-003
tblVehicleEF	OBUS	0.03	0.04
tblVehicleEF	OBUS	0.06	0.04
tblVehicleEF	OBUS	0.33	0.30
tblVehicleEF	OBUS	4.6100e-004	9.4000e-004
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.9900e-004	7.6300e-004
tblVehicleEF	OBUS	1.8210e-003	2.2360e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.04	0.04
tblVehicleEF	OBUS	1.1920e-003	1.1520e-003
tblVehicleEF	OBUS	0.04	0.05
tblVehicleEF	OBUS	0.06	0.04
tblVehicleEF	OBUS	0.36	0.33
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	6.9000e-003	5.4190e-003
tblVehicleEF	OBUS	0.03	0.03
tblVehicleEF	OBUS	0.24	0.25
tblVehicleEF	OBUS	0.47	0.40

tblVehicleEF	OBUS	5.82	5.02
tblVehicleEF	OBUS	43.02	86.49
tblVehicleEF	OBUS	1,144.46	1,224.67
tblVehicleEF	OBUS	70.88	68.08
tblVehicleEF	OBUS	1.1820e-003	2.1340e-003
tblVehicleEF	OBUS	0.07	0.19
tblVehicleEF	OBUS	0.43	0.64
tblVehicleEF	OBUS	1.64	2.32
tblVehicleEF	OBUS	8.0000e-006	2.2000e-005
tblVehicleEF	OBUS	1.9110e-003	2.6120e-003
tblVehicleEF	OBUS	9.3300e-004	8.6800e-004
tblVehicleEF	OBUS	7.0000e-006	2.1000e-005
tblVehicleEF	OBUS	1.8040e-003	2.4820e-003
tblVehicleEF	OBUS	8.5800e-004	7.9800e-004
tblVehicleEF	OBUS	8.7400e-004	1.4560e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.03
tblVehicleEF	OBUS	5.0200e-004	7.5300e-004
tblVehicleEF	OBUS	0.03	0.04
tblVehicleEF	OBUS	0.07	0.04
tblVehicleEF	OBUS	0.36	0.31
tblVehicleEF	OBUS	4.2300e-004	8.3700e-004
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	8.1100e-004	7.6900e-004
tblVehicleEF	OBUS	8.7400e-004	1.4560e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.04	0.05

tblVehicleEF	OBUS	5.0200e-004	7.5300e-004
tblVehicleEF	OBUS	0.04	0.05
tblVehicleEF	OBUS	0.07	0.04
tblVehicleEF	OBUS	0.39	0.34
tblVehicleEF	SBUS	0.84	0.82
tblVehicleEF	SBUS	8.7700e-003	0.01
tblVehicleEF	SBUS	0.06	0.06
tblVehicleEF	SBUS	9.07	8.15
tblVehicleEF	SBUS	0.52	0.65
tblVehicleEF	SBUS	7.60	7.01
tblVehicleEF	SBUS	1,056.56	1,104.15
tblVehicleEF	SBUS	1,049.12	1,075.03
tblVehicleEF	SBUS	61.15	56.16
tblVehicleEF	SBUS	3.8900e-004	7.1200e-004
tblVehicleEF	SBUS	7.46	8.02
tblVehicleEF	SBUS	3.42	3.56
tblVehicleEF	SBUS	10.87	11.89
tblVehicleEF	SBUS	6.7040e-003	7.1800e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	1.1270e-003	8.2000e-004
tblVehicleEF	SBUS	6.4140e-003	6.8690e-003
tblVehicleEF	SBUS	2.6320e-003	2.6680e-003
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	1.0360e-003	7.5400e-004
tblVehicleEF	SBUS	2.4150e-003	3.7320e-003
tblVehicleEF	SBUS	0.02	0.03

tblVehicleEF	SBUS	1.09	0.97
tblVehicleEF	SBUS	1.3540e-003	2.0050e-003
tblVehicleEF	SBUS	0.09	0.10
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.38	0.37
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	7.4200e-004	6.8300e-004
tblVehicleEF	SBUS	2.4150e-003	3.7320e-003
tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	1.57	1.40
tblVehicleEF	SBUS	1.3540e-003	2.0050e-003
tblVehicleEF	SBUS	0.11	0.12
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.41	0.41
tblVehicleEF	SBUS	0.84	0.82
tblVehicleEF	SBUS	8.9290e-003	0.01
tblVehicleEF	SBUS	0.05	0.05
tblVehicleEF	SBUS	8.98	8.04
tblVehicleEF	SBUS	0.53	0.66
tblVehicleEF	SBUS	5.91	5.58
tblVehicleEF	SBUS	1,101.41	1,153.29
tblVehicleEF	SBUS	1,049.12	1,075.03
tblVehicleEF	SBUS	61.15	56.16
tblVehicleEF	SBUS	3.8900e-004	7.1200e-004
tblVehicleEF	SBUS	7.70	8.27
tblVehicleEF	SBUS	3.27	3.35

tblVehicleEF	SBUS	10.83	11.86
tblVehicleEF	SBUS	5.6520e-003	6.0520e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	1.1270e-003	8.2000e-004
tblVehicleEF	SBUS	5.4070e-003	5.7910e-003
tblVehicleEF	SBUS	2.6320e-003	2.6680e-003
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	1.0360e-003	7.5400e-004
tblVehicleEF	SBUS	3.6780e-003	5.8010e-003
tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	1.08	0.97
tblVehicleEF	SBUS	2.3150e-003	3.0570e-003
tblVehicleEF	SBUS	0.09	0.10
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.33	0.33
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	7.1400e-004	6.5900e-004
tblVehicleEF	SBUS	3.6780e-003	5.8010e-003
tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	1.57	1.40
tblVehicleEF	SBUS	2.3150e-003	3.0570e-003
tblVehicleEF	SBUS	0.11	0.12
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.36	0.36
tblVehicleEF	SBUS	0.84	0.83

tblVehicleEF	SBUS	8.6750e-003	0.01
tblVehicleEF	SBUS	0.06	0.06
tblVehicleEF	SBUS	9.20	8.28
tblVehicleEF	SBUS	0.52	0.65
tblVehicleEF	SBUS	8.53	7.26
tblVehicleEF	SBUS	994.62	1,036.29
tblVehicleEF	SBUS	1,049.12	1,075.03
tblVehicleEF	SBUS	61.15	56.16
tblVehicleEF	SBUS	3.8900e-004	7.1200e-004
tblVehicleEF	SBUS	7.13	7.67
tblVehicleEF	SBUS	3.40	3.50
tblVehicleEF	SBUS	10.89	11.90
tblVehicleEF	SBUS	8.1580e-003	8.7360e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	1.1270e-003	8.2000e-004
tblVehicleEF	SBUS	7.8050e-003	8.3580e-003
tblVehicleEF	SBUS	2.6320e-003	2.6680e-003
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	1.0360e-003	7.5400e-004
tblVehicleEF	SBUS	1.7320e-003	3.5530e-003
tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	1.09	0.97
tblVehicleEF	SBUS	9.5400e-004	1.9330e-003
tblVehicleEF	SBUS	0.09	0.10
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	0.41	0.38

tblVehicleEF	SBUS	9.8040e-003	0.01
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	7.5800e-004	6.8700e-004
tblVehicleEF	SBUS	1.7320e-003	3.5530e-003
tblVehicleEF	SBUS	0.02	0.03
tblVehicleEF	SBUS	1.58	1.40
tblVehicleEF	SBUS	9.5400e-004	1.9330e-003
tblVehicleEF	SBUS	0.10	0.12
tblVehicleEF	SBUS	0.02	0.02
tblVehicleEF	SBUS	0.44	0.42
tblVehicleEF	UBUS	1.62	2.06
tblVehicleEF	UBUS	0.05	0.06
tblVehicleEF	UBUS	6.70	9.44
tblVehicleEF	UBUS	9.37	10.08
tblVehicleEF	UBUS	1,785.78	1,890.04
tblVehicleEF	UBUS	131.72	116.31
tblVehicleEF	UBUS	1.0400e-003	1.7360e-003
tblVehicleEF	UBUS	3.03	7.19
tblVehicleEF	UBUS	12.96	14.18
tblVehicleEF	UBUS	0.53	0.57
tblVehicleEF	UBUS	0.03	0.09
tblVehicleEF	UBUS	1.2850e-003	1.2660e-003
tblVehicleEF	UBUS	0.23	0.24
tblVehicleEF	UBUS	0.03	0.09
tblVehicleEF	UBUS	1.1820e-003	1.1640e-003
tblVehicleEF	UBUS	2.2480e-003	4.9890e-003
tblVehicleEF	UBUS	0.04	0.08

tblVehicleEF	UBUS	1.7390e-003	2.9030e-003
tblVehicleEF	UBUS	0.27	0.63
tblVehicleEF	UBUS	9.8670e-003	0.03
tblVehicleEF	UBUS	0.73	0.79
tblVehicleEF	UBUS	8.3290e-003	9.4590e-003
tblVehicleEF	UBUS	1.4860e-003	1.3450e-003
tblVehicleEF	UBUS	2.2480e-003	4.9890e-003
tblVehicleEF	UBUS	0.04	0.08
tblVehicleEF	UBUS	1.7390e-003	2.9030e-003
tblVehicleEF	UBUS	1.93	2.77
tblVehicleEF	UBUS	9.8670e-003	0.03
tblVehicleEF	UBUS	0.80	0.87
tblVehicleEF	UBUS	1.62	2.06
tblVehicleEF	UBUS	0.05	0.05
tblVehicleEF	UBUS	6.72	9.49
tblVehicleEF	UBUS	7.91	8.76
tblVehicleEF	UBUS	1,785.78	1,890.04
tblVehicleEF	UBUS	131.72	116.31
tblVehicleEF	UBUS	1.0400e-003	1.7360e-003
tblVehicleEF	UBUS	2.88	6.77
tblVehicleEF	UBUS	12.88	14.12
tblVehicleEF	UBUS	0.53	0.57
tblVehicleEF	UBUS	0.03	0.09
tblVehicleEF	UBUS	1.2850e-003	1.2660e-003
tblVehicleEF	UBUS	0.23	0.24
tblVehicleEF	UBUS	0.03	0.09
tblVehicleEF	UBUS	1.1820e-003	1.1640e-003

tblVehicleEF	UBUS	3.1800e-003	7.4210e-003
tblVehicleEF	UBUS	0.04	0.08
tblVehicleEF	UBUS	3.0000e-003	4.3000e-003
tblVehicleEF	UBUS	0.28	0.64
tblVehicleEF	UBUS	8.6570e-003	0.02
tblVehicleEF	UBUS	0.66	0.73
tblVehicleEF	UBUS	8.3300e-003	9.4610e-003
tblVehicleEF	UBUS	1.4610e-003	1.3230e-003
tblVehicleEF	UBUS	3.1800e-003	7.4210e-003
tblVehicleEF	UBUS	0.04	0.08
tblVehicleEF	UBUS	3.0000e-003	4.3000e-003
tblVehicleEF	UBUS	1.93	2.78
tblVehicleEF	UBUS	8.6570e-003	0.02
tblVehicleEF	UBUS	0.72	0.80
tblVehicleEF	UBUS	1.62	2.06
tblVehicleEF	UBUS	0.06	0.06
tblVehicleEF	UBUS	6.68	9.43
tblVehicleEF	UBUS	10.35	10.29
tblVehicleEF	UBUS	1,785.78	1,890.04
tblVehicleEF	UBUS	131.72	116.31
tblVehicleEF	UBUS	1.0400e-003	1.7360e-003
tblVehicleEF	UBUS	3.01	7.06
tblVehicleEF	UBUS	13.01	14.20
tblVehicleEF	UBUS	0.53	0.57
tblVehicleEF	UBUS	0.03	0.09
tblVehicleEF	UBUS	1.2850e-003	1.2660e-003
tblVehicleEF	UBUS	0.23	0.24

tblVehicleEF	UBUS	0.03	0.09
tblVehicleEF	UBUS	1.1820e-003	1.1640e-003
tblVehicleEF	UBUS	1.7130e-003	5.3920e-003
tblVehicleEF	UBUS	0.04	0.09
tblVehicleEF	UBUS	1.2070e-003	2.9670e-003
tblVehicleEF	UBUS	0.27	0.63
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.77	0.81
tblVehicleEF	UBUS	8.3290e-003	9.4590e-003
tblVehicleEF	UBUS	1.5030e-003	1.3490e-003
tblVehicleEF	UBUS	1.7130e-003	5.3920e-003
tblVehicleEF	UBUS	0.04	0.09
tblVehicleEF	UBUS	1.2070e-003	2.9670e-003
tblVehicleEF	UBUS	1.93	2.76
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.85	0.88
tblVehicleTrips	CC_TL	7.30	8.40
tblVehicleTrips	CNW_TL	7.30	6.90
tblVehicleTrips	CW_TL	9.50	16.60

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
		Highest		

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	4.0800e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	3.0000e-005
Energy	1.1000e-004	1.0300e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	3.8656	3.8656	1.3000e-004	4.0000e-005	3.8820
Mobile	4.3000e-004	2.2100e-003	6.5600e-003	3.0000e-005	2.5200e-003	2.0000e-005	2.5400e-003	6.8000e-004	2.0000e-005	6.9000e-004	0.0000	2.5850	2.5850	1.1000e-004	0.0000	2.5878
Waste						0.0000	0.0000		0.0000	0.0000	0.2517	0.0000	0.2517	0.0149	0.0000	0.6236
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.9594	1.0328	7.5700e-003	1.9000e-004	1.2776
Total	**4.6200e-003**	**3.2400e-003**	**7.4300e-003**	**4.0000e-005**	**2.5200e-003**	**1.0000e-004**	**2.6200e-003**	**6.8000e-004**	**1.0000e-004**	**7.7000e-004**	**0.3251**	**7.4100**	**7.7351**	**0.0227**	**2.3000e-004**	**8.3710**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	4.0800e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	3.0000e-005
Energy	1.1000e-004	1.0300e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	3.8656	3.8656	1.3000e-004	4.0000e-005	3.8820
Mobile	4.3000e-004	2.2100e-003	6.5600e-003	3.0000e-005	2.5200e-003	2.0000e-005	2.5400e-003	6.8000e-004	2.0000e-005	6.9000e-004	0.0000	2.5850	2.5850	1.1000e-004	0.0000	2.5878
Waste						0.0000	0.0000		0.0000	0.0000	0.2517	0.0000	0.2517	0.0149	0.0000	0.6236
Water						0.0000	0.0000		0.0000	0.0000	0.0734	0.9594	1.0328	7.5700e-003	1.9000e-004	1.2776
Total	**4.6200e-003**	**3.2400e-003**	**7.4300e-003**	**4.0000e-005**	**2.5200e-003**	**1.0000e-004**	**2.6200e-003**	**6.8000e-004**	**1.0000e-004**	**7.7000e-004**	**0.3251**	**7.4100**	**7.7351**	**0.0227**	**2.3000e-004**	**8.3710**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Building Construction	Building Construction	1/1/2023	1/17/2023	5	12	RP-1 Vendor
2	Building Construction 2	Building Construction	2/21/2023	3/8/2023	5	12	LN2 Vendor
3	Building Construction 3	Building Construction	4/12/2023	4/27/2023	5	12	LOX Vendor
4	Building Construction 4	Building Construction	6/1/2023	6/16/2023	5	12	He Vendor

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

<u>OffRoad Equipment</u>

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor

<u>Trips and VMT</u>

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Building Construction	0			48.00	10.80	180.00			HHDT	
Building Construction 2	0			12.00	10.80	180.00			HHDT	
Building Construction 3	0			12.00	10.80	180.00			HHDT	
Building Construction 4	0			12.00	10.80	180.00			HHDT	

3.1 Mitigation Measures Construction

3.2 Building Construction - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Building Construction 2 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Building Construction 3 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction 4 - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	4.3000e-004	2.2100e-003	6.5600e-003	3.0000e-005	2.5200e-003	2.0000e-005	2.5400e-003	6.8000e-004	2.0000e-005	6.9000e-004	0.0000	2.5850	2.5850	1.1000e-004	0.0000	2.5878
Unmitigated	4.3000e-004	2.2100e-003	6.5600e-003	3.0000e-005	2.5200e-003	2.0000e-005	2.5400e-003	6.8000e-004	2.0000e-005	6.9000e-004	0.0000	2.5850	2.5850	1.1000e-004	0.0000	2.5878

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Heavy Industry	1.50	1.50	1.50	6,642	6,642
Total	1.50	1.50	1.50	6,642	6,642

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Heavy Industry	16.60	8.40	6.90	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Heavy Industry	0.550809	0.042355	0.203399	0.115606	0.014562	0.005806	0.021810	0.035336	0.002134	0.001736	0.004891	0.000712	0.000845

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	2.7465	2.7465	1.1000e-004	2.0000e-005	2.7563
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	2.7465	2.7465	1.1000e-004	2.0000e-005	2.7563
NaturalGas Mitigated	1.1000e-004	1.0300e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1190	1.1190	2.0000e-005	2.0000e-005	1.1257
NaturalGas Unmitigated	1.1000e-004	1.0300e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1190	1.1190	2.0000e-005	2.0000e-005	1.1257

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	20970	1.1000e-004	1.0300e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1190	1.1190	2.0000e-005	2.0000e-005	1.1257
Total		**1.1000e-004**	**1.0300e-003**	**8.6000e-004**	**1.0000e-005**		**8.0000e-005**	**8.0000e-005**		**8.0000e-005**	**8.0000e-005**	**0.0000**	**1.1190**	**1.1190**	**2.0000e-005**	**2.0000e-005**	**1.1257**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	20970	1.1000e-004	1.0300e-003	8.6000e-004	1.0000e-005		8.0000e-005	8.0000e-005		8.0000e-005	8.0000e-005	0.0000	1.1190	1.1190	2.0000e-005	2.0000e-005	1.1257
Total		**1.1000e-004**	**1.0300e-003**	**8.6000e-004**	**1.0000e-005**		**8.0000e-005**	**8.0000e-005**		**8.0000e-005**	**8.0000e-005**	**0.0000**	**1.1190**	**1.1190**	**2.0000e-005**	**2.0000e-005**	**1.1257**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	8620	2.7465	1.1000e-004	2.0000e-005	2.7563
Total		**2.7465**	**1.1000e-004**	**2.0000e-005**	**2.7563**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	8620	2.7465	1.1000e-004	2.0000e-005	2.7563
Total		**2.7465**	**1.1000e-004**	**2.0000e-005**	**2.7563**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	4.0800e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	3.0000e-005
Unmitigated	4.0800e-003	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	3.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	4.6000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.6100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	3.0000e-005
Total	**4.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**3.0000e-005**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	4.6000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	3.6100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	3.0000e-005
Total	**4.0700e-003**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**3.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	1.0328	7.5700e-003	1.9000e-004	1.2776
Unmitigated	1.0328	7.5700e-003	1.9000e-004	1.2776

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	0.23125 / 0	1.0328	7.5700e-003	1.9000e-004	1.2776
Total		**1.0328**	**7.5700e-003**	**1.9000e-004**	**1.2776**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	0.23125 / 0	1.0328	7.5700e-003	1.9000e-004	1.2776
Total		**1.0328**	**7.5700e-003**	**1.9000e-004**	**1.2776**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.2517	0.0149	0.0000	0.6236
Unmitigated	0.2517	0.0149	0.0000	0.6236

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	1.24	0.2517	0.0149	0.0000	0.6236
Total		**0.2517**	**0.0149**	**0.0000**	**0.6236**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	1.24	0.2517	0.0149	0.0000	0.6236
Total		**0.2517**	**0.0149**	**0.0000**	**0.6236**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Appendix E

Sound – Background & Regulatory Requirements

E.1 Definition of Sound and Characteristics

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although continuous and extended exposure to high noise levels (e.g., through occupational exposure) can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual.

The perception and evaluation of sound involves three basic physical characteristics:

- Intensity – the acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- Frequency – the number of cycles per second the air vibrates, in Hertz (Hz)
- Duration – the length of time the sound can be detected

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. The primary human response to noise is annoyance, which is defined by the United States (U.S.) Environmental Protection Agency (EPA) as any negative subjective reaction on the part of an individual or group (U.S. Environmental Protection Agency 1974). The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual. While aircraft are not the only sources of noise in an urban or suburban environment, they are readily identified by their noise output.

E.2 Sound Intensity and Weighting

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be heard. Because of this vast range, it is unwieldy to use a linear scale to represent the intensity of sound. As a result, a logarithmic unit known as the decibel represents the intensity or amplitude of a sound, also referred to as the sound level. The dB scale simplifies the broad range of encountered sound pressures detected by the human ear and allows the measurement of sound to be more easily understood. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 and 140 dB are felt as pain (Berglund 1995).

All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale, which places less weight on very low and very high frequencies in order to replicate human hearing sensitivity. The general range of human hearing is from 20 to 20,000 cycles per second, or Hz; humans hear best in the range of 1,000–4,000 Hz. A-weighting is a frequency-dependent adjustment of sound level used to approximate the natural range and sensitivity of the human auditory system. **Error! Reference source not found.** provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Table E-1: Subjective Responses to Changes in A-Weighted Decibels

Change	Change in Perceived Loudness
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic – twice or half as loud
20 dB	Striking – fourfold change

Note: dB = decibel(s)

Error! Reference source not found. provides a chart of A-weighted sound levels from typical noise sources (Cowan 1994; Harris 1979). Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources are time-varying events and reach a maximum sound level during an event, such as a vehicle passing by. Sounds can also be part of the ambient environment (e.g., urban daytime, urban nighttime) and are described by averages taken over extended periods. A variety of noise metrics has been developed to describe noise, particularly aircraft noise, in different contexts and over different time periods.

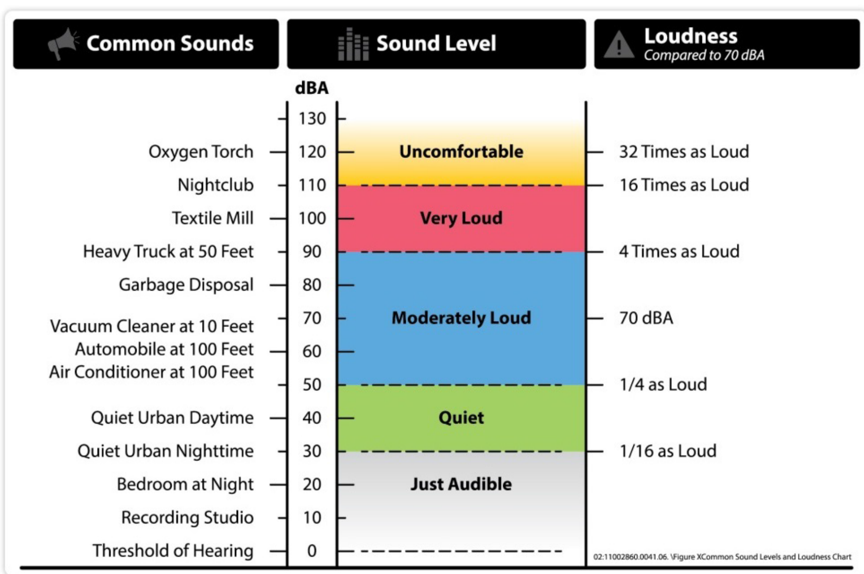

Figure E-1: A-Weighted Sound Levels from Typical Sources

E.3 Sound Metrics

A "metric" is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment. The Day-Night Average Sound Level (DNL) metric is the energy-averaged sound level measured over a 24-hour period, with a 10 dB nighttime adjustment to account for heightened human sensitivity to noise when ambient sound levels are low, such as when sleep disturbance could occur. DNL does not represent a sound level heard at any given time but instead represents long-term exposure. Scientific studies have found good correlation between the percentages of groups of people highly annoyed and the level of their average noise exposure measured in DNL (U.S. Department of the Navy et al. 1978; U.S. Environmental Protection Agency 1999). While DNL is the primary metric used to determine noise impacts by the U.S. Department of Housing and Urban Development, Federal Aviation Administration (FAA), and EPA, California has adopted the use of the Community Noise Equivalent Level (CNEL). While CNEL, like DNL, is an energy-averaged sound level measured over a 24-hour period. However, CNEL adds a ten times weighting (equivalent to a 10 dBA [A-weighted decibel] "penalty") to each operation between 10:00 p.m. and 7:00 a.m., CNEL also adds a three times weighting (equivalent to a 4.77 dBA penalty) for each operation during evening hours (7:00 p.m. to 10:00 p.m.). As such, DNL and CNEL have been determined to be a reliable measure of long-term community annoyance.

CNEL values are average quantities, mathematically representing the continuous sound level (L_{eq1H}) that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The CNEL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day.

Of note is that methods for quantifying noise depend on the potential impacts in question and on the type of noise. Another useful noise measurement in determining the effects of noise is the 1-hour average sound level, abbreviated L_{eq1H}. The L_{eq1H} can be thought of in terms of equivalent sound; that is, if a L_{eq1H} is 45.3 dB, this is what would be measured if a sound measurement device were placed in a sound field of 45.3 dB for 1 hour. The L_{eq1H} is usually A weighted unless specified otherwise (dBA). A weighting is a standard filter used in acoustics that approximates human hearing and in some cases is the most appropriate weighting filter when investigating the impacts of noise on wildlife as well as humans.

E.4 Sound Propagation

In an ideal setting in which sound propagates away from a point source without any outside influence (e.g., a barrier reflecting or attenuating the sound), sound energy radiates uniformly outward in all directions from the source in a pattern referred to as spherical spreading. As sound energy propagates away from the sound source, both the sound level and frequency change. For each doubling of distance from the source, the sound level attenuates (or drops off) at a rate of 6 dBA.

In a real-world setting, a number of factors can influence how sound propagates in the environment; the ideal case of spherical spreading is at best only an approximation of attenuation with distance. Wind has been shown to be the single most important meteorological factor within approximately 500 feet (152 meters) of the sound source, while vertical air temperature gradients are more important in sound propagation over longer distances. Other atmospheric conditions such as air temperature, humidity, and turbulence also can have a major effect on received sound levels.

Whether natural or manmade, a large object or barrier in the path between a sound source and a receptor can attenuate sound levels substantially. The impact of this shielding depends on the size and material of the object as well as the frequency content of the sound source. Natural terrain, buildings, and walls can serve as noise barriers in which attenuation of 5–10 dB is often not noticeable.

E.5 Noise Control Act

The Noise Control Act (NCA) (42 United States Code 4901 et seq.) sought to limit the exposure and disturbance that individuals and communities experience from noise. It focuses on surface transportation and construction sources, particularly near airport environments. The NCA also specifies that performance standards for transportation equipment be established with the assistance of the

U.S. Department of Transportation. Section 7 of the NCA regulates sonic booms and gave the FAA regulatory authority after consultation with the EPA. Furthermore, the 1987 Quiet Community amendment gave state and local authorities greater involvement in controlling noise.

E.6 Ambient Sound Guidance Documents

Ambient sound standards regulate ambient sound levels through time-averaged sound limits. Sound standards for land use compatibility established by DoD and civilian jurisdictions are expressed in terms of the DNL.

E.7 Federal Interagency Committee on Urban Noise Criteria

The federal government has established suggested land use compatibility criteria for different noise zones. However, land use compatibility with differing noise levels is regulated at the local level (Federal Interagency Committee on Urban Noise 1980). Residential areas and schools are considered compatible where the DNL is less than or equal to 65 dBA, and outdoor recreational activities are compatible with noise levels less than or equal to 70 dBA. Furthermore, parks are compatible with noise levels less than or equal to 75 dBA based on Land Use Guidelines.

G.8 U.S. Environmental Protection Agency Noise Standards

The level of environmental noise at which no measurable hearing loss would be expected to occur over a lifetime, as identified by the EPA, is a 24-hour exposure level of 70 dB (U.S. Environmental Protection Agency 1974).

E.9 Bibliography

Cowan, J. P. 1994. Handbook of Environmental Acoustics. New York, NY: John Wiley & Sons.

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Harris, C. 1979. Handbook of Noise Control. New York, NY: McGraw-Hill.

U.S. Department of the Navy, U.S. Department of the Air Force, and U.S. Department of the Army. 1978. Environmental Protection: Planning in the Noise Environment. (AFM 19-10 TM 5-803-2). Washington, DC.

MEMORANDUM **February 14, 2023**

TO: Federal Aviation Administration, Office of Commercial Space Transportation

FROM: SpaceX

SUBJECT: Noise Modeling Methodology for the Supplemental Environmental Assessment for the Falcon 9 Cadence Increase at Vandenberg Space Force Base, California and Offshore Landing Locations

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PCBOOM is the current Federal Aviation Administration (FAA)-approved model for modeling sonic booms from launch vehicles, and will be used to model sonic boom noise from Falcon 9 launch and landing operations at Vandenberg Space Force Base (VSFB). The FAA does not currently have an approved propulsion noise model for launch vehicles. In accordance with FAA Order 1050.1F, Environmental Impacts: Policies and Procedures, all non-standard noise analysis in support of the noise impact analysis for the National Environmental Policy Act (NEPA) must be approved by the Office of Environment and Energy (AEE).

SpaceX requests AEE's written approval to use Rocket Propulsion Noise and Emissions Simulation Model (RUMBLE) version 2.0 to model Falcon 9 launch and landing propulsion noise. RUMBLE is a publicly available software tool developed by Blue Ridge Research and Consulting, LLC used to model rocket engine noise. This sophisticated model incorporates numerous components, including the acoustic power of the rocket engine source, forward flight effects, the angle from the source to the receiver (directivity), Doppler effect, propagation between the source and receiver (ray path), atmospheric absorption, and ground interference to estimate received noise levels (Bradley et al. 2018). Default methods and data that are provided in RUMBLE and would be used during the assessment include:

- Use of the Falcon 9 launch vehicle, with the technical specification outlined in the SR118 Rocket Motor Manual and FAA AST STAR Database;
- Use of the U.S. Standard Atmosphere 1976 model; and
- Use of only noise metrics that are native to RUMBLE (i.e., CNEL, LAmax).

Trajectory information to be used as inputs to the model will be provided by SpaceX, similar to previous modeling efforts and will be representative of the proposed mission profiles. Please contact Elyse Procopio at elyse.procopio@spacex.com with any questions or concerns.

Noise Study for SpaceX Falcon 9 Launch and Landing Operations at at Vandenberg Space Force Base, California

10 February 2023

Prepared for

Space Exploration Technologies Corporation
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Prepared by

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Table of Contents

List of Tables

List of Figures

Acronyms and Abbreviations

CNEL	community noise equivalent level
dB	decibel(s)
dBA	A-weighted decibel(s)
DNL	Day-Night Average Sound Level
DoD	Department of Defense
FAA	Federal Aviation Administration
ft.	foot or feet
Hz	Hertz
L_{Amax}	A-weighted maximum noise levels
lbf	pound-force
lbm	pound-mass
L_{max}	unweighted maximum noise levels
LOA	Letter of Authorization
LOX	liquid oxygen
M1D	Merlin 1D
mi	mile(s)
MSRS	ManTech SRS Technologies, Inc.
NEPA	National Environmental Policy Act
NIOSH	National Institute for Occupational Safety and Health
NCI	Northern Channel Islands
M	million
OSHA	Occupational Safety and Health Administration
psf	pound per square foot
RP-1	rocket propellant 1
SLC-4E	Space Launch Complex 4 East
SLC-4W	Space Landing Complex 4 West
SpaceX	Space Exploration Technologies Corporation
USSF	United States Space Force
VSFB	Vandenberg Space Force Base

1.0 Introduction

Space Exploration Technologies Corporation (SpaceX) proposes to increase the annual cadence for Falcon 9 operations at Vandenberg Space Force Base (VSFB) and include additional downrange offshore landing locations in the Pacific Ocean (Figures 1-1 and 1-2). SpaceX has been performing launches of the Falcon 9 vehicle at Space Launch Complex 4 East (SLC-4E) since 2013. In 2018, SpaceX began performing first stage recovery by performing boostback of the first stage and return-to-launch-site flight trajectory, landing the first stage at Space Landing Complex 4 West (SLC-4W; also referred to as Landing Zone 4). Under current United States Space Force (USSF) approvals under the National Environmental Policy Act (NEPA) and Federal Aviation Administration (FAA) launch vehicle licensing, SpaceX is approved to conduct up to 12 Falcon 9 launches each year and up to 12 first stage landings at SLC-4W each year.

Multiple noise studies of the Falcon 9 program at VSFB have been performed to support licensing by the FAA and review and approval of the program under NEPA by the USSF and FAA. While currently under NEPA review for SpaceX's proposed increase in annual launch cadence, the FAA and SpaceX determined the need to conduct new noise modeling to characterize the noise impacts resulting from new trajectories and increased operations at VSFB. In addition, prior noise studies utilized older noise modeling methods that have been improved over the past five years. In order to characterize rocket engine noise and sonic boom impacts on the surrounding environment resulting from SpaceX's proposed increase in cadence and additional trajectories and landing locations, ManTech SRS Technologies, Inc. (MSRS) used RUMBLE v2.0, a launch vehicle acoustic simulation model, and PCBoom v4.99, a sonic boom modeling program, to predict the noise levels, peak overpressures, and affected geographic areas produced during the proposed launches and landings of the Falcon 9. The results of these analyses will be used to support an Environmental Assessment for the Falcon 9 program at SLC-4 and associated regulatory documents, USSF approval through the NEPA process, and approval of launch licenses by the FAA.

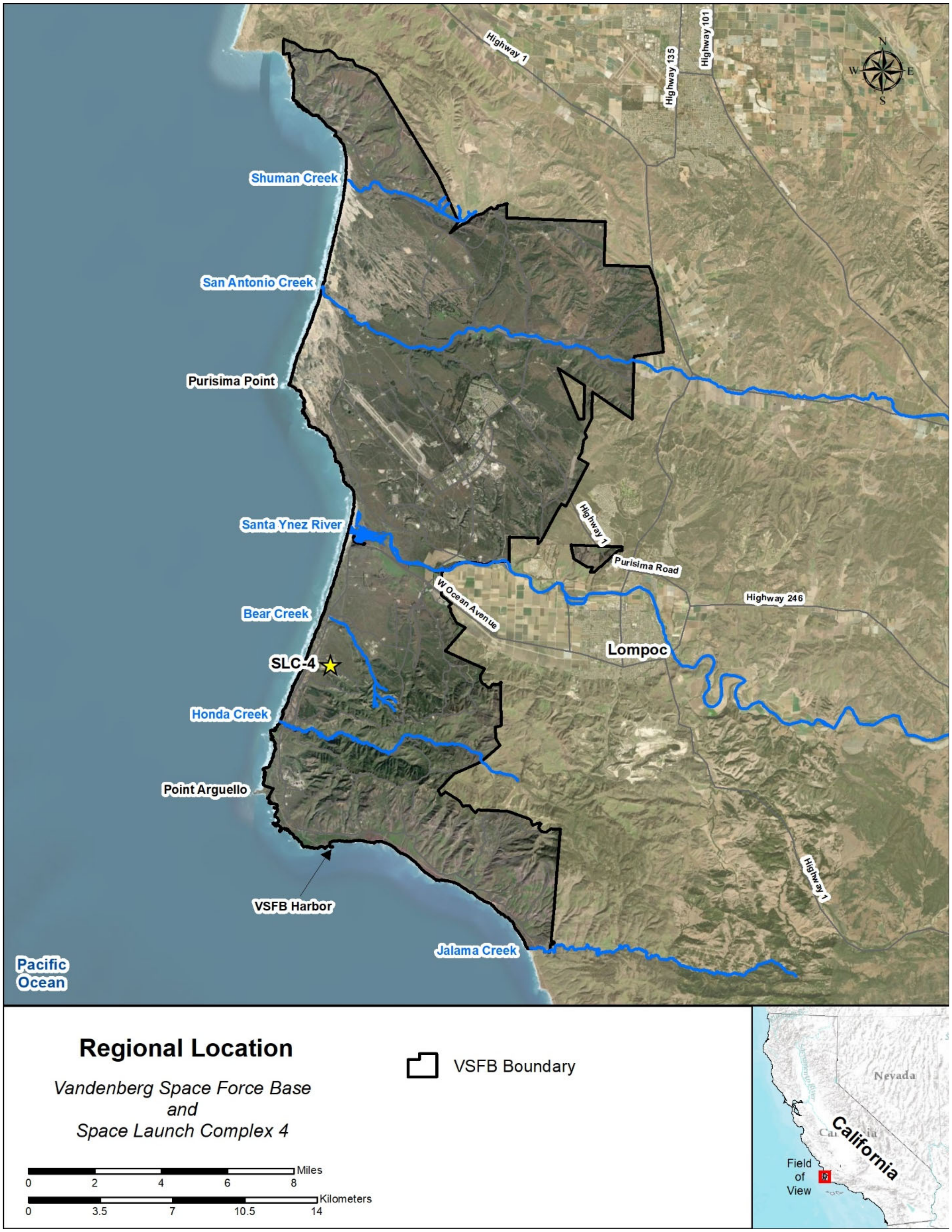

Figure 1-1. Regional location of SLC-4 at Vandenberg Space Force Base.

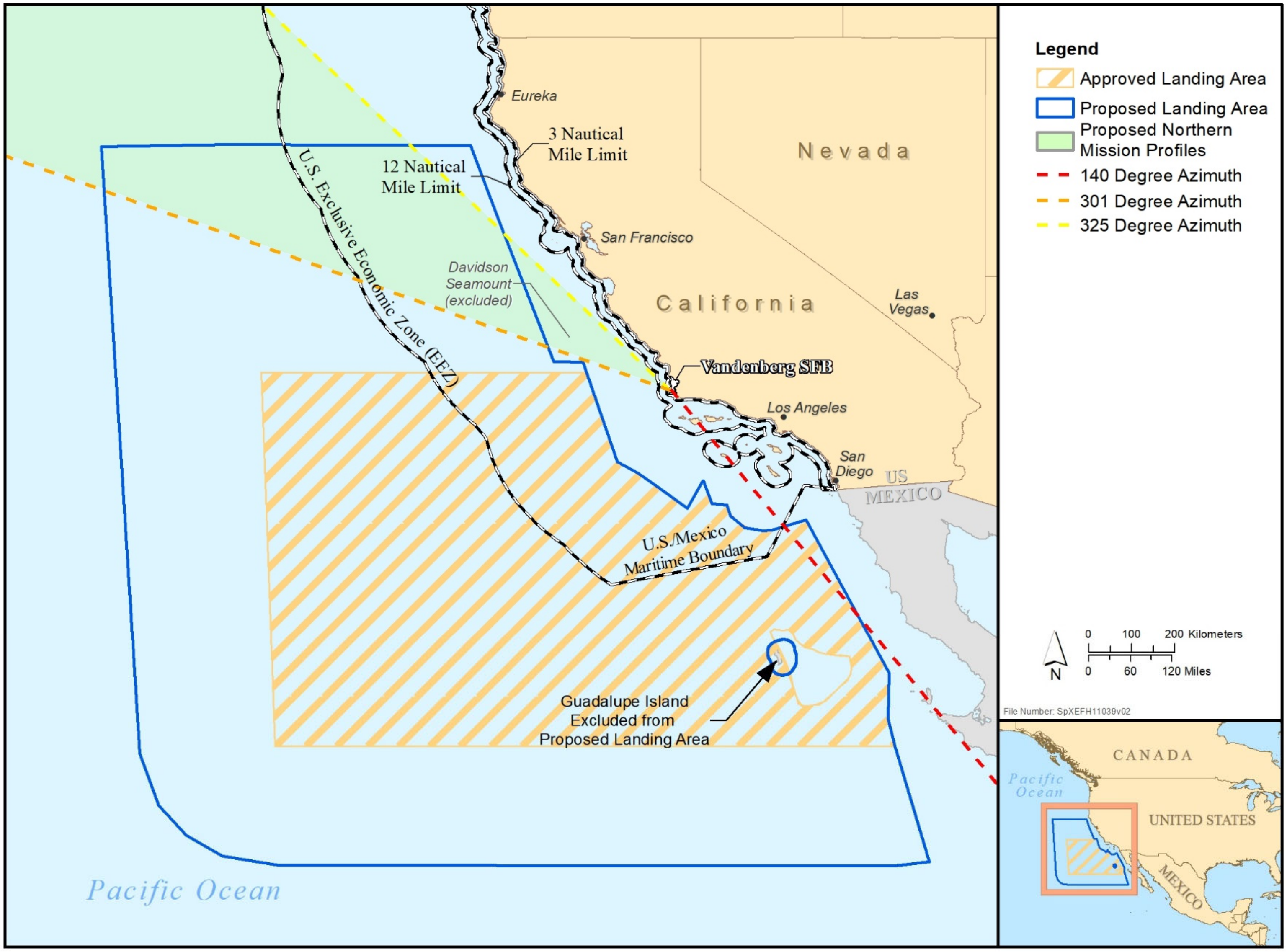

Figure 1-2. Currently approved and proposed downrange first stage landing areas.

2.0 Description of Falcon 9 Program at SLC-4

2.1 Falcon 9 Vehicle Specifications

The Falcon 9 is 229 feet (ft.) tall with a diameter of 12 ft. The first stage is 160 ft. in height, including the interstage that would be attached during landing. The first stage includes nine Merlin 1D (M1D) engines, each capable of providing 190,000 pounds (pound-force) of thrust at sea level (for a total of approximately 1.7 million pounds of thrust at liftoff). The M1D engines are propelled by liquid oxygen (LOX) and rocket propellant 1 (RP-1). They are configured in a circular pattern, with eight engines surrounding a center engine. The first stage has four deployable landing legs which are locked against the first stage during ascent. These legs are used on missions that include first stage boost-back and landing. Four grid fins near the top of the first stage support precision reentry and landing operations. The grid fins help align the first stage booster for reentry after separating from the rest of the launch vehicle in space. The specifications are presented in Table 2-1.

Table 2-1. Falcon 9 Launch Vehicle Specifications.

Specification	Units	Falcon 9
Total Vehicle Height	ft	229
Diameter	ft	12
First Stage Height	ft	160
First Stage Engines	-	9 M1D engines
Propellant	-	LOX/RP-1
Propellant Quantity (total)	lbm	1,135,925
Engine Thrust (per engine)	lbf	190,000
Total Thrust (at liftoff)	lbf	1.71 M

Notes: lbm = pound-mass; lbf = pound-force; LOX = liquid oxygen; RP-1 = rocket propellant 1, M = million

2.2 Proposed Launch and Vehicle Recovery Operations

SpaceX proposes to increase the annual number of launches of the Falcon 9 from SLC-4E from the currently approved 12 times per year to up to 36 times per year. Following each launch, SpaceX would perform a boost-back and landing of the first stage up to 36 times, either downrange on a droneship or at SLC-4W at VSFB. SpaceX does not propose to increase the number of first stage landings at SLC-4W from the currently approved 12 events per year. Each launch may be preceded by a static fire test of the engines 1 to 3 days before launch, which lasts a few seconds. The need to conduct a static fire test is mission dependent, but there would be no more than 36 static fire events per year. Launch operations would occur day or night, at any time during the year. There would be approximately 7 to 14 days between each launch event. Under current USSF and FAA approvals, SpaceX Falcon 9 missions from VSFB may range in launch azimuth from 140 degrees to 301 degrees. SpaceX proposes to add a northerly mission profile with a launch azimuth between 301 and 325 degrees to accommodate new downrange landing locations (Figure 2-1)

3.0 Noise Modeling Methods

3.1 Engine Noise Modeling

MSRS used RUMBLE v2.0, a publicly available software tool developed by Blue Ridge Research and Consulting, LLC (BRRC), to model rocket engine noise. This sophisticated model incorporates numerous components, including the acoustic power of the rocket engine source, forward flight effects, the angle from the source to the receiver (directivity), Doppler effect, propagation between the source and receiver (ray path), atmospheric absorption, and ground interference to estimate received noise levels. A full description of the methodology employed in the model can be found in Bradley et al. 2018.

The received noise is estimated by combining the source components and propagation effects. Model inputs include both details regarding the airframe (height, diameter, mass, number of stages) as well as details regarding each engine used by that airframe (engine weight, propellant type, thrust, nozzle exit diameter, nozzle exit velocity, number of nozzles, and the number of engines employed). RUMBLE uses this in conjunction with the trajectory of the airframe (which includes coordinates, speed, heading, pitch, time varying thrust, weight, and length) to calculate and prepares the modeled received noise for three noise metrics relevant to environmental noise analysis (see Section 4.1). For static fire calculations, no trajectory file is used, rather details regarding the static fire are utilized (location, nozzle exit height, nozzle exit direction, and duration).

MSRS utilized the vehicle specification (Table 2-1) and representative launch and landing trajectories, including the new northerly mission profile, to model launch and landing noise. There were no appreciable differences in launch engine noise model results from the southerly and northerly mission profiles, therefore, we present only the southerly mission profile here. Similarly, there were little differences in landing engine noise results based on representative first stage landing trajectories, therefore, we utilized the SWOT landing trajectory for the landing engine noise model results included herein. Results from these other mission profiles are available upon request.

MSRS used RUMBLE to estimate the unweighted maximum sound level (L_{max}) in decibels (dB) and the “A-weighted” maximum sound level (L_{Amax}) in A-weighted decibels (dBA) resulting from rocket engine noise during launch, landing, and static fire events. The maximum sound level is the highest sound level during a single noise event. A-weighting is a frequency-dependent adjustment used to approximate the range of human sensitivity. The general range of human hearing is from 20 to 20,000 cycles per second, or Hertz (Hz); humans hear best in the range of 1,000–4,000 Hz, therefore a weighting function is applied which gives higher value to sound energy within these ranges. L_{Amax} is thus a good indicator of perceived loudness in the human environment.

MSRS also used RUMBLE to estimate Community Noise Equivalent Level (CNEL), which is a weighted average of noise levels over time used in the State of California to assess the potential annoyance of airport noise on surrounding communities. While the FAA’s primary metric used to determine noise impacts on communities is the Day-Night Average Sound Level (DNL), the FAA accepts the CNEL in California since California adopted the use of CNEL prior to FAA adopting DNL. CNEL, like DNL, adds a ten times weighting (equivalent to a 10 dBA penalty) to each aircraft operation between 10:00 p.m. and 7:00 a.m.; however, CNEL also adds a three times weighting (equivalent to a 4.77 dBA penalty) for each aircraft operation during evening hours (7:00 p.m. to 10:00 p.m.).

In order to model CNEL, MSRS assumed the following:

- Of the 36 launch and first stage recovery events each year there would be:
  - 1 northerly mission with downrange droneship first stage recoveries per year.
  - 23 southernly missions with downrange droneship first stage recoveries per year.
  - 12 missions with first stage recovery at SLC-4W per year.
  - ½ of the launches would occur between 10:00 p.m. and 7:00 a.m. and ½ would occur between 7:00 a.m. and 7:00 p.m.
  - ½ of the first stage recoveries would occur between 10:00 p.m. and 7:00 a.m. and ½ would occur between 7:00 a.m. and 7:00 p.m.
- 36 static fire events would occur per year during daytime hours (between 7:00 a.m. and 7:00 p.m.).
- 12 sonic booms produced during SLC-4W landings; of these 6 between 7:00 a.m. and 7:00 p.m. and 6 between 10:00 p.m. and 7:00 a.m.

3.2 Sonic Boom Modeling

MSRS used PCBoom v4.99 to predict the peak overpressures and impact locations of potential sonic booms, as generated by the Falcon 9 vehicle during launches and first stage recoveries. PCBoom considers the size and shape of the vehicle and the trajectory in relationship to the thrust, drag, and weight of the vehicle, which vary during the flight of the vehicle, to estimate the initial signature of the overpressure. The model then propagates the overpressure through site and seasonally specific meteorological provides obtained from a 10-year RAWINSONDE database profile that includes the high wind, low wind, low temperature, high temperature, and median profiles sampled evenly throughout each month of the year (National Oceanic and Atmospheric Administration 2022). A full description of the methods used by PCBoom v4.99 can be found in Bradley et al. 2018.

The inputs of the model specifically addressed the geometry the Falcon 9 launch vehicle and first stage (Table 2-1). The software was used to model multiple representative launch trajectories with initial azimuths between 140 and 325 degrees. Multiple landing trajectories were also modeled, including the extents of the proposed northerly (325 degrees) and southerly (140 degrees) mission profiles and multiple representative landing trajectories for first stage recoveries at SLC-4W. Multiple sample meteorological conditions were selected from a 10-year RAWINSONDE database. A total of 30 modeling runs per trajectory were performed.

4.0 Noise Modeling Results

4.1 Engine Noise Modeling Results

4.1.1. Falcon 9 Maximum Unweighted Sound Levels

The results of modeling of the unweighted maximum sound levels for launch, landing, and static fire events from SLC-4 are presented in Figures 4-1 through 4-3, below. The FAA uses the 120 dB L_{max} noise contour for engine noise to define areas that may experience structural damage as a result of space launch vehicle noise (Fenton and Methold 2016; Guest and Slone 1972; Haber et al. 1989). The 120 dBA L_{max} contour for Falcon 9 launch event reaches approximately 2.3 miles (mi) over land from SLC-4 and entirely on VSFB (Figure 4-1). For first stage landing events the 120 dB L_{max} contour extends over land approximately up to 2.1 mi and is entirely within VSFB (Figure 4-2). Similarly, the 120 dB L_{max} contour for static fire events, extends approximately 1.3 mi and is entirely within VSFB (Figure 4-3).

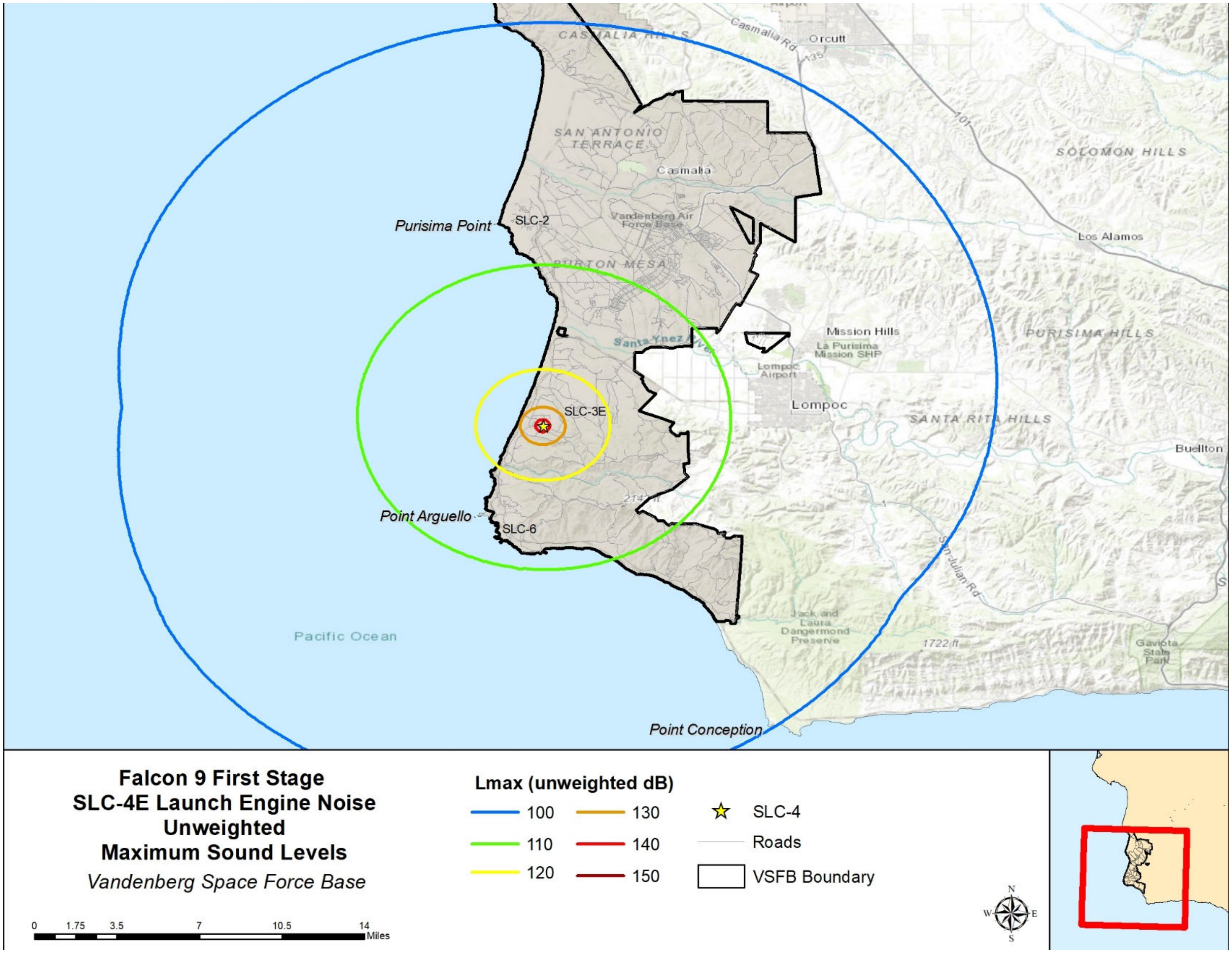

Figure 4-1. Maximum unweighted engine noise during Falcon 9 launch from SLC-4E.

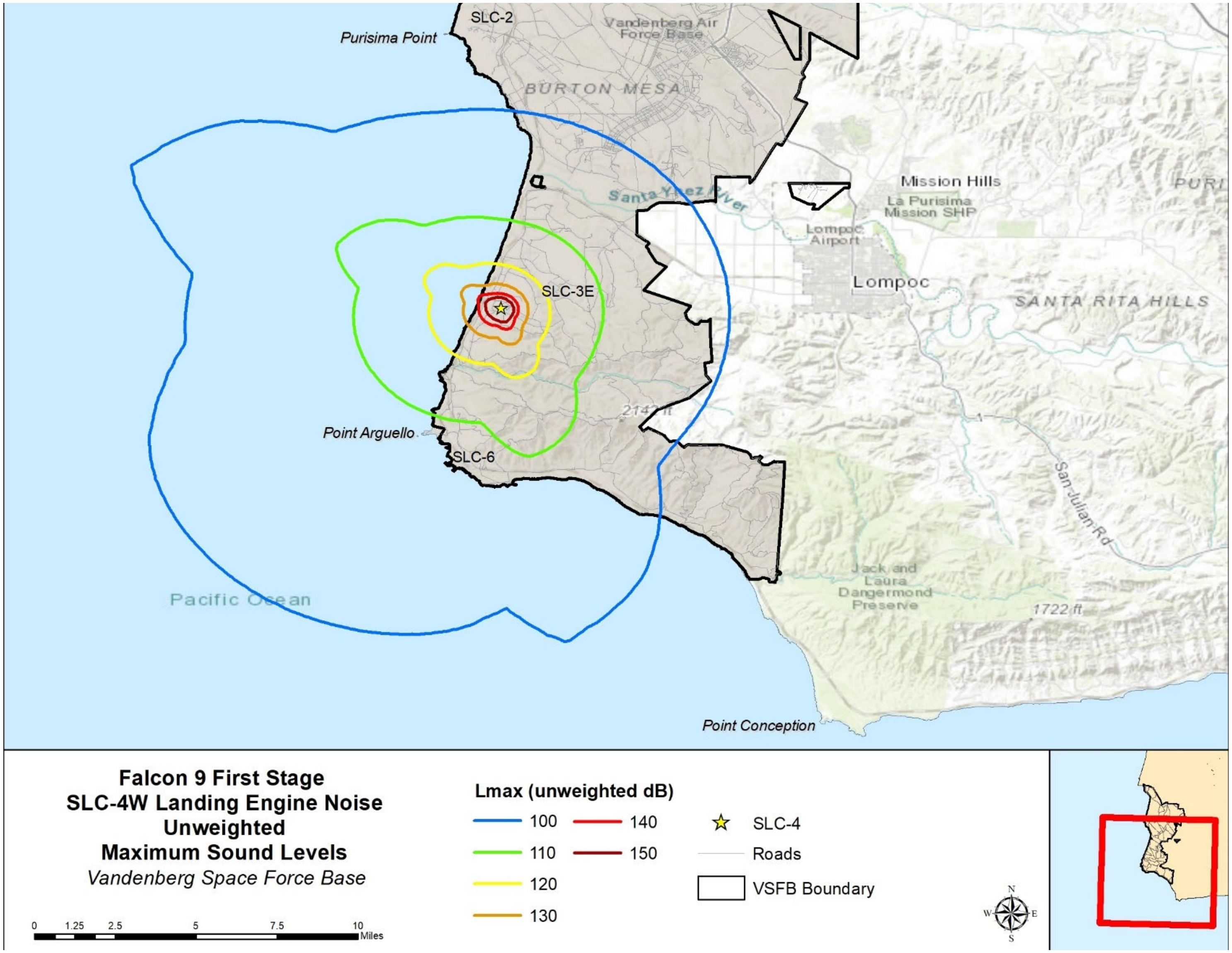

Figure 4-2. Maximum unweighted engine noise during Falcon 9 landing at SLC-4W.

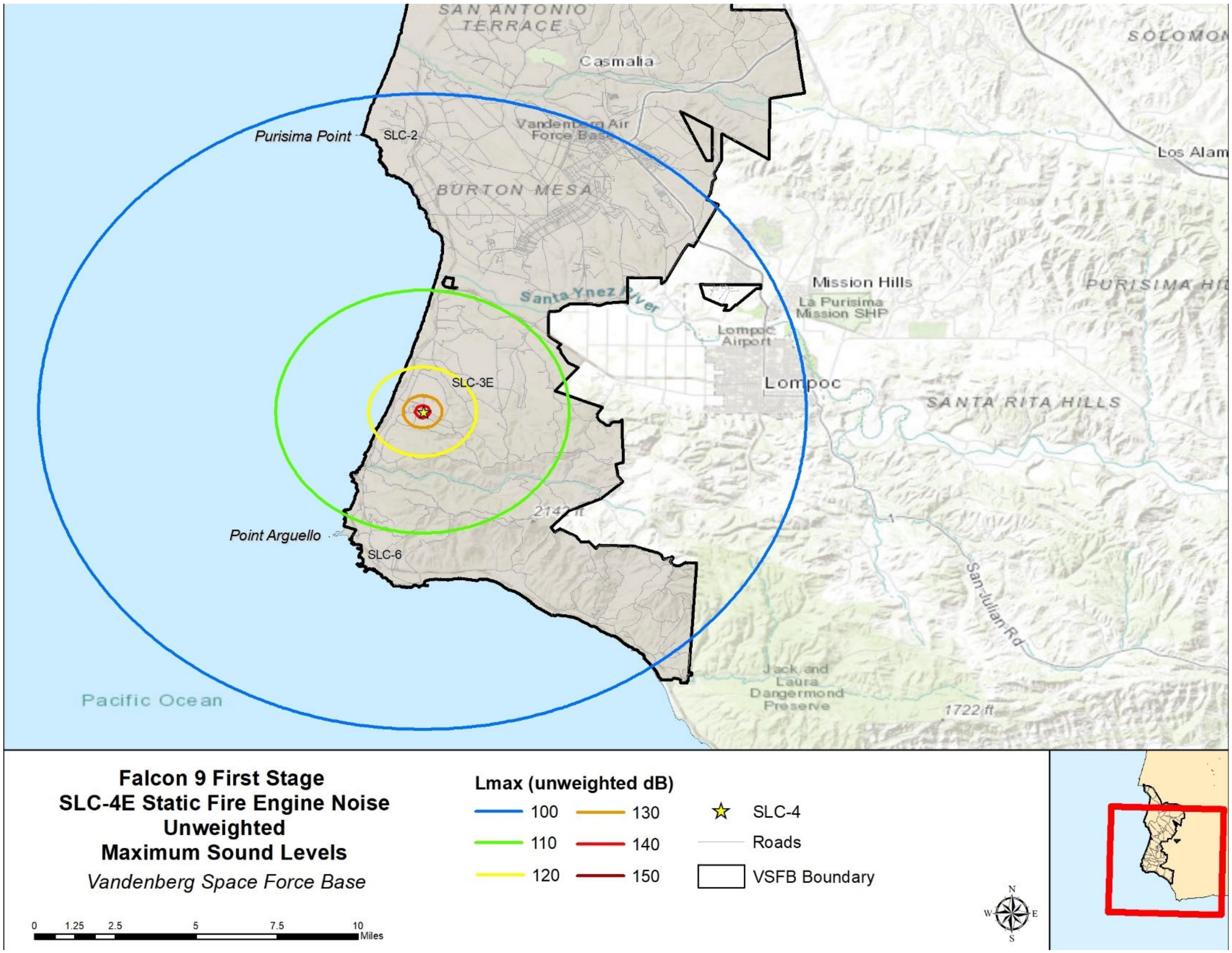

Figure 4-3. Maximum unweighted engine noise during Falcon 9 static fire test at SLC-4E.

4.1.2. Falcon 9 Maximum A-weighted Sound Levels

The results of modeling of the A-weighted maximum sound levels for launch, landing, and static fire events from SLC-4 are presented in Figures 4-4 through 4-6, below. The Department of Defense (DoD) Instruction 6055.12, *Hearing Conservation Program* (DoD 2019), the National Institute for Occupational Safety and Health (NIOSH 1998), and the Occupational Safety and Health Administration (OSHA 2022) provide upper noise level limits to protect human hearing from exposure to noise levels and prevent noise-induced hearing loss. OSHA sets the lowest limit at 115 dBA L_{Amax} with an allowable exposure of 15 minutes (OSHA 2022). The DoD and NIOSH set the allowable exposure at 115 dBA of 28 seconds.

The 115 dBA L_{Amax} contour for Falcon 9 launch event extends approximately 0.6 miles (mi) over land from SLC-4 (Figure 4-4) and is entirely within VSFB. Similarly for first stage landing and static fire events, the 115 dBA L_{Amax} contours extend approximately 0.9 mi and 0.4 mi from SLC-4, respectively (Figures 4-5 and 4-6). For both landing and static fire events, the predicted 115 dBA L_{Amax} contours are also contained entirely within VSFB. The City of Lompoc would receive approximately 80 dBA L_{Amax} during launch, 70 dBA L_{Amax} during landing, and between 70 and 75 dBA L_{Amax} during static fire tests (Figures 4-4 through 4-6).

4.1.3. Falcon 9 Community Noise Equivalent Levels

The A-weighted CNEL contours for Falcon 9 at SLC-4 is presented in Figures 4-4. A CNEL exceeding 65 dBA is generally considered unacceptable for a residential neighborhood and the CNEL 60 dBA contour is used to define the area of potentially significant noise impacts to communities (FAA 2015). The 60 dBA CNEL extends up to approximately 2.7 mi from SLC-4 and is entirely contained within VSFB (Figure 4-7).

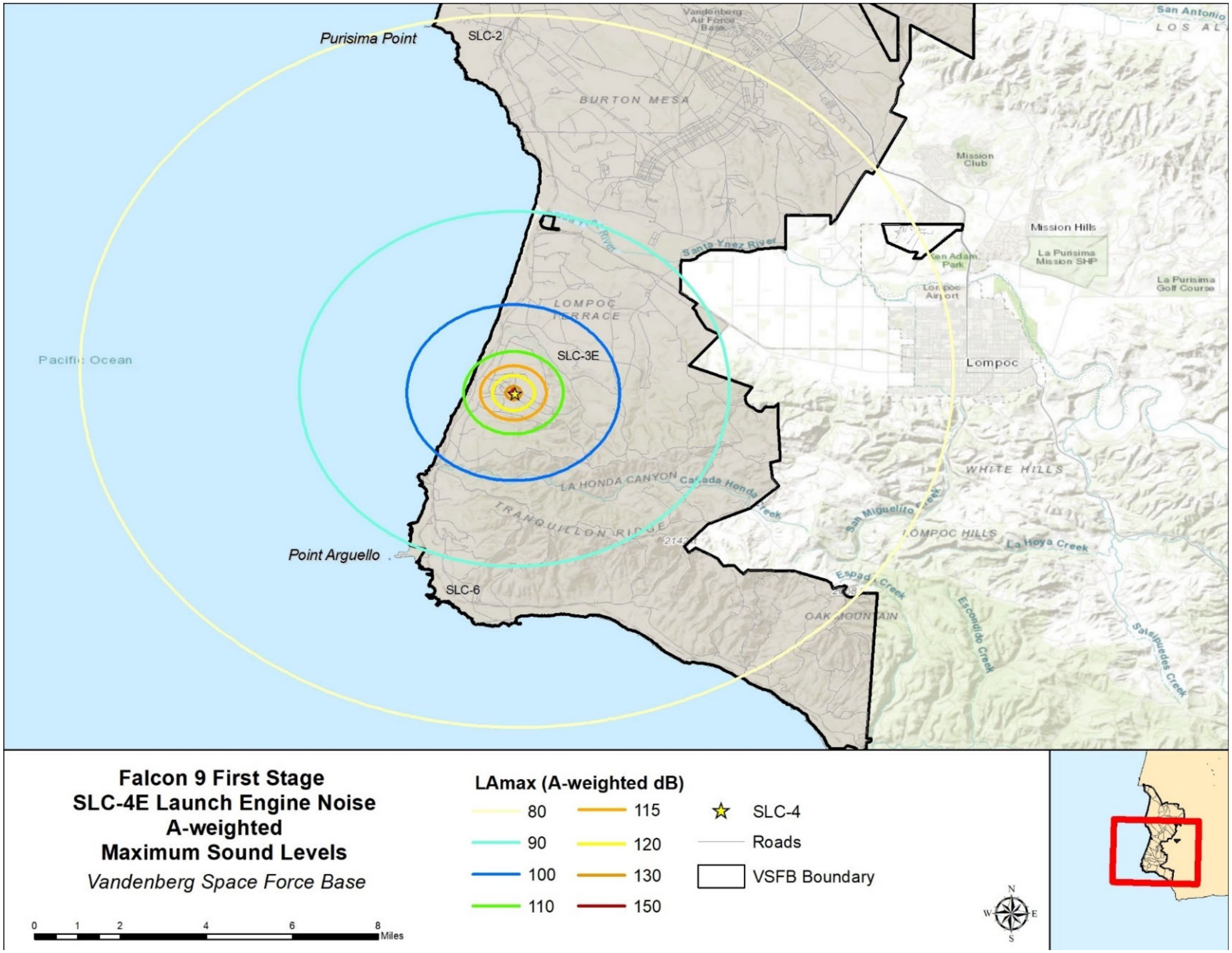

Figure 4-4. Maximum A-weighted engine noise during Falcon 9 launch from SLC-4E.

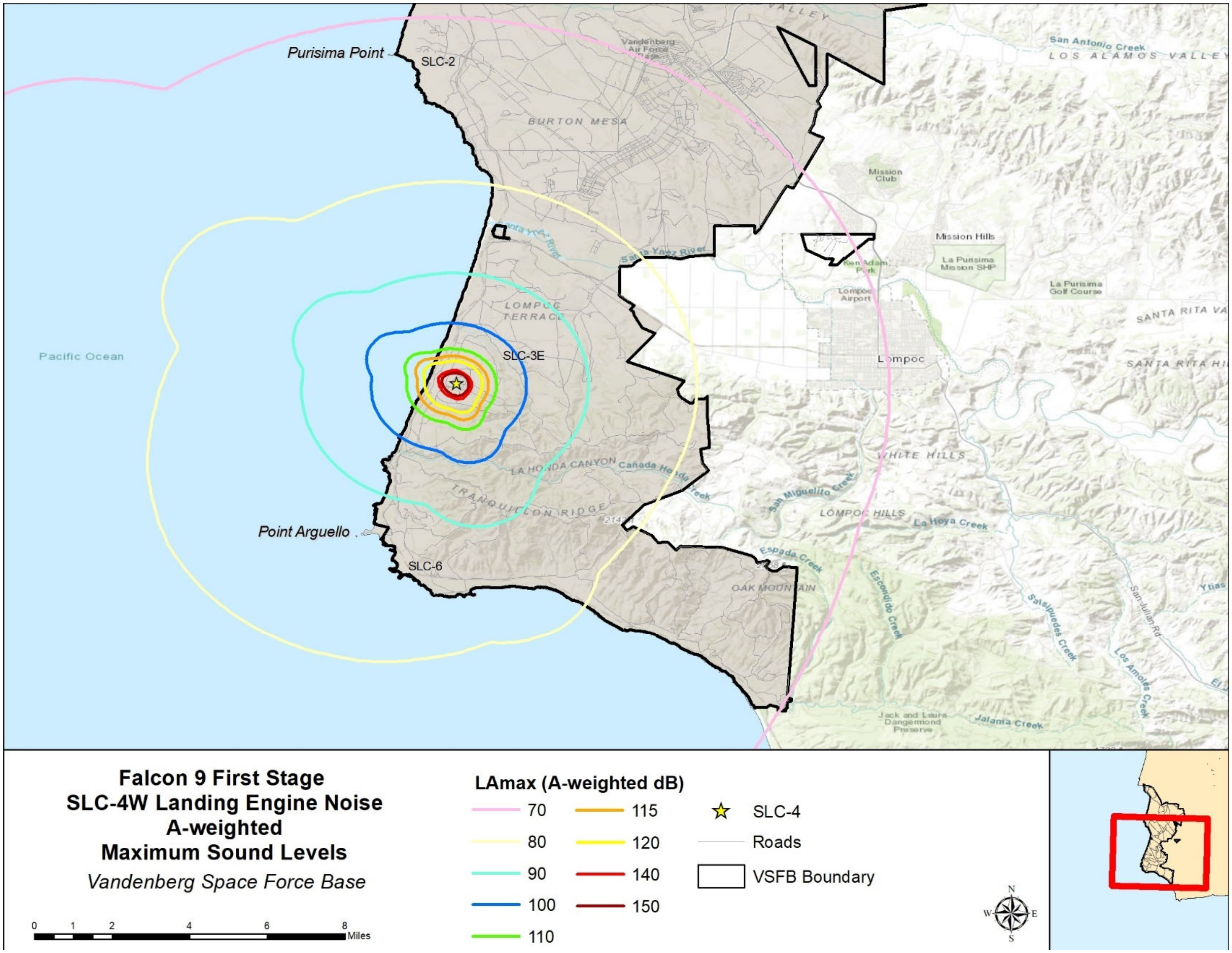

Figure 4-5. Maximum A-weighted engine noise during Falcon 9 landing at SLC-4W.

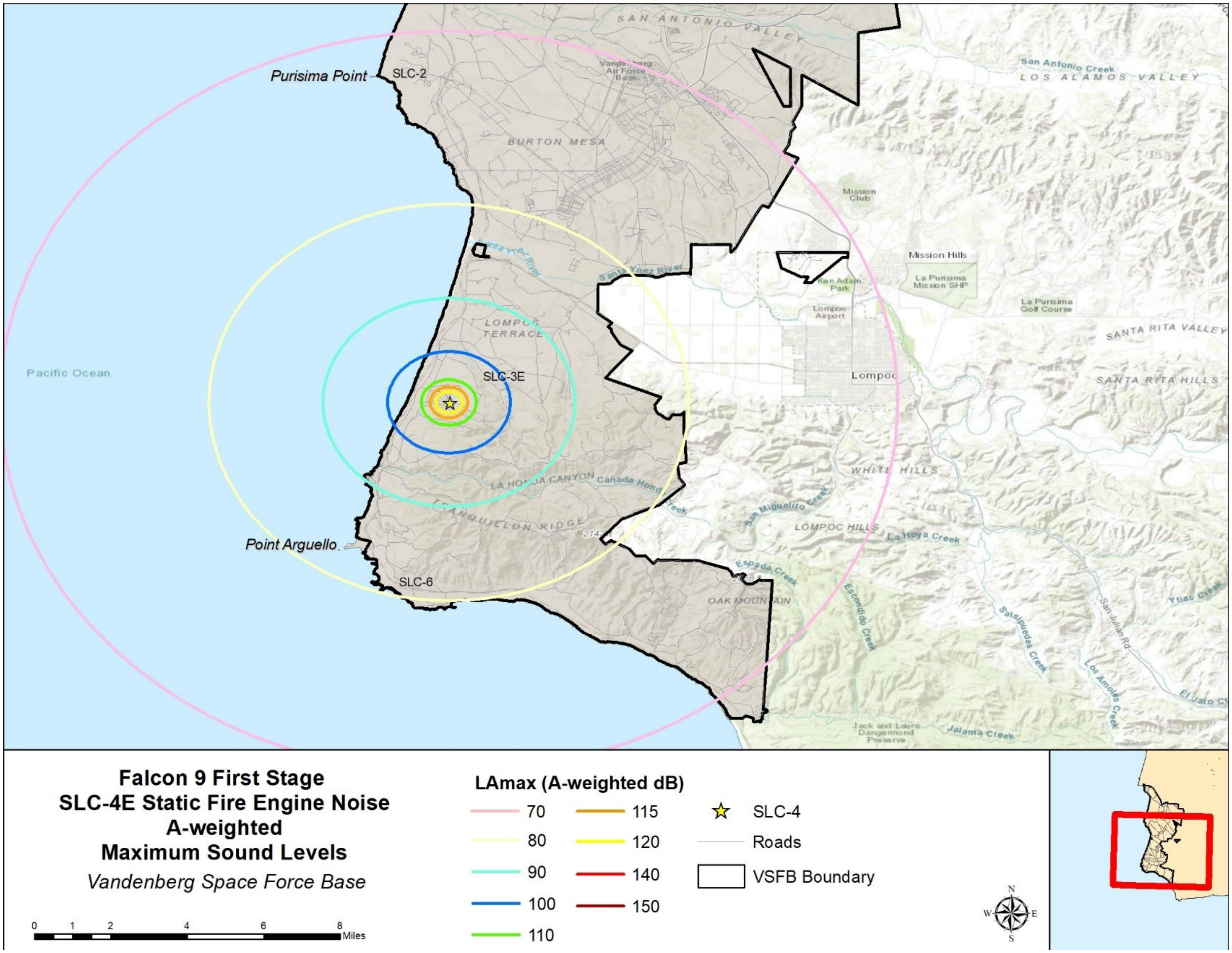

Figure 4-6. Maximum A-weighted engine noise during Falcon 9 static fire test at SLC-4E.

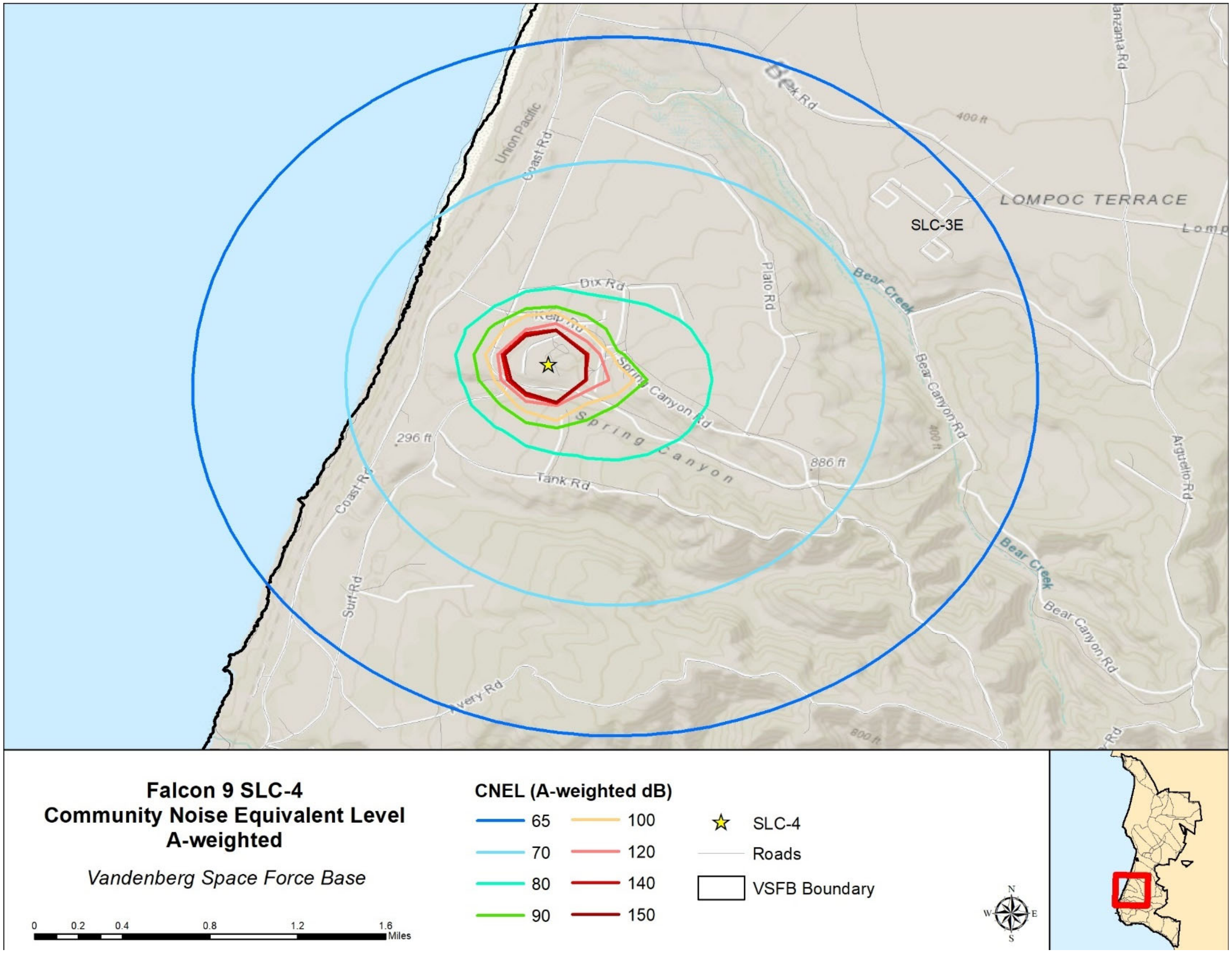

Figure 4-7. Community noise equivalent levels from the proposed Falcon 9 launch and landing operations at SLC-4.

4.2 Sonic Boom Modeling Results

4.2.1. Southerly Launch Trajectories

During ascent, a sonic boom could be generated. Depending on the steepness of the launch trajectory, the sonic boom may or may not impact the surface of the earth. Based on past modeling results, approximately 24 percent (7 out of 29) of Falcon 9 launches from SLC-4E since 2017 to present have not produced sonic booms that impact the surface of the earth because the ascent of the rocket was too steep. When the sonic booms are predicted to impact the earth's surface, they are primarily predicted to impact the open ocean. Since 2017, only 7 of the 22 Falcon 9 launches from SLC-4E that were predicted to produce sonic booms that impacted the surface of the earth were also predicted to impact the Northern Channel Islands (NCI). Of those that have been predicted to impact the NCI, the sonic boom may range up to 5.0 psf (see example in Figure 4-8). A series of representative sonic boom model outputs from an array of trajectories with potential to impact the NCI are provided in Figures 4-8 through 4-11. In addition, MSRS examined 12 representative launch trajectories with southerly launch azimuths spanning 140 to 188 degrees using a broad sample of meteorological profiles to determine the potential for sonic booms of 2 psf or greater impacting the NCI. Figure 4-12 shows the combined results using the median meteorological profiles for each mission. Launch trajectories with azimuths between 188 and the currently approved northerly azimuth of 301 have would not produce a sonic boom that could impact land during launch were therefore not evaluated. The proposed launch azimuths between 301 and 325 are discussed in Section 4.2.2.

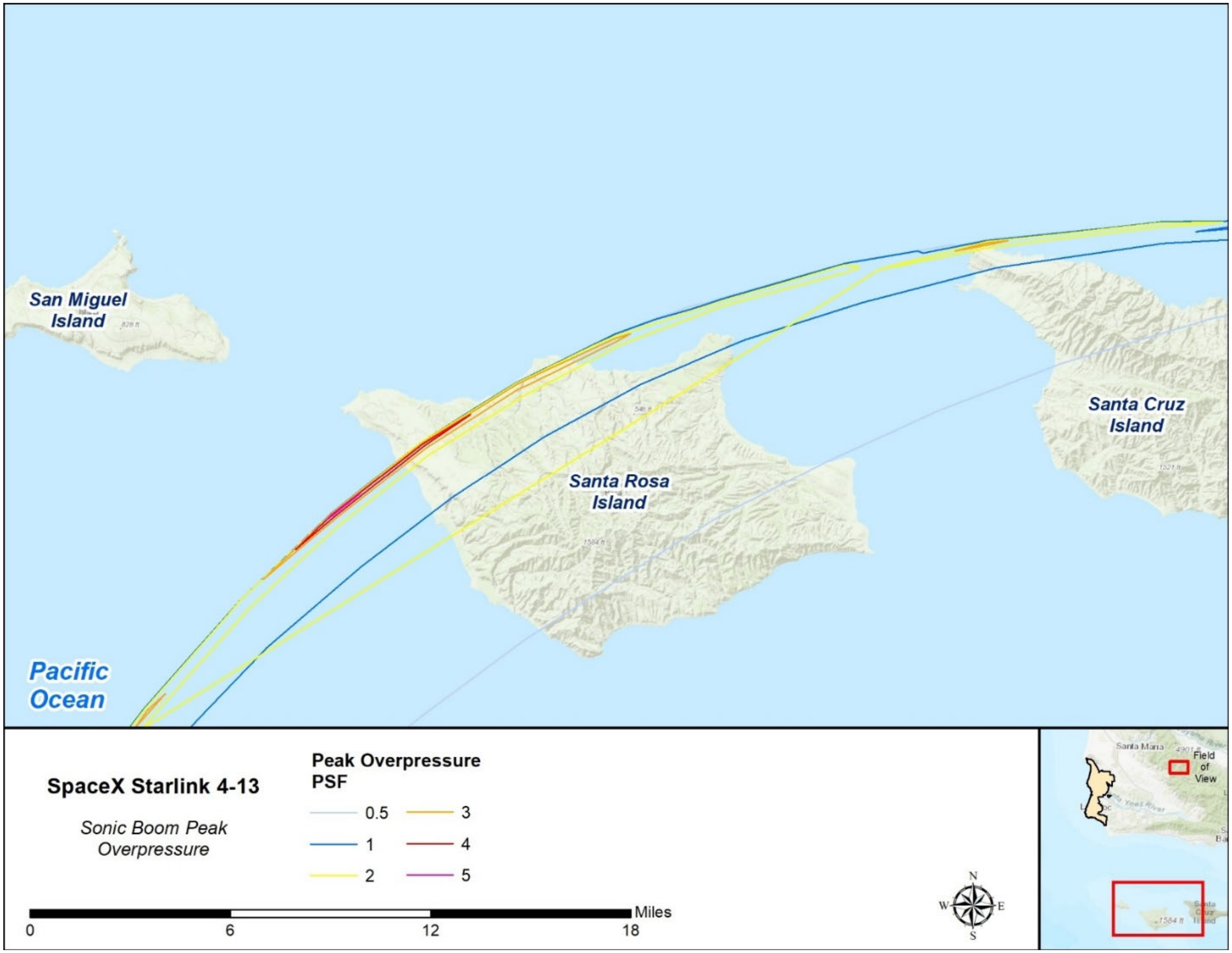

Figure 4-8. Example model output from Starlink 4-13 mission showing potential for up to 5 psf sonic boom impacting the Northern Channel Islands.

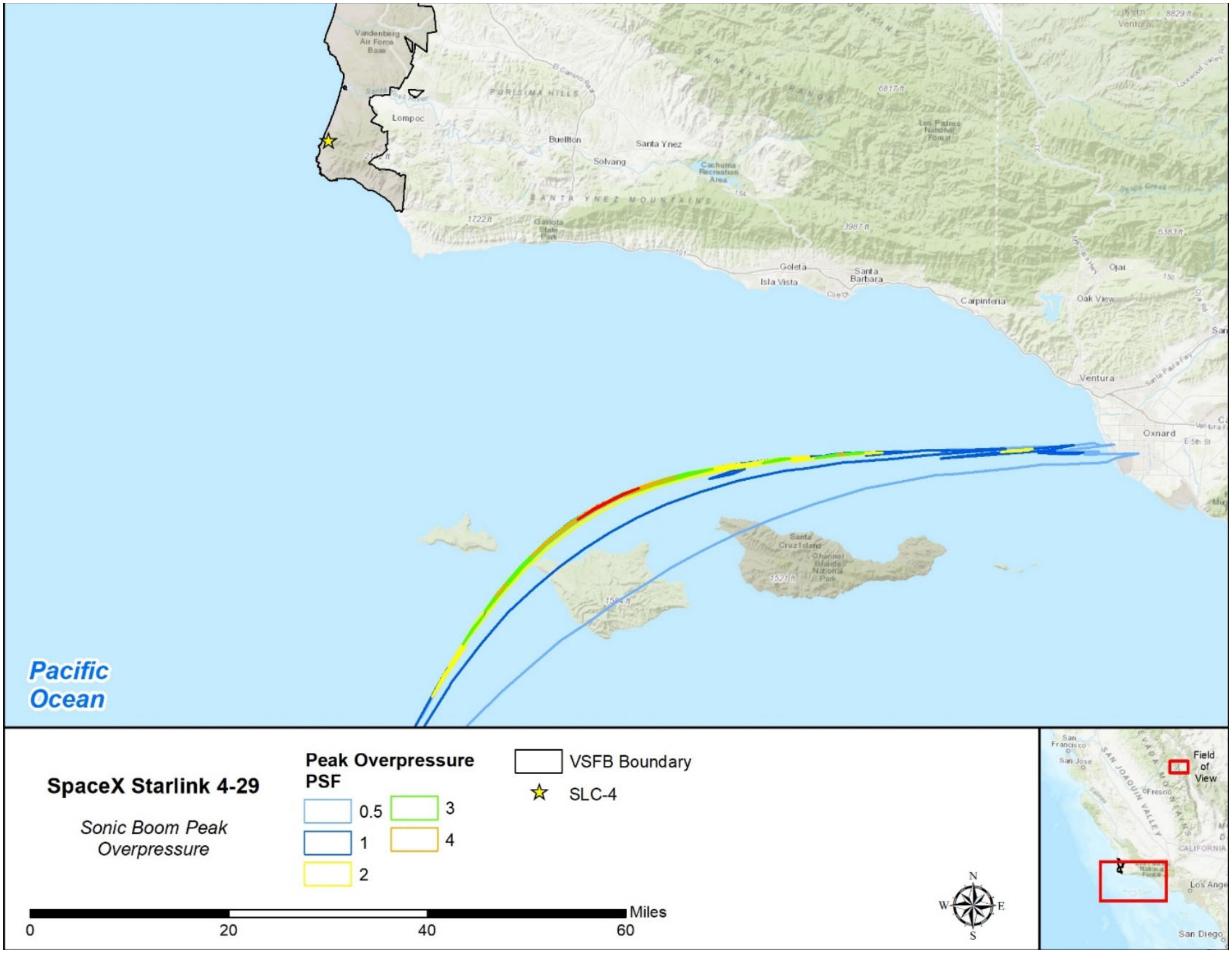

Figure 4-9. Example sonic boom footprint from Starlink 4-29 mission.

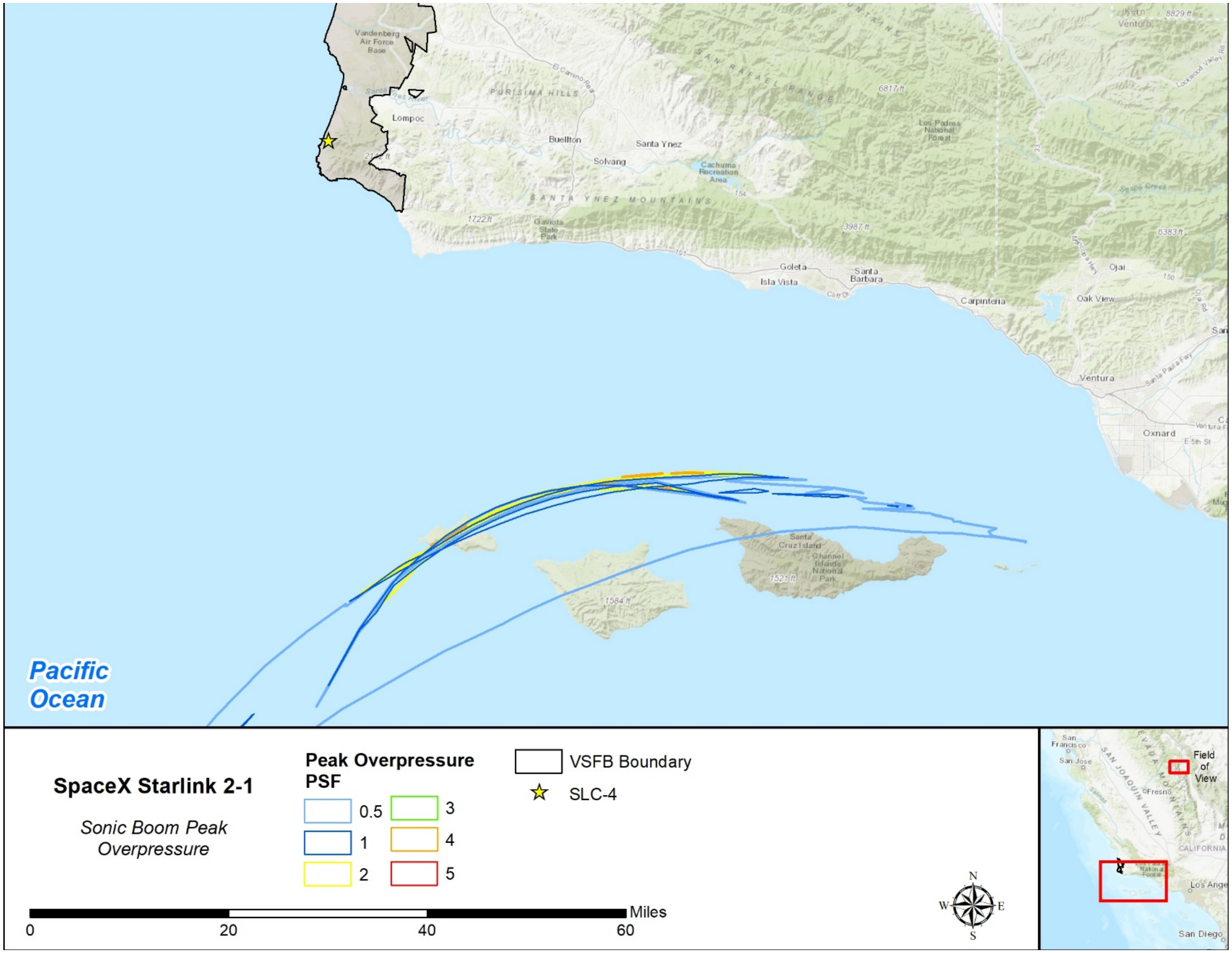

Figure 4-10. Example sonic boom footprint from Starlink 2-1 mission.

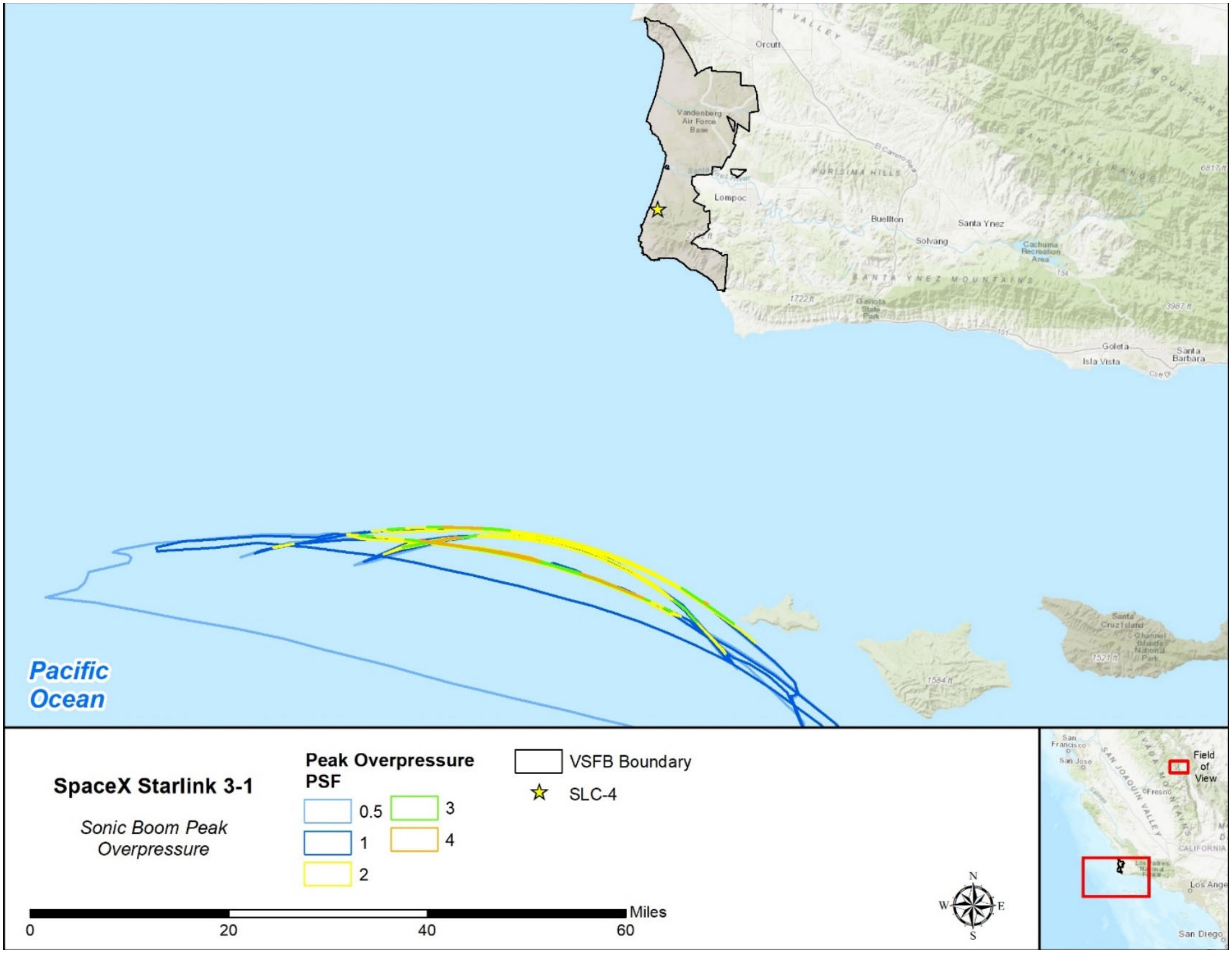

Figure 4-11. Example sonic boom footprint from Starlink 3-1 mission.

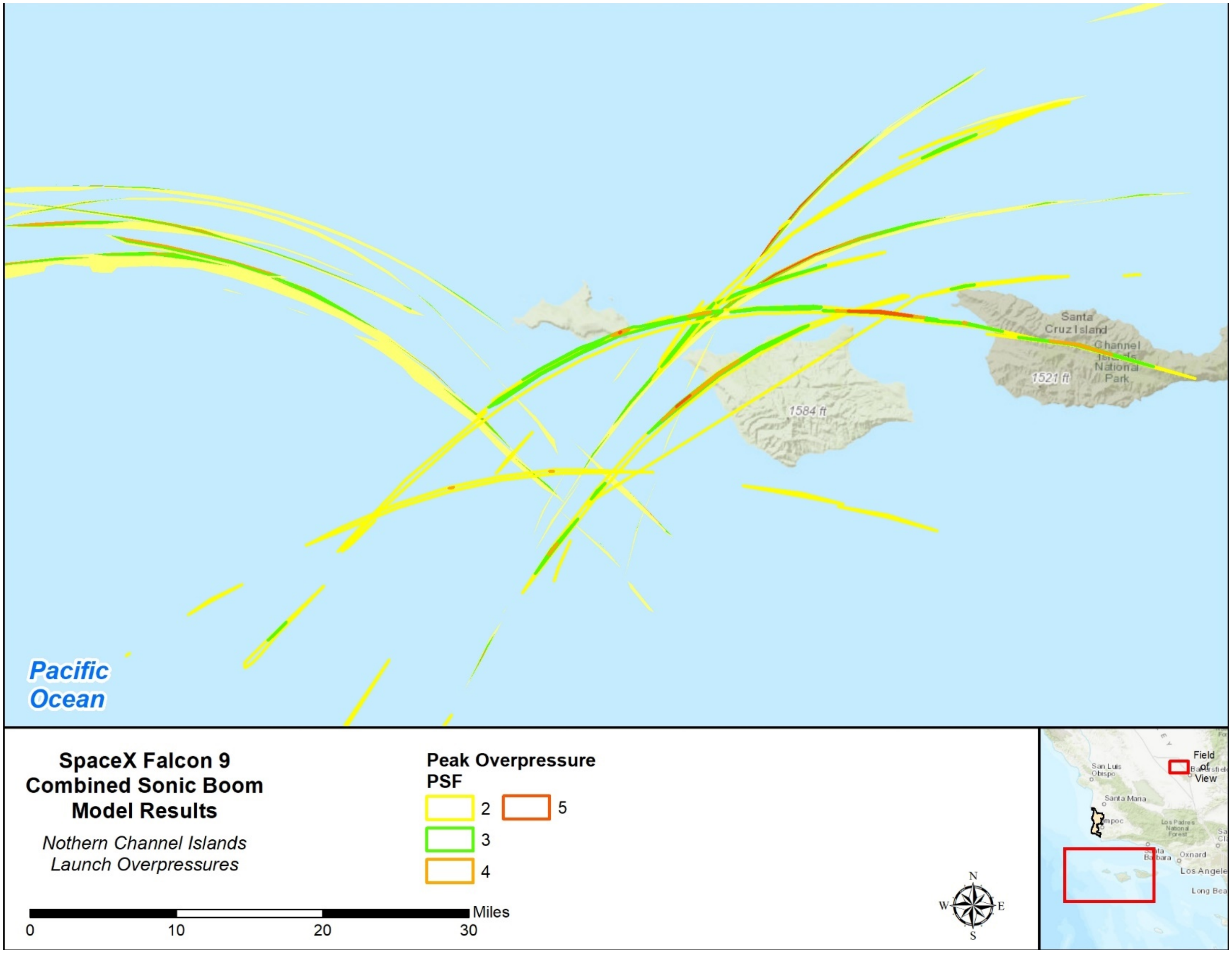

Figure 4-12. Sonic boom model results depicting boom contours greater than 2 psf from 12 representative southerly trajectories.

4.2.2. Southerly Droneship First Stage Landing Trajectories

During descent, the first stage would produce a sonic boom up to 8.5 psf at the immediate landing location. However, sonic booms would be directed entirely at the ocean surface without impacting any land for the majority of downrange droneship landings. This is because the eastern boundaries of the Approved Landing Area and the Proposed Landing Area were designed by buffering land forms with the radial distance of typical sonic boom footprints in order to avoid potential noise impacts to mainland Mexico, Isla Guadalupe, and the Southern Channel Islands (Figure 1-2). Figure 4-13 shows a typical sonic boom profile for Falcon 9 first stage landing on a droneship on the eastern edge of the Proposed Landing Areas with a southerly mission profile. Although mission trajectories modeled for this study did not produce the following result, past modeling has predicted that sonic booms up to 3.1 psf may impact the NCI during landing events at SLC-4W or on a droneship located offshore near VSFB (Bradley 2015; James et al. 2017; U.S. Air Force 2018).

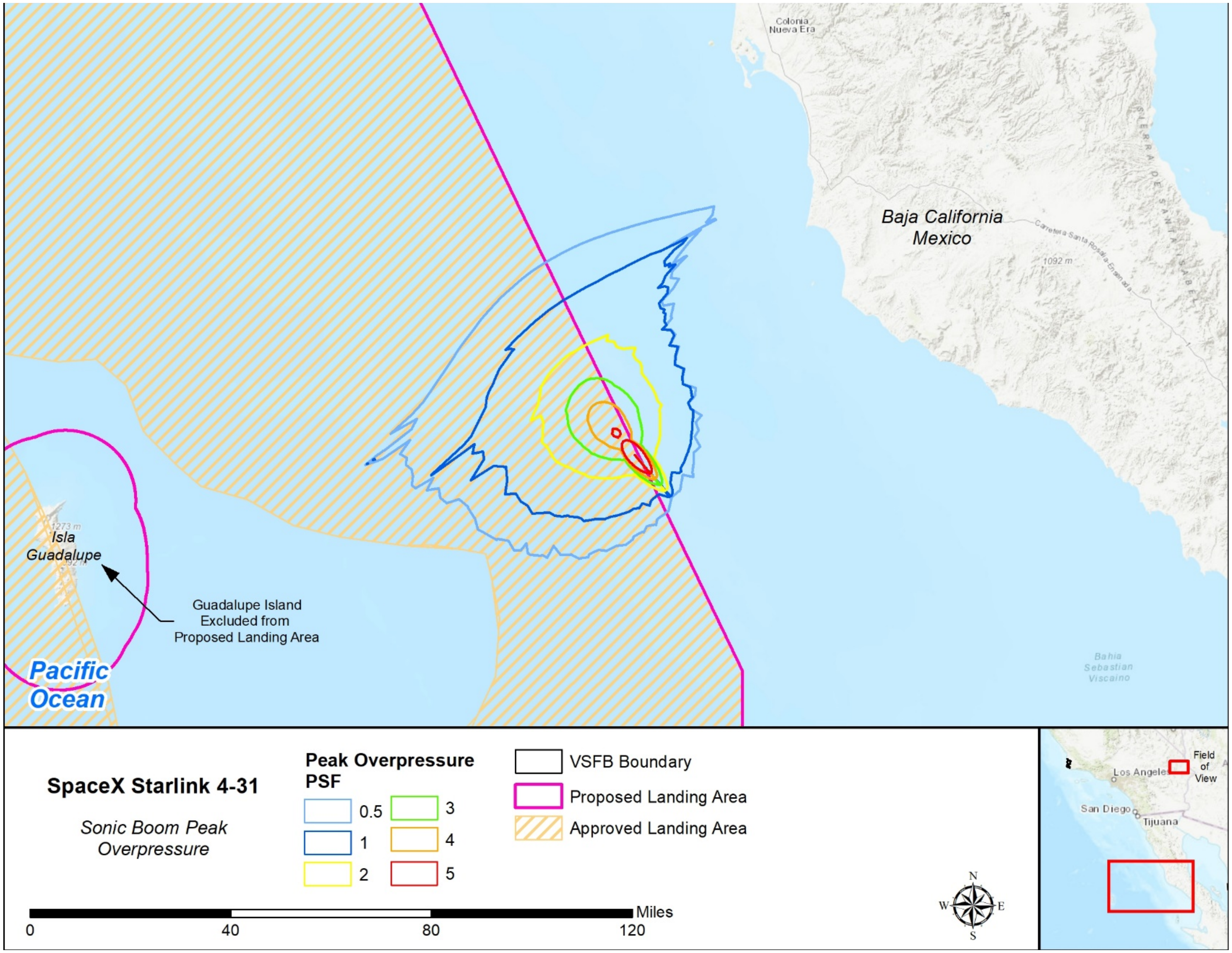

Figure 4-13. Example of a typical sonic boom profile for Falcon 9 First Stage landing on a droneship with a southerly mission profile.

4.2.3. First Stage SLC-4W Landing Trajectories

The Falcon 9 first stage would generate a sonic boom during descent to land at SLC-4W. MSRS performed modeling for 7 representative recent missions. The results predict that the first stage landing at SLC-4W has a maximum sonic boom between 2 and 5 psf. Three representative model results of representative landing trajectories are provided below (Figures 4-14 through 4-16). Sonic booms on south VSFB were typically predicted to range between 1.5 and 5.0 psf. Sonic boom levels in the City of Lompoc should typically range between 0.5 and 1.5 psf during SLC-4W landing events; however, may on occasion be greater and reach as high as 4.0 psf depending on mission trajectories (see Figures 4-17 and 4-18). Table 4-1 provide the predicted range of sonic boom levels versus measured values at several biological monitoring locations on VSFB. Since 2020, the measured sonic boom levels have been fairly consistent with the predicted values. This coincides with the release of an improved version of PCBoom software.

Table 4-1. Falcon 9 SLC-4W landing sonic boom PCBoom model versus measured results.

Mission	Date	Monitoring Location	Modeled Value (psf)	Measured Value (psf)
SAOCOM	7 Oct 2018	Oil Well Canyon	2.0	1.78
SAOCOM	7 Oct 2018	Sudden Flats	1.0	0.71
Radarsat	12 Jun 2019	Oil Well Canyon	1.0 – 1.5	2.87
Radarsat	12 Jun 2019	South Surf	1.0 – 1.5	3.63
Radarsat	12 Jun 2019	Purisima	0.5 – 1.0	2.66
Sentinel 6A	21 Nov 2020	Oil Well Canyon	2.0	2.35
Sentinel 6A	21 Nov 2020	Sudden Flats	2.0	1.76
NROL-87	2 Feb 2022	Oil Well Canyon	1.5 – 2.0	1.84
NROL-87	2 Feb 2022	Honda Canyon	2.0 – 3.0	2.42
NROL-85	17 Apr 2022	Oil Well Canyon	1.5 – 2.0	1.29
NROL-85	17 Apr 2022	South Surf	1.5 – 2.0	1.95
SARah-1	18 Jun 2022	Oil Well Canyon	1.5 – 2.0	1.38
SARah-1	18 Jun 2022	South Surf	2.0 – 3.0	2.53
SARah-1	18 Jun 2022	Purisima	1.0 – 1.5	1.12
SWOT	16 Dec 2022	Oil Well Canyon	3.0	2.54
SWOT	16 Dec 2022	Sudden Flats	3.0	3.4
SWOT	16 Dec 2022	Honda Canyon	4.0 - 5.0	4.7

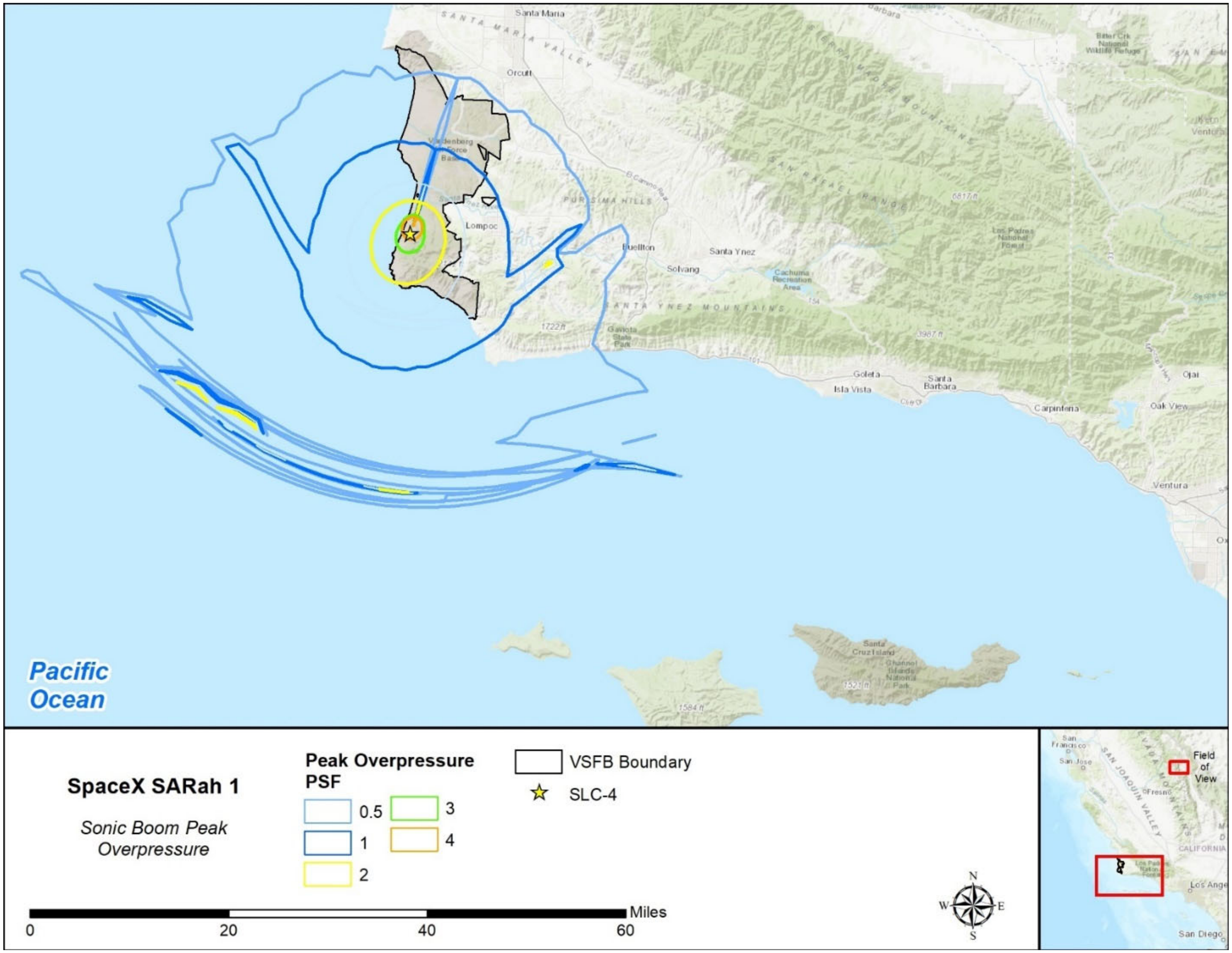

Figure 4-14. Example of a typical sonic boom profile for Falcon 9 first stage landing at SLC-4W (SARah-1 mission).

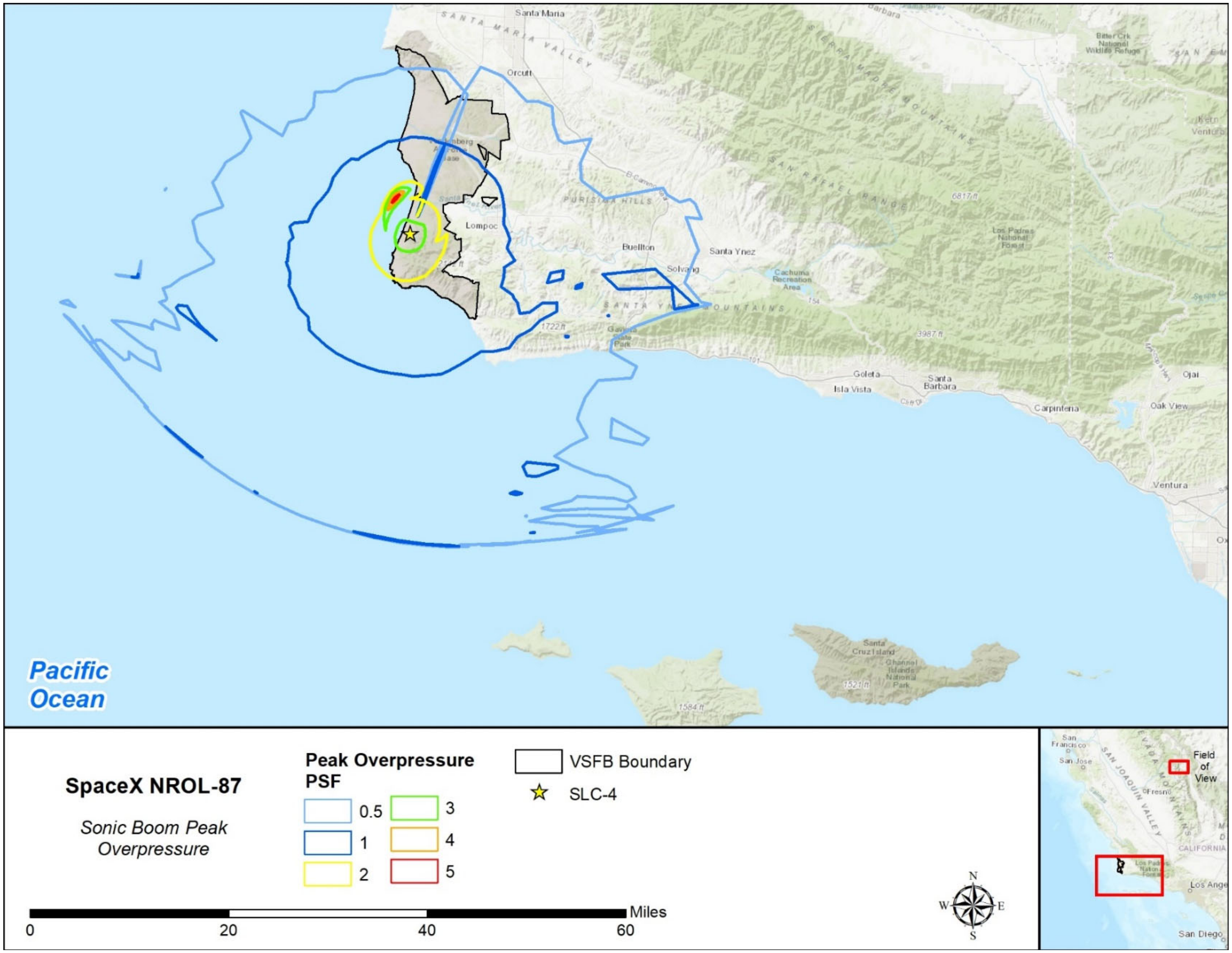

Figure 4-15. Example of a typical sonic boom profile for Falcon 9 first stage landing at SLC-4W (NROL-87 mission).

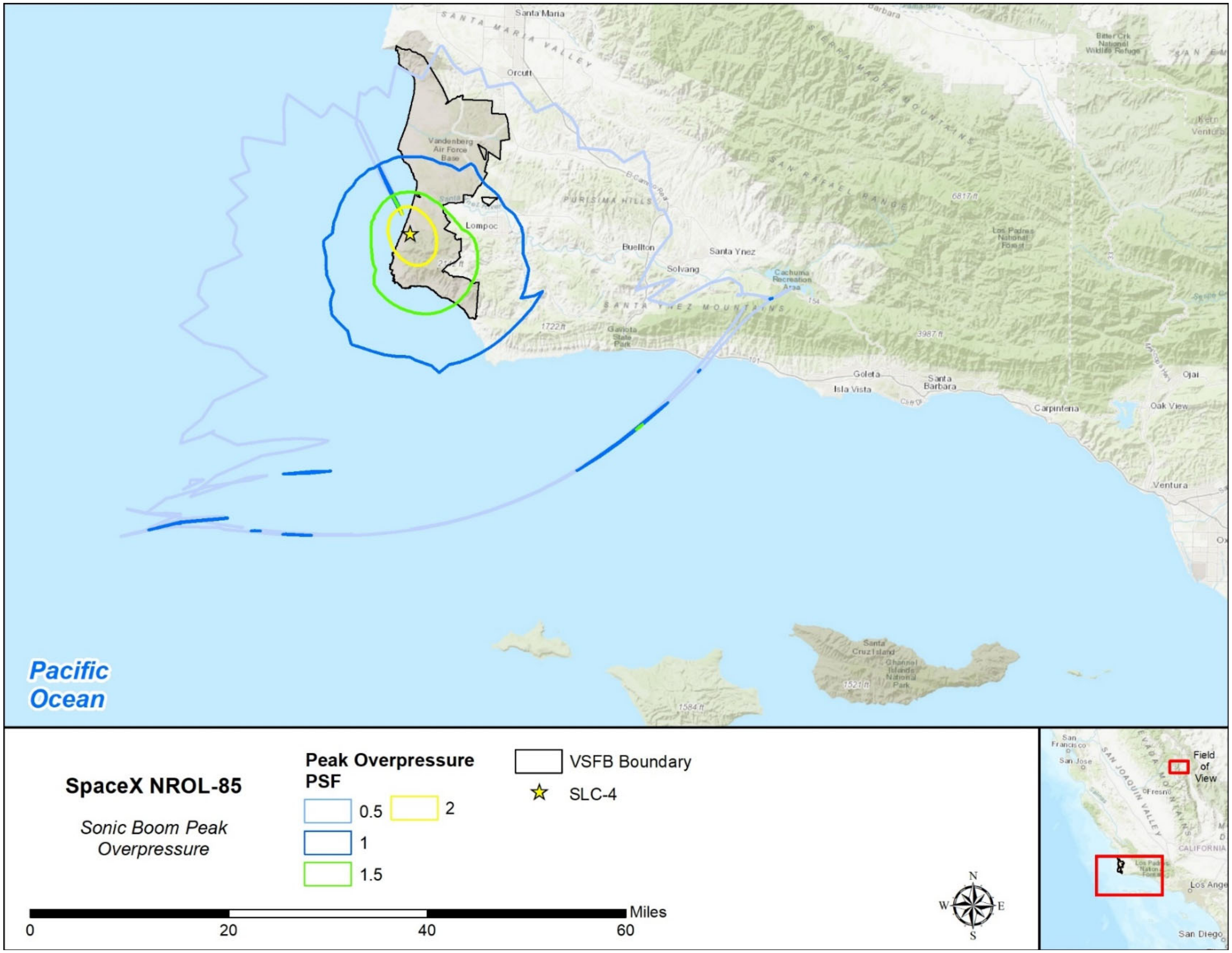

Figure 4-16. Example of a typical sonic boom profile for Falcon 9 first stage landing at SLC-4W (NROL-85 mission).

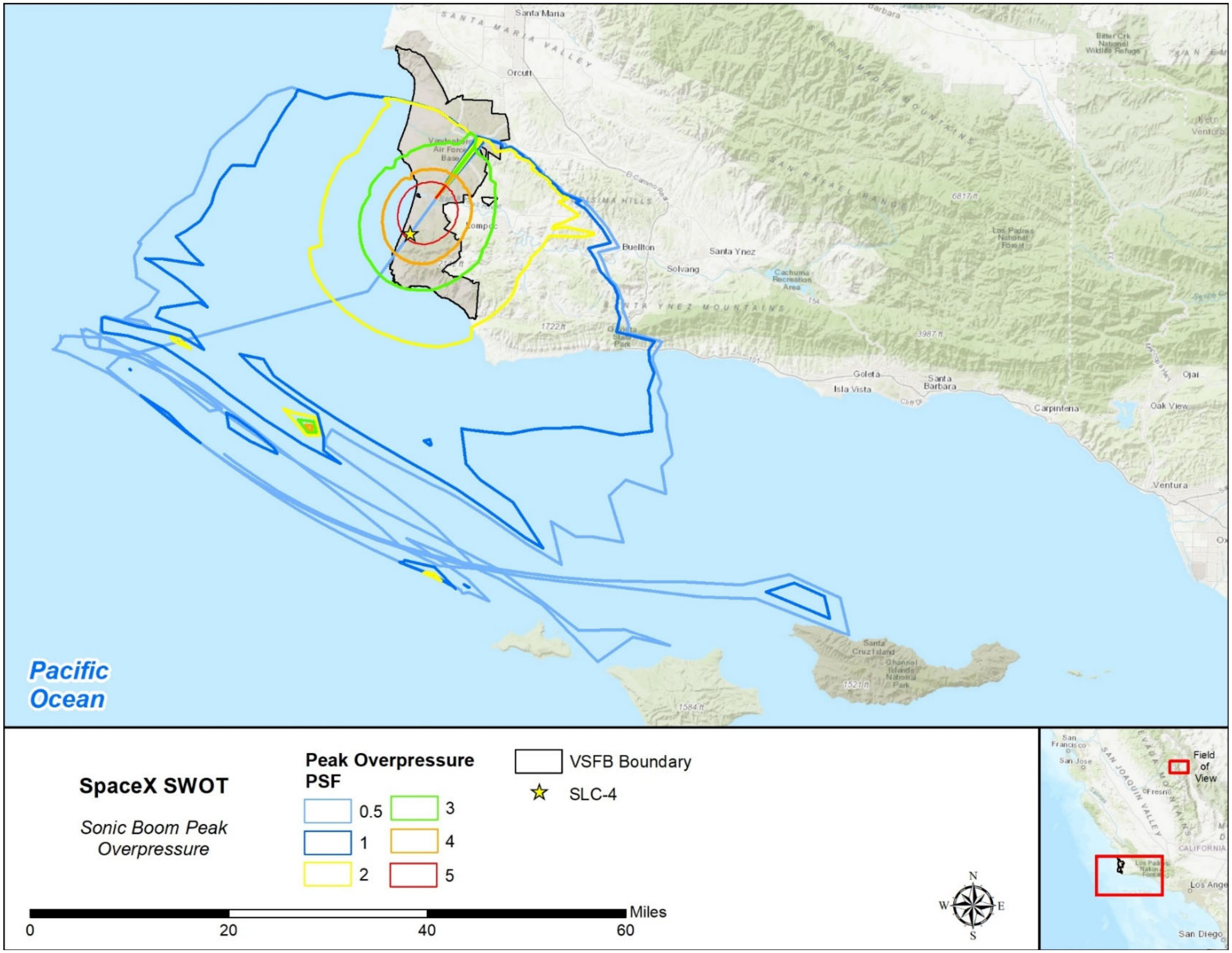

Figure 4-17. Falcon 9 first stage SLC-4W landing sonic boom results for the SWOT mission with uncharacteristically higher levels over Lompoc.

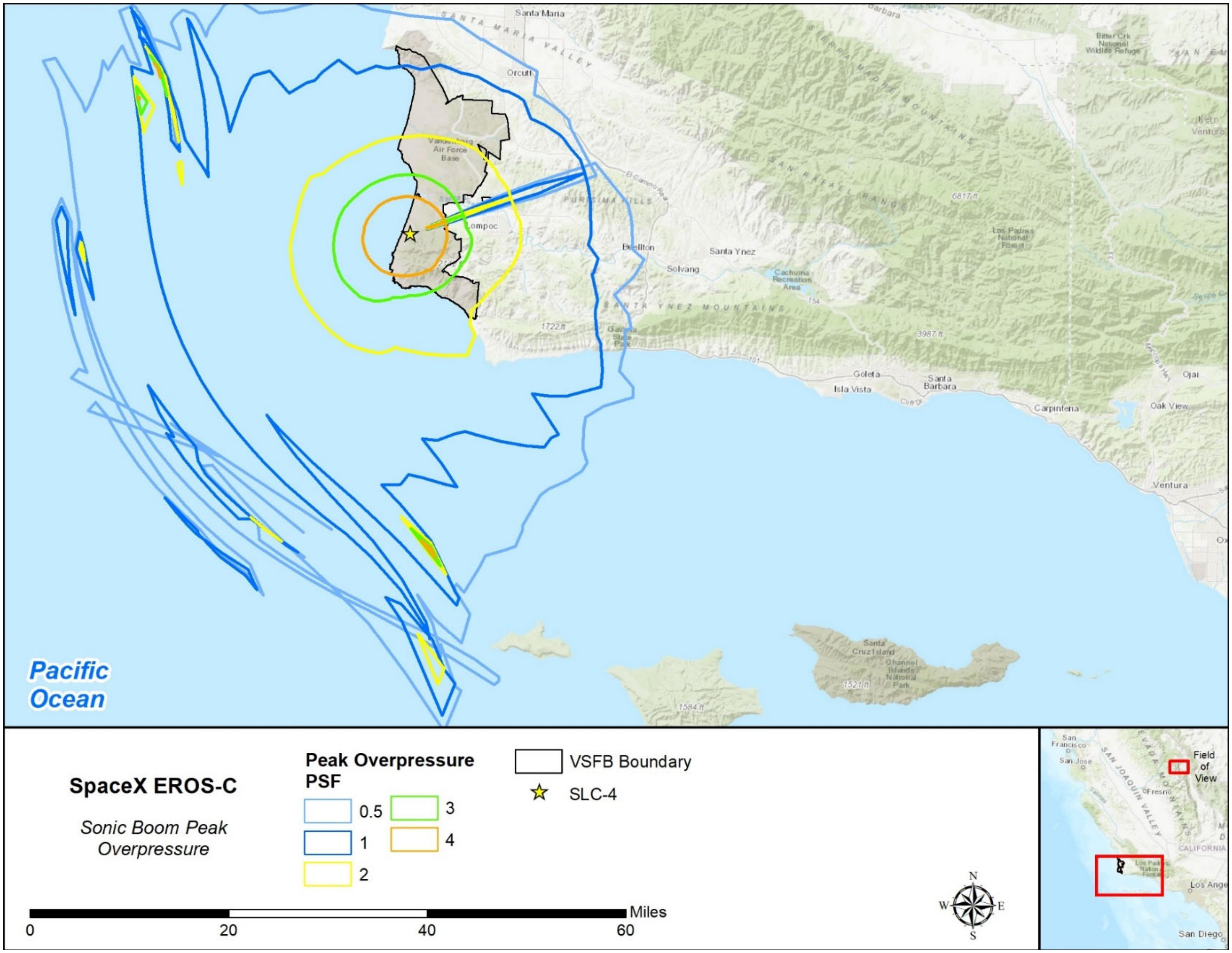

Figure 4-18. Falcon 9 first stage SLC-4W landing sonic boom results for the EROS-c mission with uncharacteristically higher levels over Lompoc.

4.2.4. Proposed Northerly Trajectories

As noted in Section 2.2, SpaceX proposes to add a northerly mission profile with launch azimuths between 301 and 325 degrees (Figure 1-2). MSRS performed modeling of a typical trajectory over numerous meteorological profiles for the most northerly proposed launch azimuth (325 degrees). The model results showed that the launch would not produce a sonic boom that would impact the surface of the earth. A sonic boom up to 5 psf is predicted to impact at the droneship landing location, but the sonic boom footprint would be entirely over open ocean and not impact land (Figure 4-19).

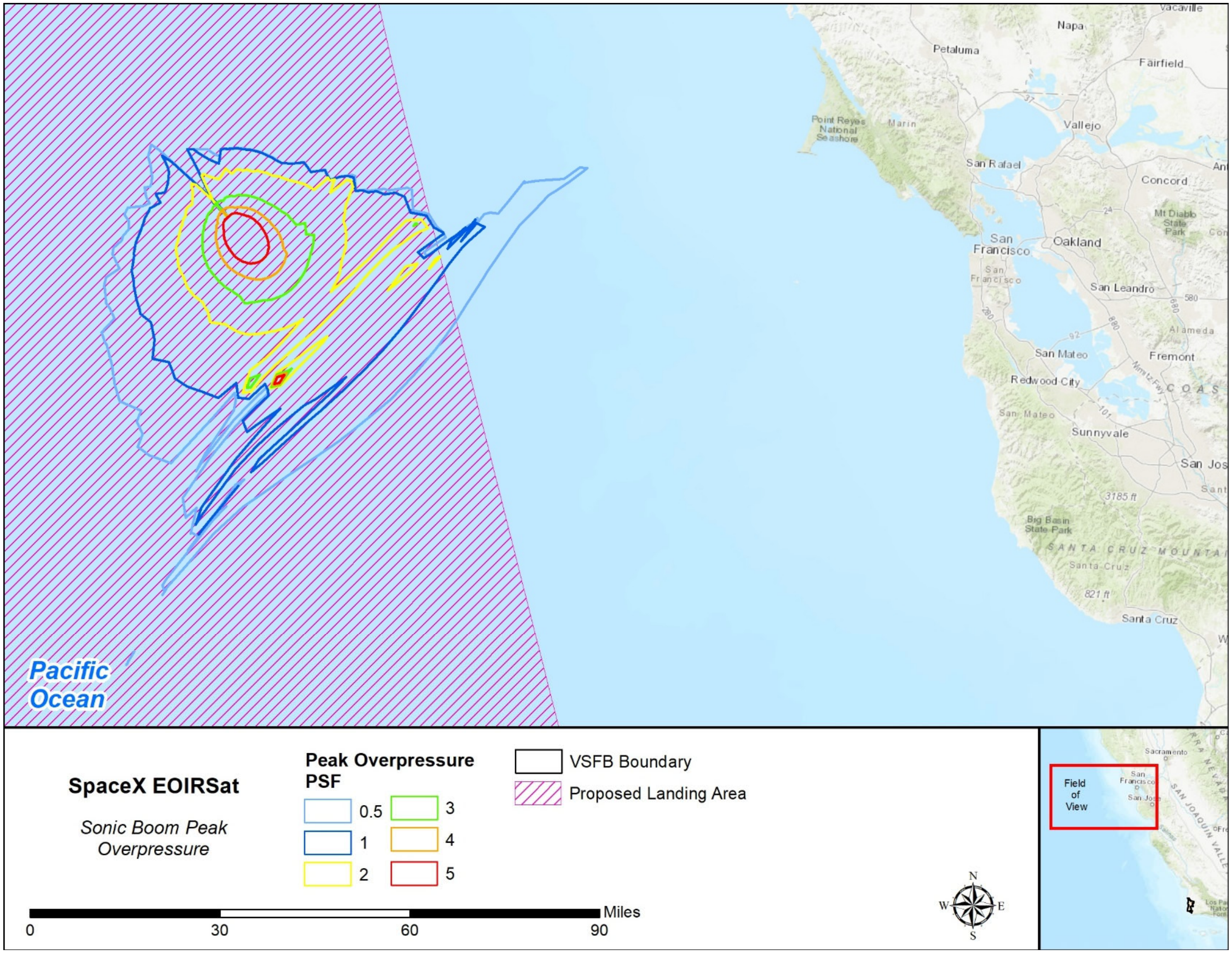

Figure 4-19. Example of a typical sonic boom profile for Falcon 9 First Stage landing on a droneship in the Proposed Landing Areas with a northerly mission profile.

5.0 Conclusions

The 115 dB L_{Amax} and 60 dBA CNEL noise contours produced by the Falcon 9 during launch, landing, and static fire operations at SLC-4 are entirely contained within VSFB boundaries. Based on analysis of an array of southerly trajectories, parts of the NCI would occasionally receive sonic booms of 2 psf or greater. Sonic booms created during first stage landing at SLC-4W would impact a variable area of land depending on mission profiles, occasionally ranging into areas adjacent to VSFB, with sonic booms at or above 2 psf. The 120 dB L_{max} noise contours for launch, landing, and static fire are entirely encompassed by VSFB.

The FAA uses the 120 dB L_{max} noise contour for engine noise and an overpressure contour of 2 psf or greater to define areas that may experience structural damage as a result of space launch vehicle noise (Fenton and Methold 2016; Guest and Slone 1972; Haber et al. 1989). SpaceX and the USSF have evaluated these results and are currently using them to assess the potential for any structural damage to historic properties on the NCI and the VSFB region under a separate effort.

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Appendix F
Terrestrial Biological Resources

F.1 Tidewater Goby (Federally Listed Endangered Species)

F.1.1 Status

The tidewater goby (TWG) was listed as endangered on 7 March 1994 (59 Federal Register [FR] 5494). On 24 June 1999, the United States Fish and Wildlife Service (USFWS) proposed to remove the populations occurring north of Orange County, California, from the endangered species list (64 FR 33816). In November 2002, the USFWS withdrew this proposed delisting rule and retained the TWG's listing as endangered throughout its range (67 FR 67803). The USFWS published a Recovery Plan for the TWG in 2005 (USFWS 2005). In January 2014, USFWS proposed to reclassify the TWG from endangered to threatened (79 FR 14340-14362). In addition, the USFWS is considering a proposed taxonomic split between northern and southern populations of this species, with an expectation to delist the northern population (including all individuals at VSFB). A decision on this proposal has not been made.

F.1.2 Life History

The TWG is a small, bottom-dwelling fish found in California's coastal estuaries, wetlands, lagoons, and lower reaches of coastal streams and rivers. It is an annual species, with individuals typically not living for more than a year. TWG population size is heavily influenced by environmental conditions. In years experiencing high rains, when lagoons are breached, TWG numbers fall as fish are washed out to sea. Individuals able to access refugia, such as that provided by vegetation in littoral marshes, are able to survive flood events. These surviving individuals breed after the lagoons close, allowing populations to rebound the following summer (Swift et al. 1989). Breeding may occur year-round (Swenson 1999), with peak spawning activity usually occurring during the spring and a second peak during the late summer (Swift et al. 1989).

The key threat to TWG is the degradation of coastal lagoons as a result of diversion of water (dewatering streams affects marsh habitat extent, and alters temperature and salinity within the marshes), pollution from agricultural and sewage effluents, siltation (often through sediment generated during cattle overgrazing and feral pig activity), and coastal development. In addition, introduced predatory fish (especially centrarchids and channel catfish [*Ictalurus punctatus*], crayfish [*Procambarus clarkii*], and mosquito fish [*Gambusia affinis*]) pose a direct threat to TWG populations through predation of eggs, larvae, and adults.

F.1.3 Occurrence in the Action Area

TWG have been reported in all the major drainages on VSFB, including Shuman Creek, San Antonio Creek, Santa Ynez River, Honda Creek, and Jalama Creek (Swift et al. 1997). TWG typically favor areas within the fresh-saltwater interface with salinities of less than 12 parts per thousand (Swift et al. 1989). However, this species will range into fresh water and has been recorded up to 7.5 mi (12 km) upstream from the ocean in the Santa Ynez River (Swift et al. 1997).

Suitable habitat for TWG is found in Honda Creek. TWG were first found in the Honda estuary lagoon in 1995 (Lafferty et al. 1999). The species was again documented in 2001; however, seine net surveys conducted in Honda Creek in 2008 indicated that TWG were no longer present (MSRS 2009a). Seine net surveys were again conducted in Honda Creek in 2015 and 2016 with no TWG present (MSRS 2016, 2018). Despite being easily detectable in shallow water with a flashlight during night frog surveys, no TWG were observed during night CRLF surveys of the Honda Creek estuary for SpaceX launch monitoring activities in January 2022 (J. LaBonte, pers. obs.).

In 2013, the estuary lagoon dried and stayed dry through 2016 before rehydrating in the winter of 2016–2017 (MSRS 2018). Since 2017, the lagoon has been subject to drying during late summer months, making more than short-term occupancy by fish dependent on them being able to establish in areas east of Coast Road, but the narrowness and shallowness of the creek in this area makes this unlikely. Occurrence within the Proposed Action Area would be dependent on TWG recolonizing the lagoon if it fills and breaches in response to winter rains. Unless environmental conditions return to a consistently wetter regime conducive to perennial water in the Honda lagoon, any TWG occupancy is likely to be of short duration.

F.1.4 Critical Habitat

The USFWS issued a final rule for designation of critical habitat for the TWG on 6 February 2013 (78 FR 8745-8819). Critical habitat does not include VSFB, since it is owned by the DoD and is exempted under section 4(a)(3) of the ESA. Further, USFWS has adopted VSFB's Integrated Natural Resources Management Plan (INRMP; USSF 2021), prepared under section 101 of the Sikes Act (16 U.S.C. 670a).

F.2 Unarmored Threespine Stickleback (Federally Listed Endangered Species)

F.2.1 Status

The UTS was listed as endangered in 1970 (35 FR 16047-16048). A Recovery Plan was issued in 1985 (USFWS 1985a).

F.2.3 Life History

UTS are small fish (approximately 6 centimeters) that are short-lived (i.e., rarely surviving 2–3 years; USFWS 1985a). UTS reproduce throughout the year with highest recruitment noted from May to September (USFWS 1985a). These fish are opportunistic feeders and primarily feed on invertebrates and aquatic insects (USFWS 1985a). In San Antonio Creek, UTS coexist with other native and introduced species, many of which likely prey on UTS.

F.2.4 Occurrence within the Action Area

UTS was abundant throughout the Los Angeles basin, but was reported to be extirpated by 1942. As of 1985, UTS was generally restricted to the Santa Clara River drainage in Los Angeles County and the San Antonio Creek drainage in Santa Barbara County (USFWS 1985). On VSFB, UTS have are found in San Antonio Creek from Barka Slough to the lagoon and found mostly in the creek channel rather than the lagoon (MSRS 2009a, Swift et al. 1997). UTSs were previously documented as being most concentrated near the El Rancho Road bridge (Swift et al. 1997).

UTS were introduced into Honda Creek in 1984 (MSRS 2009a). Extensive aquatic surveys conducted in 2008, 2016, and 2017 did not detect any fish in the creek (MSRS 2009a, 2016, 2018a). Between 2008 and 2022, Honda Creek has gone through multiple cycles of drying and rehydration, which would preclude occupancy by and persistence of fish.

F.2.5 Critical Habitat

Critical habitat for the UTS was proposed in 1980 (45 FR 76012-76015), but has not been finalized

F.3 California Red-Legged Frog (Federally Threatened Species)

F.3.1 Status

The UFSWS listed the California red-legged frog (*Rana draytonii*; CRLF) as threatened on 23 May 1996 (61 FR 25813-25833). In 2002, USFWS issued a Recovery Plan to stabilize and restore CRLF populations (USFWS 2002).

F.3.2 Life History

The CRLF is a member of the family Ranidae and is California's largest native frog. In order to breed, CRLF require water bodies with sufficient hydroperiods and compatible salinity levels to accommodate larval and egg development. Breeding typically takes place from November through April with most egg deposition occurring in March. Eggs require 7 to 28 days, depending on water temperature, to develop into tadpoles (Cook 1997). Tadpoles typically require 11 to 20 weeks to develop into terrestrial frogs (USFWS 2002), although some individuals may overwinter in the tadpole stage (Fellers et al. 2001).

Adult CRLF have been documented traveling distances of over 1 mile (1.6 km) during the wet season and spending considerable time in terrestrial riparian vegetation. Christopher (2018) found that 90 percent of the CRLF observations at Vandenberg Air Force Base within the dry season occurred within 197 ft (60 m) of riparian or other aquatic habitats. It is thought that riparian vegetation provides good foraging habitat, as well as good dispersal corridors, due to canopy cover and presence of adequate moisture (USFWS 2002).

Habitat loss and degradation, combined with over-exploitation and introduction of exotic predators, were important factors in the decline of CRLF in the early to mid-1900s. Continuing threats to CRLF include direct habitat loss due to stream alteration and loss of aquatic habitat and drought, and indirect effects of expanding urbanization, competition or predation from non-native species including the bullfrog (*Lithobates catesbeianus*), catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquitofish (*Gambusia affinis*), and crayfish (*Procambarus clarkii*). Chytrid fungus (*Batrachochytrium dendrobatidis*) is a waterborne fungus that can decimate amphibian populations and is considered a threat to CRLF populations.

F.3.3 Occurrence in the Action Area

CRLF have been documented in nearly all permanent streams and ponds on VSFB as well as most seasonally inundated wetland and riparian sites (Christopher 1996, 2004). CRLF have been consistently documented in Honda Creek (Christopher 1996, 2004; MSRS 2009b, 2016, 2018, 2021) and during SpaceX launch monitoring activities in January 2022 (MSRS 2022). The Santa Ynez River and Bear Creek, to the north of SLC-4, have CRLF populations and suitable breeding habitat (Christopher 2004; MSRS 2009b, 2014).

Spring Canyon is an ephemeral drainage located approximately 200 ft. (61 m) south of SLC-4. Spring Canyon has no definable channel through the majority of the drainage and minimal evidence of potential pooling or flow of surface water (MSRS 2013). Depending on annual rainfall levels, several small areas of Spring Canyon may constitute suitable habitat for CRLF during wet periods when adequate surface water is present; however, in July 2017, after an above-average rain year, a USFWS-permitted biologist reassessed the drainage in support of the 2017 Falcon 9 BA (MSRS 2017) and found no significant changes from the habitat assessment conducted in 2013, including no suitable breeding habitat within the vegetation removal area or downstream. Since 2017, across 11 survey efforts to perform minimization measures associated with the 2017 BO, no suitable habitat has been found, likely a result of the protracted drought conditions in Santa Barbara County. It is therefore unlikely that CRLF occupy this area on a regular basis, other than as transitory habitat.

Suitable upland dispersal habitat exists throughout VSFB between the various riparian zones and ponds on Base but, as noted above, dispersal into these upland habitats is not likely to be as extensive as has been observed in more mesic parts of the range of this species. CRLF also occur throughout San Antonio Creek on VSFB from Barka Slough to the estuary (MSRS 2009a, 2009b, 2016).

F.3.4. Critical Habitat

The USFWS issued a final rule revising the CRLF's critical habitat on 16 March 2010 (75 FR 12816–12959). The USFWS excluded VSFB from this designation pursuant to Section 4(b)(2) of the ESA. However, USFWS designated critical habitat for the species along the southeastern (Unit STB-4) and northeastern (Unit STB-2) perimeters of VSFB.

F.4 Marbled Murrelet (Federally Threatened Species)

F.4.1 Status

The USFWS listed the marbled murrelet (*Brachyramphus marmoratus*; MAMU) as threatened on 1 October 1992 (57 FR 45328) and published a Recovery Plan for the species in 1997 (USFWS 1997). The USFWS completed a 5-year review of the species in 2009 (USFWS 2009).

F.4.2 Life History

The MAMU is a small seabird that breeds along the Pacific coast, foraging in nearshore marine waters on small fish and invertebrates, and flying inland to breed. The species requires nearshore marine habitats with abundant prey (fish and invertebrates). Among alcids, the species is unique because it uses old-growth coniferous forests and mature trees for nesting (USFWS 1997). MAMU are wing-pursuit divers. Although little has been known about the MAMU movement and home range, more information is becoming available. The first MAMU nest was not documented until 1974. Since then, the MAMU’s home range has been observed as 655 square kilometers (km^2) for non-nesters and 240 km^2 for nesters within California. In addition, at-sea resting areas have also been observed an average of 5.1 km from the mouths of drainages. MAMU spend nighttime hours resting in the ocean at these areas and commute to foraging areas during the day. Nests have been observed from sea level to 5,020 ft. (USFWS 2009). MAMU range from Alaska to California and may occur as far south as Baja California.

F.4.3 Occurrence within the Action Area

MAMU have been observed semi-regularly off the coast in nearshore waters between the Santa Maria River and offshore of VSFB from on-land observation sites. Specifically, one individual was observed at an unreported distance offshore from an observation site located approximately 0.5 mi (0.8 km) west of SLC 4 in 2011 (eBird 2022). Two separate sightings were also documented in 1995 offshore of Purisima Point (eBird 2022). MAMU has never been documented breeding on VSFB, nor is any old-growth coniferous forest present on VSFB or in the Action Area.

F.4.4 Critical Habitat

The USFWS designated critical habitat for the MAMU on 24 May 1996 (61 FR 26257) and revised this designation on 4 August 2016 (81 FR 51348–51370). There is no designated critical habitat for this species within or adjacent to the Action Area. The nearest critical habitat is over 160 mi (97 km) to the north near Santa Cruz, California.

F.5 Western Snowy Plover (Federally Threatened Species)

F.5.1 Status

The USFWS listed the Pacific coast population of the western snowy plover (*Charadrius nivosus*; SNPL) as federally threatened in March of 1993 (58 FR 12864–12874).

F.5.2 Life History

The SNPL is a small shorebird with pale tan back, white underparts, and dark patches on the sides of the neck reaching around to the top of the chest. The Pacific coast population of snowy plovers is limited to individuals that nest adjacent to tidal waters. The population's range extends from Southern Washington to Baja California, Mexico.

F.5.3 Occurrence within the Action Area

VSFB provides important breeding and wintering habitat for SNPL, which includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north VSFB (approximately 7.7 mi [12.4 km]). Also included are all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach south to the rock cliffs at the south end of Surf Beach on South VSFB (approximately 4.8 mi [7.7 km]).

VSFB has consistently supported one of the largest populations of breeding SNPL along the west coast of the United States (Robinette et al. 2016). VSFB has performed annual monitoring of SNPL since 1993 (Robinette et al. 2021). In 2014, VSFB supported an estimated 11 percent of California's breeding population (USFWS 2014). The breeding population of SNPL on VSFB has been highly variable but relatively stable since 2007, with 235 adults and 472 nests initiated in 2021 (Robinette et al. 2021). The nearest SNPL nesting area to SLC-4 is on South Surf Beach, approximately 0.7 mi (1.1 km) northwest of SLC-4.

The SNPL is considered a permanent resident of Santa Rosa Island (SRI). On San Miguel Island (SMI), a high count of 61 SNPL was documented during the 2016–2017 winter window survey; however, counts at SMI typically document very few to no individuals (USFWS 2017a).

F.5.4 Critical Habitat

The USFWS designated Critical Habitat for the SNPL in 1999 and revised this designation on 29 September 2005 (70 FR 56969–57119) and on 19 June 2012 (77 FR 36727). VSFB was exempted from Critical Habitat designation under section 4(a)(3) of the ESA. The nearest Critical Habitat is approximately 8 mi (13 km) to the south on SRI

F.6 California Least Tern (Federally Endangered Species)

F.6.1 Status

The USFWS listed the California least tern (*Sternula antillarum browni*; LETE) as federally endangered on 13 October 1970 (35 FR 16047–16048). The USFWS published a Recovery Plan for the species in 1985 (USFWS 1985b).

F.6.2 Life History

The LETE is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. The upperparts are gray and the underparts are white.

The California populations are localized and increasingly fragmented, due to coastal development resulting in habitat loss. LETEs are migratory and winter along the Pacific coast of southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. This species nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal or wind action.

The total population of LETE increased from less than 700 pairs circa 1985 to greater than 7,000 pairs circa 2006. The population has since declined and remains steady at 4,000 to 5,000 pairs since 2006. The majority of the population is south of Point Conception (Robinette et al 2016).

F.6.3 Occurrence within the Action Area

Historically, LETE nested in colonies in several locations along the coastal strand of the north VAFB coastline. Since 1998, with the exception of two nests established south of San Antonio Creek in 2002, LETE have nested only at the primary colony site, in relatively undisturbed blufftop open dune habitat at Purisima Point. The population of LETE at VSFB represents a small percentage of all known breeding colonies. Robinette et al. (2016) estimated that VSFB supports a breeding population of 25 pairs of LETE. Although this population is small, VSFB is one of only three breeding colonies that nest between Monterey and Point Conception; therefore, the Purisima Point breeding colony is considered important. This colony is approximately 8 mi (12.9 km) north of SLC-4. Adult LETE forage in the Santa Ynez River lagoon and estuary, approximately 3.7 mi (6.0 km) north of SLC-4. After young have fledged in late summer, LETE also disperse to this location to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (Robinette & Howar 2010).

F.6.4 Critical Habitat

The USFWS has not designated critical habitat for the LETE

F.7 California Condor (Federally Listed Endangered Species)

F.7.1 Status

The USFWS listed the California condor (*Gymnogyps californianus*) as endangered on 11 March 1967 (32 FR 4001) and completed a Recovery Plan for the species on 25 April 1996 (USFWS 1996). In 1982, there were only 23 California condors in existence. To prevent the condor from going extinct, all remaining condors were placed into a captive breeding program in 1987. The USFWS and its partners began releasing condors back into the wild in 1992. The nearest release site to the Action Area is Bitter Creek National Wildlife Refuge (USFWS 2017). Other release sites include the Ventana Wilderness and Pinnacles National Park. Almost all condors released into Santa Barbara County have either died or were brought back into captivity, with the last nesting attempt occurring in 2001 (Lehman 2020).

F.7.2 Life History

Condors nest in rock formations (e.g., ledges and crevices) and less frequently in giant sequoia trees (*Sequoiadendron giganteum*). They normally lay a single egg between late January and early April. Both parents incubate the egg and share responsibilities for feeding the nestling after hatching. Condors require large remote areas and can range up to 150 mi (241 km) a day in search of food. Chicks usually take their first flight around 6 to 7 months from hatching. The cause of the California condor's decline is inconclusive, but experts believe that lead poisoning and hunting greatly contributed to their decline (USFWS 1996).

F.7.3 Occurrence within the Action Area

The California condor's current range is not within the Action Area. However, in March 2017, the USSF learned that telemetry data from USFWS showed there was a California condor ranging within VSFB. This condor was SB 760 (“VooDoo”), an immature, non-reproductive female (USFWS, personal communication, 27 March 2017). She hatched in captivity on 22 May 2014, was released at the Ventana Wilderness on 9 November 2016 (Ventana Wildlife Society 2017), and departed the VSFB area on or about 22 April 2017. Several months later, SB 760 was found deceased, in northern San Luis Obispo County. VSFB natural resource managers maintain routine communications with the USFWS and Ventana Wildlife Society for SpaceX launch monitoring requirements and condors have not been present since. However, given the wide ranging nature of this species, individuals may occur on Base in the future.

F.7.4 Critical Habitat

The USFWS designated critical habitat for the California condor in 1976 and revised it in 1977 (42 FR 47840). The nearest designated critical habitat for the California condor is near San Luis Obispo, approximately 44 mi (70 km) from the Action Area. There is no critical habitat within or adjacent to the Action Area.

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Appendix G

Marine Biological Resources

G.1 ESA-Listed Fishes

G.1.1 Steelhead (Onchorhynchus mykiss)

G.1.1.1 Status

The National Marine Fisheries Service (NMFS) listed several Evolutionarily Significant Units of anadromous steelhead as endangered or threatened, including the Southern California Distinct Population Segment (DPS) of steelhead, which encompasses the populations occurring from the Santa Maria River in Santa Barbara County to the California-Mexico border, as endangered in 1997 (62 Federal Register [FR] 43937). In January 2012, NMFS issued a final Recovery Plan to stabilize and restore steelhead trout populations in coastal streams from the Santa Maria River in Santa Barbara County south to the United States and Mexico border (NMFS 2012).

Steelhead populations have experienced significant declines along the Pacific Coast of North America since the early 1900s. The Santa Ynez River in Santa Barbara County, California, once supported what was likely the largest steelhead run south of San Francisco Bay. The run size for the Santa Ynez, Santa Clara, and Ventura Rivers and Malibu Creek is estimated to have been between 32,000 and 46,000 individuals (Boughton & Fish 2003; Helmbrecht & Boughton 2005; Good et al. 2005; Williams et al. 2011). Even after the construction of Gibraltar Dam in 1920, 72 mi (116 km) upstream of the Santa Ynez River mouth, historic run sizes for the Santa Ynez River were estimated at 12,995 to 25,032 individuals (Shapovalov & Taft 1954; Busby et al. 1996). Runs remained large and supported a recreational fishing industry until the construction of Bradbury Dam in 1954 (Alagona et al. 2012). Bradbury Dam is located 48 mi (77 km) upstream from the Pacific Ocean on the mainstem of the Santa Ynez River. It is an impassable barrier that blocks two-thirds of the former steelhead spawning and rearing habitat (Alagona et al. 2012). Following Bradbury Dam's construction, runs of steelhead on the Santa Ynez River were reported at less than 100 individuals on an annual basis (Nehlsen et al. 1991; Reavis 1991). Between 2001 and 2011, an average of 3.4 adult steelhead were trapped per year at a lower Santa Ynez River monitoring station and no adults were observed between 2010 and 2016 (NMFS 2016a).

G.1.1.2 Life History

There is considerable variation in this life history pattern within the population, partly due to Southern California's variable seasonal and annual climatic conditions. Some winters produce heavy rainfall and flooding, which allow juvenile steelhead easier access to the ocean, while dry seasons and periods of drought may close the mouths of coastal streams and rivers, limiting juvenile steelheads' access to marine waters (NMFS 1997) as well as adult access to spawning grounds (U.S. Bureau of Reclamation 2013).

G.1.1.3 Occurrence within the Action Area

The natural range of anadromous steelhead includes the U.S. Pacific Coast to Southern California (Good et al. 2005), but it has been introduced throughout the world. Spawning and rearing habitat are found outside of the ROI in freshwater creek and river systems, where adults may migrate up to 930 mi (1,497 km) from their ocean habitats to reach their freshwater spawning grounds in high-elevation tributaries. Near the Action Area, the primary rivers that steelhead migrate into are the Santa Maria and Santa Ynez Rivers (Good et al. 2005). Steelhead hatch in freshwater streams, where they spend their first 1 to 3 years. They later move into the ocean, where most of their growth occurs. After spending between 1 and 4 years in the ocean, steelhead return to their home freshwater stream to spawn. Unlike other species of Pacific salmon, steelhead do not necessarily die after spawning and are able to spawn more than once.

G.1.1.4 Critical Habitat

In September 2005, the NMFS issued the final critical habitat designation for the Southern California Steelhead DPS (70 FR 52488). This critical habitat designation does not include VSFB because it was excluded under section 4(b)(2) of the ESA and exempted under section 4(a)(3) of the ESA. In addition, designated critical habitat for steelhead in Southern California is restricted to rivers and estuaries and therefore does not overlap with the Action Area

G.1.2 Chinook Salmon (Onchorhynchus mykiss)

G.1.2.1 Lower Columbia River ESU

The Lower Columbia River Chinook Salmon ESU was listed as threatened on 24 March 1999 (64 FR 14308), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls.

In general, the more abundant juvenile Lower Columbia River fall-run Chinook migrate north upon entering the Pacific Ocean (Fisher et al. 2014). However, the less-abundant juvenile Lower Columbia River spring-run Chinook, though more common beyond the continental shelf, with most migrating far offshore after their first year of marine residence (Quinn & Myers 2005; Sharma 2009), have been detected in the coastal waters of Oregon and Washington for much of the year (Fisher et al. 2014). Occurrence of chinook salmon from the Lower Columbia River ESU would be rare in the ROI.

G.1.2.2 California Coastal ESU

The California Coastal Chinook Salmon ESU was listed as threatened on 16 September 1999 (64 FR 50394), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned Chinook salmon originating from rivers and streams south of the Klamath River to and including the Russian River (79 FR 20802).

The California Coastal Chinook salmon ESU produces primarily ocean-type juveniles that reside for less than a year in fresh water before moving to the ocean between March and August of their first year. In the ocean, California coastal Chinook remain primarily between Pt. Reyes and southern Oregon, with highest abundances in the Fort Bragg and Klamath subareas (Bellinger et al. 2015; Satterthwaite et al. 2015). Adults of the California Coastal Chinook DPS (fall-run) migrate from September through December or January in larger rivers that remain open to the ocean all summer (NMFS 2019a). This ESU occurs within the ROI.

G.1.2.3 Sacramento River Winter-Run ESU

The Sacramento River Winter-Run Chinook Salmon ESU was listed as threatened on 4 August 1989 (54 FR 32085) and was reclassified as endangered in 1994 (55 FR 46515). This ESU includes all naturally spawned populations of winter-run Chinook salmon in the Sacramento River and its tributaries, as well as two conservation programs maintained at the Livingston-Stone National Fish Hatchery (79 FR 20802).

Juvenile fry and smolts emigrate downstream from July through March through the Sacramento River and reach the Delta from September through June (Satterthwaite et al. 2015). Due to limited data, Teel et al. (2015) combined this ESU with other California ESUs. They found that the distribution of these fish largely occurred in Oregon and California coastal waters, consistent with other authors (Hendrix et al. 2019; Moyle 2002; Windell et al. 2017). Returning adults migrate through coastal waters and enter San Francisco Bay, then migrate up the Sacramento River in November and continue upstream from December through early August (California Department of Fish and Wildlife [CDFW] 2022a). Due to the coastal distribution of this ESU, Sacramento River Winter-Run Chinook salmon occur in the ROI.

G.1.3 Coho Salmon (Oncorhynchus kisutch)

G.1.3.1 Southern Oregon and Northern California Coast ESU

The Southern Oregon and Northern California Coast Coho Salmon ESU was listed as threatened on 6 May 1997 (62 FR 24588), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned coho salmon originating from coastal streams and rivers between Cape Blanco, Oregon, and Punta Gorda, California (79 FR 20802).

Although juvenile behaviors, life histories, and habitat associations can be variable, the majority of coho juveniles reside about one year in fresh water before migrating to sea (NMFS 2019a). Upon entry into the open ocean, juvenile coho use nearshore marine habitats, with some fish remaining in local waters and others moving northward along the continental shelf to central Alaska (Fisher et al. 2014). In general, fish in this ESU exhibit a three-year life cycle, with adults entering natal streams and rivers from mid-November to January (NMFS 2019a). Due to prevalence of coho in Oregon coastal waters, Southern Oregon and Northern California Coast coho salmon are present in the ROI.

G.1.3.2 Central California Coast ESU

The Central California Coast Coho Salmon ESU was listed as threatened on 31 October 1996 (61 FR 56138) and downgraded to endangered on 28 June 2005 (70 FR 37160). The ESU status was reaffirmed as endangered on 2 April 2012, (77 FR 19552) and subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned coho salmon originating from rivers south of Punta Gorda, California, to and including Aptos Creek, as well as such coho salmon originating from tributaries to San Francisco Bay (79 FR 20802).

Coho smolts from this population begin migrating downstream to the ocean in late March or early April but can sometimes begin prior to March and persist well into July (CDFW 2022b). Once in the ocean, immature coho remain in in-shore waters, congregating in schools as they move north along the continental shelf (CDFW 2022b; Fisher et al., 2014). Adults in this ESU generally enter freshwater to spawn from September through January, with spawning mainly from November to January, although it can extend into February or March (CDFW 2022b). Due to prevalence of coho in Oregon coastal waters, Central California Coast coho salmon occur in the ROI.

G.1.4 Green Sturgeon (Acipenser medirostris)

G.1.4.1 Status

The Southern DPS of North American Green Sturgeon was listed as threatened on 7 April 2006 (71 FR 17757) and critical habitat for this DPS was designated on 9 October 2009 (74 FR 52300).

G.1.4.2 Occurrence within the Action Area

Subadult green sturgeon leave their Californian natal rivers and disperse widely along continental shelf waters of the West Coast within the 360 ft. (110-meter [m] contour (Erickson & Hightower 2007; Moyle 2002; NMFS 2005). This DPS preferentially distributes north of their natal river during fall and moves into bays and estuaries during summer and fall (Heironimus et al. 2022; Israel et al., 2009). Sub-adult and mature fish exhibit a narrow and shallow depth distribution in marine habitat of < 328 ft. (100 m) within the 360 ft. (110 m) contour of the continental shelf, typically occupying depths of 130 to 230 ft. (40–70 m; Erickson & Hightower, 2007; NMFS 2005; Payne et al., 2015). While Huff et al. (2011) found that green sturgeon appeared to prefer marine areas with high seafloor complexity and boulder presence, Payne et al. (2015) found that that green sturgeon are also associated with flat, soft bottom habitats that lack high relief bottoms. Information regarding their preference for areas of high seafloor complexity and prey selection in coastal waters (benthic prey) indicate green sturgeon reside and migrate along the seafloor while in coastal waters. Huff et al. (2011) found that green sturgeon in the open ocean may also occupy the upper 65 ft. (20 m) of the water column on a seasonal basis (July to November) and use deeper habitats throughout the rest of the year.

The primary concentration of sturgeon is estimated to be approximately 41–51.5° North within the 656 ft. (200 m) isobath in the coastal waters of Washington, Oregon, and Vancouver Island (Huff et al. 2012). Additionally, Huff et al. (2011) suggested that green sturgeon occur at low densities in the coastal marine environment. Southern DPS are likely to be present in the ROI.

G.1.4.3 Critical Habitat

Critical habitat includes coastal U.S. marine waters within 360 ft. (110 m) depth from Monterey Bay, California north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to the U.S. boundary. Critical habitat includes several rivers and estuaries along the U.S. West Coast (74 FR 52300).

For coastal marine areas, the physical or biological features of critical habitat designated for green sturgeon include food resources, migratory corridors, and water quality. Corresponding species life history events include subadult growth and development, movement between estuarine and marine areas, and migration between marine areas, as well as adult sexual maturation, growth and development, movements between estuarine and marine areas, migration between marine areas, and spawning migration (74 FR 52300). Green sturgeon critical habitat does not overlap the ROI.

G.1.5 Oceanic Whitetip Shark (Carcharhinus longimanus)

G.1.5.1 Status

NMFS completed a comprehensive status review of the oceanic whitetip shark and based on the best scientific and commercial information available, including the status review report (Young et al. 2016), and listed the species as threatened on 1 March 2018 (83 FR 4153).

G.1.5.2 Occurrence within the Action Area

Oceanic whitetip sharks are found worldwide in warm tropical and subtropical waters between the 30° North and 35° South latitude near the surface of the water column (Young et al. 2016). Oceanic whitetips occur throughout the Central Pacific, including the Hawaiian Islands south to Samoa Islands and in the eastern Pacific from Southern California to Peru, including the Gulf of California. This species has a clear preference for open ocean waters, with abundances decreasing with greater proximity to continental shelves. In terms of California fish fauna, Allen and Cross (2006) categorized oceanic white tip sharks as holoepipelagic and individuals would be found mostly far from shore. Preferring warm waters near or over 20°C (68°F), and offshore areas, the oceanic whitetip shark is known to undertake seasonal movements to higher latitudes in the summer (NOAA 2016) and may regularly survey extreme environments (deep depths, low temperatures) as a foraging strategy (Young et al. 2016).

Oceanic whitetip sharks could occur in deep open ocean areas in the California Current Large Marine Ecosystem. They are known to occur in Baja California and may be found in surface waters off the continental shelf (Baum et al. 2015). Oceanic whitetip sharks are therefore expected to occur within the ROI.

G.1.5.3 Critical Habitat

Critical habitat has not been designated for this species.

G.1.6 Scalloped Hammerhead Shark (Sphyrna lewini)

G.1.6.1 Status

On 3 July 2014, four of six identified distinct population segments of scalloped hammerhead sharks were listed as endangered or threatened (79 FR 38214). The Eastern Pacific distinct population segment of the scalloped hammerhead population, which includes the west coast of the United States and the Southern California Range Complex, is listed as endangered under the ESA. The scalloped hammerhead shark has undergone substantial declines throughout its range (Baum et al. 2003). There is evidence of population increases in some areas of the southeast U.S., such as the Gulf of Mexico (Ward-Paige et al. 2012), but because many catch records do not differentiate between the hammerhead species, or shark species in general, population estimates and commercial or recreational fishing landing data are unavailable in the ROI. Most of the abundance data is from the Gulf of California, where it is estimated that the scalloped hammerhead population is currently decreasing by 6 percent per year (INP 2006).

G.1.6.2 Occurrence in the Action Area

The scalloped hammerhead shark is a coastal and semi-oceanic species distributed in temperate and tropical waters (Froese & Pauly 2016). Distribution in the eastern Pacific Ocean extends from the coast of southern California, including the Gulf of California, to Ecuador and possibly Peru (Compagno 1984), and off Hawaii in the central Pacific Ocean. A genetic marker study suggests that females remain close to coastal habitats, while males disperse across larger open ocean areas (Daly-Engel et al. 2012).

Juveniles rear in coastal nursery areas in the southern California portion of the Action Area (Duncan & Holland 2006), but rarely inhabit the open ocean (Kohler & Turner 2001). Sub adults and adults occur over shelves and adjacent deep waters close to shore and entering bays and estuaries (Compagno 1984). In the California Current Large Marine Ecosystem, records of the presence of scalloped hammerhead sharks in this area are very rare. Sighting and landings in the ROI are documented to have occurred in San Diego Bay in 1981, 1996, and 1997 (Shane 2001).

G.1.6.3 Critical Habitat

Critical habitat has not been designated for this species.

G.2 Sea Turtles

G.2.1 General Background

Sea turtles are highly migratory, long-lived reptiles that occur throughout the open-ocean and coastal regions of the Action Area. Generally, sea turtles are distributed throughout tropical to subtropical latitudes (i.e., in warmer waters closer to the equator), with some species extending poleward into temperate seasonal foraging areas. In general, sea turtles spend most of their time at sea, with the notable exception of mature females returning to land, primarily beaches, to nest. The habitat preferred by sea turtles and their distribution at sea varies by species and life stage (i.e., hatchling, juvenile, adult).

G.2.2 Green Sea Turtle (Chelonia mydas)

G.2.2.1 Status

The green sea turtle was listed under the ESA in July 1978 because of excessive commercial harvest, a lack of effective protection, evidence of declining numbers, and habitat degradation and loss (NMFS and USFWS 2007a). A revised final rule listing the East Pacific DPS of the green sea turtle was issued in 2016 (81 FR 20057).

G.2.2.2 Occurrence in the Action Area

The green sea turtle is found in tropical and subtropical coastal and open ocean waters, between 30° North and 30° South. Green sea turtles are widely distributed in the subtropical coastal waters of southern Baja California, Mexico, and Central America (Cliffton et al. 1995; NMFS and USFWS 1998a). Another green sea turtle population resides in Long Beach, California, although less is known about this population (Eguchi et al. 2010). Ocean waters off southern California and northern Baja California are designated as areas of occurrence because of the presence of rocky ridges and channels and floating kelp habitats suitable for green sea turtle foraging and resting (Stinson 1984); however, these waters are often at temperatures below the thermal preferences of this primarily tropical species.

G.2.2.3 Critical Habitat

Critical habitat has not been designated in the Pacific Ocean.

G.2.3 Loggerhead Turtle (Caretta caretta)

G.2.3.1 Status

In September 2011, NMFS listed all three Pacific Ocean distinct population segments of loggerhead sea turtles as endangered (76 FR 588868). In the Pacific, there are two distinct population segments of loggerheads. The North Pacific Ocean DPS nests only on the coasts of Japan. This population has declined 50 to 90 percent during the last 60 years, however the overall nesting trend in Japan has been stable or slightly increasing over the last decade. The South Pacific Ocean DPS nests primarily in Australia with some nesting in New Caledonia. In 1977, about 3,500 females may have nested in the South Pacific—today there are only around 500 per year.

G.2.3.2 Occurrence in the Action Area

Loggerhead turtles are found worldwide mainly in subtropical and temperate regions of the Atlantic, Pacific, and Indian Oceans, and in the Mediterranean Sea (Conant et al. 2009). In the eastern Pacific, the loggerheads primary range extends from offshore of Vancouver Island, south to Central America. The highest densities of loggerheads can be found just north of Hawaii in the North Pacific Transition Zone (Polovina et al. 2000). The North Pacific Transition Zone is defined by convergence zones of high productivity that stretch across the entire North Pacific Ocean from Japan to California (Polovina et al. 2001). The loggerhead turtle is known to occur at sea off of southern California, but does not nest on southern California beaches.

G.2.3.3 Critical Habitat

There is no critical habitat designated for the North Pacific Ocean DPS.

G.2.4 Olive Ridley Sea Turtle (Lepidochelys olivacea)

G.2.4.1 Status

The breeding population along the Pacific coast of Mexico was listed as endangered under the ESA in 1978 (43 FR 32800), because of extensive overharvesting of olive ridley turtles in Mexico, which caused a severe population decline (NMFS and USFWS 1998b). Olive ridleys offshore of California and Baja Mexico would likely belong to this population. All other populations are listed under the ESA as threatened. A five-year review was completed in 2014 (NMFS and USFWS 2014).

G.2.4.2 Occurrence in the Action Area

Most olive ridley turtles lead a primarily open ocean existence (NMFS and USFWS 1998b). Individuals occasionally occur in waters as far north as California and as far south as Peru, spending most of their life in the oceanic zone (NMFS and USFWS 2007b). The olive ridley has a large range in tropical and subtropical regions in the Pacific Ocean, and is generally found between 40° North and 40° South. There are few documented occurrences of olive ridley sea turtles in waters off the west coast of the United States (NMFS and USFWS 1998b).

G.2.4.3 Critical Habitat

Critical habitat has not been designated for the olive ridley turtle.

G.2.5 Hawksbill Sea Turtle (Eretmochelys imbricata)

G.2.5.1 Status

The hawksbill turtle is listed as endangered throughout its range in 1970 under the ESA (35 FR 8491). A five-year review was completed in 2013 (NMFS and USFWS 2013a).

G.2.5.2 Occurrence in the Action Area

Water temperature in the southern California offshore waters is generally too low for hawksbills, and their occurrence offshore of California would be considered rare. They are more common in nearshore foraging grounds, including coral reefs and mangrove estuaries from Baja California to South America (NMFS and USFWS 2013a). However, hatchlings utilize floating algal mats and drift lines in pelagic (open sea) habitat (NMFS and USFWS 2013a) and therefore may be found in the ROI.

G.2.5.3 Critical Habitat

Critical habitat has not been designated for the hawksbill in the Pacific Ocean.

G.2.6 Leatherback Sea Turtle (Dermochelys coriacea)

G.2.6.1 Status

The leatherback sea turtle is listed as a single population and is classified as endangered under the ESA (35 FR 8491). Although USFWS and NMFS believe the current listing is valid, preliminary information indicates an analysis and review of the species should be conducted under the DPS policy (NMFS and USFWS 2013b). In early 2018, NMFS and the USFWS initiated a status review for the globally listed endangered leatherback sea turtles, to determine if DPS existed and if so, given their status, to consider whether the listing (currently "endangered") should be changed for each DPS. The status review was completed in 2020 (NMFS and USFWS 2020). While seven populations of leatherbacks were found globally distinct due to their genetic discontinuity, spatial differences (i.e., marked separation of the seven populations at nesting beaches), and separation due to physical factors, including land masses, oceanographic features and currents, all populations were found to be at risk of extinction. This is as a result of reduced nesting female abundance, declining nest trends, and numerous, severe threats (NMFS and USFWS 2020). Therefore, the leatherback sea turtle remains globally endangered under the ESA.

Most leatherback nesting populations in the Pacific Ocean are faring poorly and have declined by more than 80 percent since the 1980s. The International Union for Conservation of Nature has predicted a decline of 96 percent for the western Pacific subpopulation and a decline of nearly 100 percent for the eastern Pacific subpopulation by the year 2040 (Sarti-Martinez et al. 1996; Clark et al. 2010; NMFS 2016c). Causes for the decline in the Pacific include the intensive egg harvest at leatherback rookeries and high levels of mortality through the 1980s associated with bycatch in the gill net fisheries (NMFS 2016c).

G.2.6.2 Occurrence in the Action Area

The leatherback sea turtle is the most widely distributed of all sea turtles, found from tropical to subpolar oceans. Because leatherback nest on tropical and occasionally subtropical beaches, it has the most extensive range of any turtle (Eckert 1995; Myers & Hays 2006; NMFS and USFWS 2013b; NMFS and USFWS 2020). Leatherbacks are also the most migratory sea turtles, with populations traversing the Pacific, Atlantic, and Indian oceans between nesting and foraging grounds, and migratory routes extending into subpolar regions (Spotila 2004; Bailey et al. 2012; Gaspar & Lalire 2017).

Pacific leatherbacks are split into western and eastern Pacific subpopulations based on their distribution and biological and genetic characteristics (Bailey et al. 2012). Eastern Pacific leatherbacks nest along the Pacific coast of the Americas, primarily in Mexico and Costa Rica, and forage throughout coastal and pelagic habitats of the eastern tropical Pacific. Western Pacific leatherbacks nest in the Indo-Pacific, primarily in Indonesia, Papua New Guinea, and the Solomon Islands, disperse after hatching into the central North Pacific along the North Pacific Transition Zone, and forage in the eastern North Pacific as juveniles and adults (Bailey et al. 2012; Gaspar & Lalire 2017; NMFS and USFWS 2020).

Leatherback sea turtles are regularly seen off the west coast of the United States, with the greatest densities found in waters along Central California during summer and fall when sea surface temperatures are highest (Bailey et al. 2012). The Action Area does not include any known or suitable leatherback sea turtle nesting habitat (NMFS and USFWS 2020).

G.2.6.3 Critical Habitat

In 2012, NMFS designated critical habitat for the leatherback sea turtle in California waters from Point Arena to Point Arguello out to the 3,000-m isobath (77 FR 4169; Figure 3.2-1). The Primary Constituent Elements (PCEs) defining leatherback critical habitat are the occurrence of prey species, primarily scyphomedusae, commonly known as jellies, of the order Semaeostomeae (Chrysaora, Aurelia, Phacellophora, and Cyanea), of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks…" (50 C.F.R. 226.207).

G.3 Marine Mammals

G.3.1 Blue Whale (Balaenoptera musculus)

G.3.1.1 Status

The world's population of blue whales can be separated into three subspecies, based on geographic location and some morphological differences. Within the ROI the subspecies *Balaenoptera musculus musculus* is present. The blue whale is listed as endangered under the ESA and as depleted under the

Marine Mammal Protection Act (MMPA) throughout its range. A revised Recovery Plan was completed in 2020 (NMFS 2020).

G.3.1.2 Occurrence in the Action Area

The blue whale inhabits all oceans and typically occurs near the coast, over the continental shelf, though they are also found in oceanic waters (Stafford et al. 2001; Stafford et al. 2004; Ferguson 2005; Hamilton et al. 2009; Bradford et al. 2013; Klinck et al. 2015; Barlow 2016).

The Eastern North Pacific Stock of blue whales includes animals found in the eastern north Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta et al. 2019). Relatively high densities of blue whales occur off Central and Southern California during the summer and fall (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Becker et al. 2016). Data from year-round surveys conducted off Southern California from 2004 to 2013 show that the majority of blue whales were sighted in summer (62 sightings) and fall (9 sightings), with only single sightings in winter and spring (Campbell et al. 2015).

Most baleen whales spend their summers feeding in productive waters near the higher latitudes and winters in the warmer waters at lower latitudes (Širović et al. 2004). Blue whales in the eastern north Pacific are known to migrate between higher latitude feeding grounds of the Gulf of Alaska and the Aleutian Islands to lower latitudes, including Southern California; Baja California, Mexico; and the Costa Rica Dome (Calambokidis & Barlow 2004; Calambokidis et al. 2009a; Calambokidis et al. 2009b; Mate et al. 2015b; Mate et al. 2016; Palacios et al. 2019). The West Coast is known to be a blue whale feeding area for the Eastern North Pacific stock during summer and fall (Bailey et al. 2012; Calambokidis et al. 2015; Mate et al. 2015b; Calambokidis et al. 2019; Palacios et al. 2019). Of the nine feeding areas for blue whales identified by Calambokidis et al. (2015) along the U.S. West Coast as “Biologically Important Areas” (BIAs), the “Point Conception/Arguello” feeding area overlaps the Action Area in the summer to fall (June through October) feeding season.

The blue whale feeding areas identified in waters extending from Point Conception to the Mexico border represent only a fraction of the total area within those waters where habitat models predict high densities of blue whales (Calambokidis et al. 2015; Ferguson et al. 2015). Additionally, while those identified areas tend to have the highest blue whale density from July through October when averaged over multiple years, the areas are associated with ephemeral prey distributions that are less predictable over the short term (Ferguson et al. 2015; Abrahms et al. 2019).

Blue whales have shown site fidelity, returning to their mother’s feeding grounds on their first migration (Calambokidis & Barlow 2004), and exhibit strong foraging site fidelity, even when conditions are not conducive to successful foraging in less than optimal years (Palacios et al. 2019). However, a sufficient density of prey is necessary to balance the energy requirements of their lunge feeding strategy (Goldbogen et al. 2015; Hazen & Goldbogen 2015; Straley et al. 2017), and there are daily, seasonal, interannual, and decadal variability in the locations and density of krill at a given feeding location (Brinton & Townsend 2003).

G.3.1.3 Critical Habitat

There is no designated critical habitat for this species.

G.3.2 Fin Whale (Balaenoptera physalus)

G.3.2.1 Status

The fin whale is listed as depleted under the MMPA and endangered under the ESA throughout its range, but there is no designated critical habitat for this species. A Recovery Plan was completed for the fin whale in 2010 (NMFS 2010a). In the North Pacific, NMFS recognizes three fin whale stocks: (1) a Northeast Pacific stock in Alaska; (2) a California, Oregon, and Washington stock; and (3) a Hawaii stock. NMFS does not recognize fin whales from the Northeast Pacific stock as being present in Southern California.

G.3.2.2 Occurrence in the Action Area

The fin whale is found in all the world's oceans and is the second-largest species of whale (Jefferson et al. 2008). Fin whales prefer temperate and polar waters and are scarcely seen in warm, tropical waters (Reeves et al. 2002). This species has been documented from 60° North to 23° North. Fin whales have frequently been recorded in waters within Southern California and are present year-round (Širović et al. 2004; Barlow & Forney 2007; Mizroch et al. 2009).

Fin whales are not known to have a specific habitat and are highly adaptable, following prey, typically off the continental shelf (Azzellino et al. 2008; Panigada et al. 2008; Scales et al. 2017). Off the U.S. West Coast, fin whales typically congregate in areas of high productivity, allowing for extended periods of localized residency that are not consistent with the general baleen whale migration model (Scales et al. 2017).

Based on predictive habitat-based density models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, relatively high densities of fin whales are predicted off Southern California during the summer and fall (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Becker et al. 2016). Aggregations of fin whales are present year-round in Southern and Central California (Forney et al. 1995; Forney & Barlow 1998; Douglas et al. 2014; Jefferson et al. 2014; Campbell et al. 2015; Scales et al. 2017), although their distribution shows seasonal shifts. In 2005–2006, during a period of cooler ocean temperatures, fin whales were encountered more frequently than during normal years (Peterson et al. 2006). Sightings from year-round surveys off Southern California from 2004 to 2013 show fin whales farther offshore in summer and fall and closer to shore in winter and spring (Douglas et al. 2014; Campbell et al. 2015).

G.3.2.3 Critical Habitat

No critical habitat has been designated for the fin whale.

G.3.3 Western North Pacific Gray Whale (Eschrichtius robustus)

G.3.3.1 Status

There are two north Pacific populations of gray whales: the Western subpopulation and the Eastern subpopulation designated in the Pacific Stock Assessment Report (SAR) (Weller et al. 2013). Both DPSs could be present in the Action Area during their northward and southward migration (Sumich & Show 2011).

The Western North Pacific DPS is considered depleted (Weller et al. 2002; Cooke 2019). This subpopulation is endangered and should be very few in number in the Action Area given the small population and their known wintering areas in waters off Russia and Asia (Mate et al. 2015a). Analysis of the data available for 2005 through 2016 estimates the combined Sakhalin Island and Kamchatka populations are increasing (Cooke 2019). The Eastern North Pacific subpopulation has recovered and was delisted under the ESA in 1994 (Swartz et al. 2006; Carretta et al. 2020).

G.3.3.2 Occurrence in the Action Area

Gray whales of the Western North Pacific DPS primarily occur in shallow waters over the U.S. West Coast, Russian, and Asian continental shelfs and are considered to be one of the most coastal of the great whales (Jefferson et al. 2008; Jones & Swartz 2009). Feeding grounds for the population are the Okhotsk Sea off Sakhalin Island, Russia, and in the southeastern Kamchatka Peninsula (in the southwestern Bering Sea) in nearshore waters generally less than 225 ft. (68 m) deep (Jones & Swartz 2009). The breeding grounds consist of subtropical lagoons in Baja California, Mexico, and suspected wintering areas in southeast Asia (Urban-Ramirez et al. 2003). At least 12 members of the Western North Pacific DPS have been detected in waters off the Pacific Northwest (Weller & Brownell 2012; Mate 2013; Moore & Weller 2018). NMFS reported that 18 Western North Pacific gray whales have been identified in waters far enough south to have passed through Southern California waters (NMFS 2014).

Gray whales migrate along the Pacific coast twice a year between October and July (Calambokidis et al. 2015). Although they generally remain mostly over the shelf during migration, some gray whales may be found in more offshore waters to the west of San Clemente Island and the Channel Islands (Calambokidis et al. 2015; Schorr et al. 2019; Guazzo et al. 2019). In aerial surveys occurring in December and April each year, gray whales were the third-most encountered large cetacean in Southern California (Smultea 2014).

The main gray whale migrations that pass through the Action Area can be loosely categorized into three phases (Rugh et al. 2008; Calambokidis et al. 2015). Calambokidis et al. (2015) note these migration phases are not distinct, the timing for a phase may vary based on environmental variables, and a migration phase typically begins with a rapid increase in migrating whales, followed by moderate numbers over a period of weeks, and then slowly tapering off. A southward migration from summer feeding areas in the Chukchi Sea, Bering Sea, Gulf of Alaska, and the Pacific Northwest begins in the fall (Mate et al. 2013; Calambokidis et al. 2015; Mate et al. 2015a). This Southbound Phase includes all age classes as they migrate primarily to the nearshore waters and lagoons of Baja California, Mexico, as a destination. During this southward migration, the whales generally are within 10 km of the coast (Calambokidis et al. 2015), although there are documented exceptions where migrating gray whales have bypassed the coast by crossing sections of the open ocean (Rice & Wolman 1971; Mate & Urban-Ramirez 2003; Mate 2013; Mate et al. 2015a).

The northward migration for gray whales to the feeding grounds in Arctic waters, Alaska, the Pacific Northwest, and Northern California occurs in two phases (Calambokidis et al. 2015). Northbound Phase A consists mainly of adults and juveniles that lead the beginning of the north bound migration from late January through July, peaking in April through July. Newly pregnant females go first to maximize feeding time, followed by adult females and males, then juveniles (Jones & Swartz 2009). The Northbound Phase B consists primarily of cow-calf pairs that begin their northward migration later (March to July) remaining on the reproductive grounds longer to allow calves to strengthen and rapidly increase in size before the northward migration (Urban-Ramirez et al. 2003; Jones & Swartz 2009).

The gray whale migration corridors (north of Point Conception), the potential presence buffer area, and the months these four sections of the Pacific coastal waters were designated as cumulatively in use (October through July), were identified by Calambokidis et al. (2015) as BIAs for gray whales. A portion of the gray whale potential presence migration area and the migration routes off Southern California pass through the ROI.

G.3.3.3 Critical Habitat

There has been no designated critical habitat for the Western North Pacific gray whale DPS.

G.3.4 Humpback Whale (Megaptera novaeangliae), Mexico Distinct Population Segment and Central American Distinct Population Segment

G.3.4.1 Status

Humpback whales that are seasonally present in the Action Area are from two DPSs, given they represent populations that are both discrete from other conspecific populations and significant to the species of humpback whales to which they belong (NMFS 2016c). These DPSs are based on animals identified in breeding areas in Mexico and Central America (Bettridge et al. 2015; Muto et al. 2019). Humpback whales of the Mexico DPS are listed as threatened, and those from the Central America DPS are listed as endangered under the ESA (NMFS 2016c).

Although estimates show variable trends in the number of humpback whales along the U.S. West Coast, the overall trend in the estimates is consistent with growth rate of 6–7 percent for the California, Oregon, Washington stock and appears consistent with the highest-yet abundances of humpback whales in the most recent 2014 survey of that stock. For the DPSs in Mexico and in Central America, photo identification data collected between 2004 and 2006 are the main basis for the estimates for specific to those populations (Bettridge et al. 2015; NMFS 2016c; Wade et al. 2016). The new best overall estimate of abundance of humpback whales along the U.S. West Coast has been provided by photo identification data gathered between 2015 and 2018 along the U.S. West Coast (Calambokidis & Barlow 2020). This estimate, which includes the Mexico DPS and the Central America DPS, is 4,973, which is higher than the abundance (2,900) in the 2019 Pacific SAR (Calambokidis & Barlow 2020).

G.3.4.2 Occurrence in the Action Area

The habitat requirements of wintering humpbacks appear to be controlled by the conditions necessary for calving, such as warm water (75–80 ^{o}F) and relatively shallow, low-relief ocean bottom in protected areas, nearshore, or created by islands or reefs (Smultea 1994; Clapham 2000; Craig & Herman 2000). In breeding grounds, females with calves occur in significantly shallower waters than other groups of whales, and breeding adults use deeper, more offshore waters (Smultea 1994; Ersts & Rosenbaum 2003). Breeding and calving areas for the Mexico DPS and for the Central America DPS are both located within the ROI.

Off the U.S. West Coast, humpback whales are more abundant in shelf and slope waters (<2,000 m deep) and are often associated with areas of high productivity (Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Redfern et al. 2013; Campbell et al. 2015; Becker et al. 2016; Calambokidis et al. 2019). While most humpback whale sightings are in nearshore and continental shelf waters, humpback whales frequently travel through deep oceanic waters during migration (Dohl et al. 1983; Forney & Barlow 1998; Campbell et al. 2015). Humpback whales migrating from breeding grounds in Central America to feeding grounds at higher latitudes may cross the Action Area.

Peak occurrence during migration occurs in the Action Area from December through June (Calambokidis et al. 2015). In quarterly surveys undertaken in the 10-year period between 2004 and 2013 off Southern California, humpback whales were generally encountered in coastal and shelf waters, with the largest concentration occurring in relatively shallow waters, north of Point Conception (Campbell et al. 2015). During winter and spring, a substantially greater proportion of the humpback whale population is found farther offshore than during the summer, with (in all seasons) the majority of the population found north of the Channel Islands (Forney & Barlow 1998; Campbell et al. 2015; Becker et al. 2017; Calambokidis et al. 2017).

BIAs for humpback whales overlap the ROI. Passive acoustic monitoring at Monterey Bay California from 2015 to 2018 demonstrated that the timing of humpback whales feeding and migration in that area is variable, with detections generally occurring from September through May (Ryan et al. 2019). Location data from satellite tags also has demonstrated that, in some cases, the feeding BIAs do not represent the core area of humpback whale presence, at least for the time and sample of the population represented by humpback whales that were tagged and otherwise present in or around the area (Mate et al. 2018). In 2014, 2015, and 2016, humpback whales were more commonly sighted in coastal waters of Santa Monica Bay, and from Long Beach south to waters off Dana Point (Calambokidis et al. 2017). The variable use of the Santa Barbara Channel–San Miguel feeding BIA was also evident, corresponding to the 2014–2016 increase in ocean temperatures off California that resulted in the changes to the nominal distribution and availability of krill and anchovy (Zaba et al. 2018; Fiechter et al. 2020; Santora et al. 2020) and the distribution of humpback whales in 2014, resulting in a much higher density off Central California than a nominal year (Becker et al. 2018). Similar high ocean temperatures in 2016 also corresponded to a documented scarcity of healthy humpback whales in the Santa Barbara Channel–San Miguel feeding BIA and vicinity. However, more humpback whales were found further north off Central California and in better condition, which investigators suggested was indicative of good feeding areas that were likely to be sustained in that region in that anomalous year (Oregon State University 2017).

G.3.4.3 Critical Habitat

A final rule to designate critical habitat for humpback whales for the endangered Central America DPS and the threatened Mexico DPS was published on 21 April 2021 (75 FR 21082) pursuant to Section 4 of the ESA. This action followed a 9 October 2019 proposed rule to designate critical habitat for the humpback whales within the U.S. Exclusive Economic Zone (EEZ) in the Pacific for the endangered Central America DPS and the threatened Mexico DPS pursuant to section 4 of the ESA (84 FR 54378). In the proposal, NMFS considered 19 Regions/Units of habitat as critical habitat for the listed humpback whale DPSs. These 19 areas include almost all coastal waters off California, Oregon, Washington, and Alaska in the Pacific. Humpback whale critical habitat is depicted in Figure 3.3-4; as shown, there is overlap between the Action Area and the critical habitat.

Region/Unit 17 has been referred to by NMFS in the proposed rule as the “Central California Coast Area,” which covers an area of 6,697 square nm extending from 36° 00' to 34° 30' north latitude. Within those north and south boundaries, Region/Unit 17 begins at the 98 ft. (30 m) depth contour out to the 12,139 ft. (3,700 m) depth contour. This region’s area includes waters off of southern Monterey, San Luis Obispo, and Santa Barbara counties. This region/unit of habitat is characterized by NMFS as having a very high conservation value (84 FR 54378).

The essential feature for the Central America DPS as defined by NMFS (2019b) is “Prey species, primarily euphausiids (Thysanoessa, Euphausia, Nyctiphanes, and Nematoscelis) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth. The Mexico DPS is very similar, but adds capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) to the essential prey species lists. NMFS has noted that prey as an essential feature may require special management considerations or protections as a result of ecosystem shifts driven by climate change, commercial fisheries, and pollution (NMFS 2019b).

Humpback whales are generalists, taking a variety of prey while foraging and switching between target prey depending on what is most abundant in the system (Witteveen et al. 2014; Szabo 2015; Fleming et al. 2016). Consistent with the designated critical habitat, the humpback whales' diet is dominated by euphausiids and small pelagic fishes, such as northern anchovy, Pacific herring, Pacific sardine, and capelin (Santora et al. 2010; Szabo 2015; Fleming et al. 2016; Keen et al. 2017; Gabriele et al. 2017; Straley et al. 2017; Witteveen & Wynne 2017). Like other large mysticetes, they are a "lunge feeder," taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. All feeding behavior seem to involve patches of prey with sufficient density to support feeding bouts (Mate et al. 2019; Frisch-Jordan et al. 2019). The size of individual krill seems to be an aspect of prey quality for the species (Santora et al. 2010; Szabo 2015; Burrows et al. 2016). For example, Santora et al. (2010) found that different species of baleen whales aggregated to krill hotspots that were differentiated by the size of individual krill, with humpback whales having preference for small (<35 mm) juvenile krill.

In the California Current Ecosystem, changing oceanographic factors (e.g., upwellings, temperatures, winds, salinity) result in seasonal, interannual, and decadal variability in the locations and density of krill and forage fish (Brinton & Townsend 2003; Keister et al. 2011; Santora et al. 2011; Deutsch et al. 2015; Santora et al. 2017a; Zaba et al. 2018; Cimino et al. 2020; Rockwood et al. 2020; Fiechter et al. 2020; Santora et al. 2020). As a result, the location, timing, and intensity of prey aggregations can vary greatly both seasonally and from year to year. Given that concentrations of prey tend to be spatially and temporally ephemeral at scales on the order of tens of meters to kilometers and hours to days (Zaba et al. 2018; Hazen et al. 2018; Rockwood et al. 2020; Fiechter et al. 2020; Santora et al. 2020), the presence of feeding humpback whales and prey as an essential feature of the critical habitat are also highly variable over these small spatial and temporal scales.

The critical habitat overlaps with the humpback whale feeding BIAs designated in 2015 (Calambokidis et al. 2015), but in the Action Area it extends farther offshore to incorporate the maximum extent of the predicted humpback abundance in cooler months (Becker et al. 2016; Becker et al. 2017) and farther inshore to incorporate distributions derived from satellite telemetry data for 13 humpback whales (Mate et al. 2018). Although the location, timing, and intensity of humpback whale prey vary greatly (Santora et al. 2011; Santora et al. 2017a; Zaba et al. 2018; Santora et al. 2020; Fiechter et al. 2020), static spatial management strategies such as the designation of critical habitat can effectively mitigate risks associated with fixed large and long-term actions such as established commercial vessel traffic lanes (associated with ship strikes) or within fishery regulations (associated with entanglement) (Rockwood et al. 2017; Moore & Weller 2018; Redfern et al. 2019; Redfern et al. 2020; Rockwood et al. 2020; Santora et al. 2020).

G.3.5 Killer Whale (Orcinus orca)

G.3.5.1 Status

NMFS listed the Southern Resident killer whale DPS as endangered in 2005 (70 FR 69903) and adopted a recovery plan in 2008 (73 FR 4176; NMFS 2008). There are 73 Southern Resident killer whales in the DPS (Couture et al. 2022). The Southern Resident DPS is divided into three pods identified as J, K, and L (Carretta et al. 2021).

Concerns over impacts on the population from several sources have been raised in recent years, including disturbance from whale watching vessels (Ferrara et al. 2017; Holt et al. 2017; Lacy et al. 2017; NMFS

2021), commercial shipping noise (Cominellli et al. 2018; McWhinnie et al. 2021), and prey availability (Hanson et al. 2021).

G.3.5.2 Occurrence in the Action Area

Southern Resident killer whales occur mainly along the outer coast and inland waters of Washington and British Columbia, Canada. In recent years the population has shifted and expanded its range to areas up to hundreds of miles from Washington waters both north (as far as Southeast Alaska) and south as far as central California (Cogan 2015; Dahlheim et al. 2008). Specifically, K-pod and L-pod have ranged widely along the coast and been sighted as far south as Monterey Bay in recent years; L-pod is known to have traveled as far north as Chatham Strait, Southeast Alaska. J-pod has largely remained in inland waters (Carretta et al. 2021).

Satellite-tag locations found that Southern Resident killer whales generally inhabit nearshore waters (Hanson et al. 2018; Hanson et al. 2017). Ninety-five percent of reported locations were within 18 nm (34 km) of shore, and 50 percent were within 5 nm (10 km) of shore. On the outer coast, 75 percent of tag locations were in a narrow corridor between 1.6 and 10 nm (3 and 19 km) offshore (Hanson et al. 2017). The proposed landing and fairing recovery area is in deep waters between approximately 46–400 nm off Rockport, California in the north to 158–910 nm off Baja California, Mexico in the south and no recovery activities would occur within 12 nm of islands. Therefore, relatively few killer whales are expected to occur in areas where these activities would be conducted.

G.3.5.3 Critical Habitat

NMFS amended and expanded the critical habitat designation for Southern Resident killer whales to include nearshore waters along the coasts of Washington, Oregon, and California in 2021. The elements of critical habitat essential for conservation of the Southern Resident killer whale are (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging. The amended critical habitat designation extends along the entire Oregon coastline but is outside the ROI.

G.3.6 Sei Whale (Balaenoptera borealis)

G.3.6.1 Status

The sei whale is listed as endangered under the ESA and as depleted under the MMPA throughout its range. A recovery plan for the sei whale was completed in 2011 and provided a research strategy for obtaining data required to estimate population abundance and trends, and to identify factors that may be limiting the recovery of this species (NMFS 2011). Sei whales along the U.S. West Coast are assigned to the Eastern North Pacific stock within the U.S. EEZ (Carretta et al. 2020). NMFS has determined that an assessment of the sei whale population trend will likely require additional survey data and reanalysis of all datasets using comparable methods (Carretta et al. 2018b). There are no data on Eastern North Pacific sei whale trends in abundance (Carretta et al. 2020).

G.3.6.2 Occurrence in the Action Area

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes. During the winter, sei whales are found in warm tropical waters. Sei whales are also encountered during the summer off California and the North America coast from approximately the latitude of the Mexican border to as far north as Vancouver Island, Canada (Masaki 1976; Horwood 2009; Smultea et al. 2010).

A total of 10 sei whale sightings were made during systematic ship surveys conducted off the U.S. West Coast in summer and fall between 1991 and 2008 (Barlow 2010), with an additional 14 groups sighted during a 2014 survey (Barlow 2016). Sei whales are expected to be present in offshore waters in the ROI.

G.3.6.3 Critical Habitat

There is no designated critical habitat for this species.

G.3.7 Sperm Whale (Physeter macrocephalus)

G.3.7.1 Status

The sperm whale has been listed as endangered since 1970 under the precursor to the ESA (NMFS 2009) and is depleted under the MMPA throughout its range. In the North Pacific sperm whales are divided into three stocks in the Pacific; one (California/Oregon/Washington) occurs within the Action Area (Carretta et al. 2020). Based on genetic analyses, Mesnick et al. (2011) found that sperm whales in the California Current are demographically independent from animals in the rest of the tropical Pacific. A Recovery Plan was completed for the sperm whale in 2010 (NMFS 2010b).

Line-transect surveys conducted off the U.S. West Coast from 1991 to 2014 include a high level of uncertainty but indicate that sperm whale abundance has appeared stable, with some evidence for an increasing number of sperm whales (Moore & Barlow 2014; Moore & Barlow 2017; Carretta et al. 2020).

G.3.7.2 Occurrence in the Action Area

This species is primarily found in the temperate and tropical waters of the Pacific (Rice 1989; Merkens et al. 2019). Its secondary range includes areas of higher latitudes up to and including the Gulf of Alaska (Whitehead & Weilgart 2000; Jefferson et al. 2008; Whitehead et al. 2008; Whitehead et al. 2009). This species appears to prefer deep waters and the continental shelf break and slope (Rice 1989; Whitehead 2003; Jefferson et al. 2008; Whitehead et al. 2008; Baird 2013). Typically, sperm whale concentrations also correlate with areas of high productivity, generally near drop offs and areas with strong currents and steep topography (Gannier & Praca 2007; Jefferson et al. 2008).

Sperm whales are found year-round in California waters, but their abundance is temporally variable, most likely due to the availability of prey species (Forney & Barlow 1993; Barlow 1995; Barlow & Forney 2007; Smultea 2014). Based on habitat models derived from line-transect survey data collected between 1991 and 2008 off the U.S. West Coast, sperm whales show an apparent preference for deep waters (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012). During quarterly ship surveys conducted off Southern California between 2004 and 2008, there were a total of 20 sperm whale sightings, the majority (12) occurring in summer in waters greater than 2,000 m deep (Douglas et al. 2014).

Sperm whales are somewhat migratory. General shifts in distribution occur during summer months for feeding and breeding, while in some tropical areas sperm whales appear to be largely resident (Rice 1989; Whitehead 2003; Whitehead et al. 2008; Whitehead et al. 2009). Pods of females with calves remain on breeding grounds throughout the year, between 40° North and 45° North (Rice 1989; Whitehead 2003), while males migrate between low-latitude breeding areas and higher-latitude feeding grounds (Pierce et al. 2007). In the northern hemisphere, "bachelor" groups (males typically 15 to 21 years old and bulls [males] not taking part in reproduction) generally leave warm waters at the beginning of summer and migrate to feeding grounds that may extend as far north as the perimeter of the arctic zone. In fall and winter, most return south, although some may remain in the colder northern waters during most of the year (Pierce et al. 2007).

G.3.7.3 Critical Habitat

There is no designated critical habitat for this species.

G.3.8 Southern Sea Otter (Federally Threatened Species)

G.3.8.1 Status

The USFWS listed the Southern sea otter as federally threatened on 14 January 1977 (42 FR 2965) and published a Recovery Plan in 2003 (USFWS 2003). The USWFS completed a 5-year review of the species in 2015 (USFWS 2015).

G.3.8.2 Life History

The Southern sea otter is the smallest species of marine mammal in North America. It inhabits the nearshore marine environments of California from San Mateo County to Santa Barbara County with a small geographically isolated population around San Nicolas Island. On occasion, Southern sea otters have been observed beyond these limits and have been documented as far south as Baja, Mexico (USFWS 2015).

This species breeds and gives birth year round and pups are dependent for 120–280 days (average 166 days; Riedman & Estes 1990). Sea otters are opportunistic foragers known to eat mostly abalones, sea urchins, crabs, and clams. They play a key ecological role in kelp bed communities by controlling sea urchin grazing.

G.3.8.3 Occurrence in the Action Area

Southern sea otters occur regularly off the coast of VSFB, with animals typically concentrated in the kelp beds offshore of Purisima Point on north VSFB, and offshore of Sudden Flats on south VSFB. Transitory otters occasionally traverse the coast between SLC-4 and Point Arguello. This area is, however, not regularly occupied and no otters have been detected at this location during the last three annual spring census counts from 2011 to 2016 (U.S. Geological Survey Western Ecological Resource Center 2017, 2018, 2019, 2020).

G3.8.4 Critical Habitat

There is no designated critical habitat for this species.

G.3.9 California Sea Lion

G.3.9.1 Status

The California sea lion (*Zalophus californianus*) is not listed under the ESA, and the population has been designated as the U.S. stock by NMFS.

G.3.9.2 Life History

Typically, during the summer, California sea lions congregate near rookery islands and specific open-water areas. The primary rookeries off the coast of the United States are on San Nicolas, San Miguel, Santa Barbara, and San Clemente Islands (Le Boeuf & Bonnell 1980; Lowry et al. 1992; Carretta et al. 2000; Lowry & Forney 2005; Lowry et al. 2017). Haulout sites are also found on Richardson Rock, Santa Catalina Island, Santa Cruz Island, and Santa Rosa Island in the Southern California Bight (Le Boeuf 2002; Lowry et al. 2017).

In the nonbreeding season, beginning in late summer, adult and subadult males migrate northward along the coast of California to Washington and return south the following spring (Lowry & Forney 2005; Laake

2017). Females and juveniles also disperse somewhat but tend to stay in the Southern California area, although north and west of the Channel Islands (Melin & DeLong 2000; Lowry & Forney 2005; Thomas et al. 2010). Tagging results showed that lactating females foraging along the coast would travel as far north as Monterey Bay and offshore to the 1,000 meter isobath (Melin & DeLong 2000; Melin et al. 2008; Henkel & Harvey 2008; Kuhn & Costa 2014; McHuron et al. 2017). There is a general distribution shift northwest in fall and southeast during winter and spring, probably in response to changes in prey availability (DeLong et al. 2017a; DeLong et al. 2017b; Lowry et al. 2017). California sea lions are usually found in waters over the continental shelf and slope; they are also known to occupy locations far offshore in deep, oceanic waters, such as Guadalupe Island and Alijos Rocks off the Baja Peninsula, Mexico (Zavala-Gonzalez & Mellink 2000; Jefferson et al. 2008; Melin et al. 2008; Urrutia & Dziendzielewski 2012). California sea lions are the most frequently sighted pinnipeds offshore of Southern California during the spring, and peak abundance is during the May through August breeding season (Green et al. 1992; Keiper et al. 2005; Lowry et al. 2017). Overall, the California sea lion population is abundant and has been generally increasing (Jefferson et al. 2008; Carretta et al. 2010; Lowry et al. 2017; Carretta et al. 2020). Using count and resighting data gathered between 1975 and 2015, NMFS researchers showed that California sea lion population growth was above the maximum net productivity level and within the range of the optimal sustainable population (Laake et al. 2018).

G.3.9.3 Occurrence in the Action Area

California sea lions are common offshore of VSFB and haul out sporadically on rocks and beaches along the coastline of VSFB. This species hauls out at sites in the southern portion of VSFB, which are located approximately 3.6 mi (5.8 km) south of SLC-4, as well as the NCI (VSFB 2021). However, California sea lions rarely pup on the VSFB coastline (VSFB 2021) and one pup was observed in 2015 (VSFB, unpubl. data). California sea lions are the most abundant pinniped species in the Channel Islands (Lowry et al., 2017a). SMI is the northern extent of the species' breeding range; and, along with San Nicolas Island, it contains one of the largest breeding colonies of the species in the Channel Islands (Melin et al., 2010; Lowry et al., 2017a). Pupping occurs in large numbers on SMI at the rookeries found at Point Bennett on the west end of the island and at Cardwell Point on the east end of the island. During aerial surveys of the NCI conducted by NMFS in February 2010, 21,192 total California sea lions (14,802 pups) were observed at haulouts on San Miguel Island and 8,237 total (5,712 pups) at Santa Rosa Island (M. Lowry, NMFS, unpubl. data). During aerial surveys in July 2012, 65,660 total California sea lions (28,289 pups) were recorded at haulouts on SMI, 1,584 total (3 pups) at SRI, and 1,571 total (zero pups) at Santa Cruz Island (M. Lowry, NMFS, unpubl. data).

G.3.10 Northern Fur Seal

G.3.10.1 Status

The California stock of Northern fur seal (*Callorhinus ursinus*) that is present in the ROI is not considered depleted under the Marine Mammal Protection Act and is not listed under the ESA (Carretta et al. 2020). Animals from the California stock may remain in or near San Miguel Island throughout the year but after the breeding season in November generally move to the North Pacific in waters off Canada, Washington, Oregon, and Northern California to forage (Koski et al. 1998; Melin et al. 2012; Sterling et al. 2014; Adams et al. 2014; Lowry et al. 2017; Zeppelin et al. 2019).

G.3.10.2 Life History

Migrating seals and those along the U.S. West Coast are typically found over the edge of the continental shelf and slope (Kenyon & Wilke 1953; Sterling & Ream 2004; Gentry 2009; Adams et al. 2014). Their offshore distribution has been correlated with oceanographic features (e.g., eddies and fronts) where prey may be concentrated (Ream et al. 2005; Sterling et al. 2014). The abundance of northern fur seals at San Miguel Island, the primary rookery for the California stock, has increased steadily over the past four decades, except for two severe declines associated with El Niño-southern Oscillation events in 1993 and 1998 (DeLong & Stewart 1991; Melin et al. 2006; Melin et al. 2008; Orr et al. 2012; Carretta et al. 2020).

G.3.10.3 Occurrence in the Action Area

The California stock of Northern fur seal that is present in the project area is not considered depleted under the MMPA (Carretta et al. 2020). Animals from the California stock may remain in or near SMI throughout the year but, after the breeding season in November, generally move to the North Pacific in waters off Canada, Washington, Oregon, and Northern California to forage (Melin et al. 2012; Sterling et al. 2014; Adams et al. 2014; Lowry et al. 2017b; Zeppelin et al. 2019). Migrating seals and those along the U.S. West Coast are typically found over the edge of the continental shelf and slope (Kenyon & Wilke 1953; Sterling & Ream 2004; Gentry 2009; Adams et al. 2014). Their offshore distribution has been correlated with oceanographic features (e.g., eddies and fronts) where prey may be concentrated (Ream et al. 2005; Sterling et al. 2014). The abundance of northern fur seals at SMI, the primary rookery for the California stock, has increased steadily over the past four decades, except for two severe declines associated with El Niño-southern Oscillation events in 1993 and 1998 (DeLong & Stewart 1991; Melin et al. 2006; Melin et al. 2008; Orr et al. 2012; Carretta et al. 2017b; Carretta et al. 2020). Northern fur seals have not been observed at any VSFB haulout location (VSFB 2021).G.3.11

G.3.11 Guadalupe Fur Seal (Federally Listed Threatened Species)

G.3.11.1 Status

The Guadalupe fur seal is listed as threatened under the ESA and depleted under the Marine Mammal Protection Act throughout its range (Carretta et al. 2020). The population has been designated the Mexico to California stock (Carretta et al. 2020).

G.3.11.2 Life History

Guadalupe fur seals are most common at their primary breeding ground of Guadalupe Island, Mexico (Melin & DeLong 1999). A second rookery was found in 1997 at the San Benito Islands off the Baja Peninsula, Mexico (Maravilla-Chavez & Lowry 1999; Aurioles-Gamboa et al. 2010; Esperon-Rodriguez & Gallo-Reynoso 2012), and they have also been found in La Paz Bay in the southern Gulf of California (Elorriaga-Verplancken et al. 2016). Satellite tracking data from Guadalupe fur seals tagged at Guadalupe Island have demonstrated movements into the offshore waters between 31 and 186 miles (mi.). (50 and 300 kilometers [km]) from the U.S. West Coast (Norris et al. 2015; Norris 2017b, 2017a; Norris & Elorriaga-Verplancken 2020). Satellite tags have also documented the movement of females without pups at least as far as 800 mi. (1,300 km) north of Guadalupe Island (approximately Point Cabrillo in Mendocino County, California) (Norris 2019). Adult males have not been tagged but typically undertake some form of seasonal movement either after the breeding season or during the winter, when prey availability is reduced (Arnould 2009). The most recent stock assessment reports reflect the population of Guadalupe fur seals from a survey in 2010, which indicated a total estimated population size of approximately 20,000 animals and an average annual growth rate of 10.3 percent (Carretta et al. 2019). The ongoing Unusual Mortality Event involving Guadalupe fur seals (National Oceanic and Atmospheric Administration 2018; National Marine Fisheries Service 2019a) is likely to have impacted the recent population trend (Elorriaga-Verplancken et al. 2016; Ortega-Ortiz et al. 2019). However, based on counts off Mexico in 2018 at Guadalupe Island and the San Benito Archipelago, the minimum population estimate was 29,747

Guadalupe fur seals at those locations (Norris 2019). Valdivia et al. (2019) has noted that since being ESA-listed in 1985, the population of the Guadalupe fur seal increased about nine-fold at a rate of approximately 15 percent per year. The dispersion of Guadalupe fur seal from rookeries off Mexico may be an indicator of potential species recovery (Ortega-Ortiz et al. 2019).

G.3.11.3 Occurrence in the Action Area

Guadalupe fur seals are most common at their primary breeding ground of Guadalupe Island, Mexico (Melin & DeLong 1999). A second rookery was found in 1997 at the San Benito Islands off the Baja Peninsula, Mexico (Maravilla-Chavez & Lowry 1999; Aurioles-Gamboa et al. 2010; Esperon-Rodriguez & Gallo-Reynoso 2012), and they have also been found in La Paz Bay in the southern Gulf of California (Elorriaga-Verplancken et al. 2016a). Satellite tracking data from Guadalupe fur seals tagged at Guadalupe Island have demonstrated movements into the offshore waters between 50 and 300 km from the U.S. West Coast (Norris et al. 2015; Norris 2017b, 2017a; Norris & Elorriaga-Verplancken 2020). Based on that data, the seals can be expected to occur in both deeper waters of the open ocean and coastal waters within the project area. Adult and juvenile males have occasionally been observed at SMI since the mid-1960s; in the late 1990s, a pup was born on that island. Rare sightings of individuals have also occurred at Santa Barbara, San Nicolas, and San Clemente Islands (Stewart 1981; Stewart & Yochem 1984; Stewart et al. 1993; Stewart & Yochem n.d.). In NMFS aerial surveys between 2011 and 2015, Guadalupe fur seals were not observed on any of the Channel Islands other than at SMI (Lowry et al. 2017; Burke 2017). Guadalupe fur seals have not been observed at any VSFB haulout locations (VSFB 2021).

Satellite tags have documented the movement of females without pups at least as far as 808 mi (1,300 km) north of Guadalupe Island (to approximately Point Cabrillo in Mendocino County, California; Norris 2019). Adult males have not been tagged but typically undertake some form of seasonal movement either after the breeding season or during the winter, when prey availability is reduced (Arnould 2009). Based on counts off Mexico in 2018 at Guadalupe Island and the San Benito Archipelago, the minimum population estimate was 29,747 Guadalupe fur seals at those locations (Norris 2019). Valdivia et al. (2019) has noted that, since being ESA-listed in 1985, the population of the Guadalupe fur seal increased about nine-fold at a rate of approximately 15 percent per year. The dispersion of Guadalupe fur seal from rookeries off Mexico may be an indicator of potential species recovery (Ortega-Ortiz et al. 2019).

G.3.12 Steller Sea Lion

G.3.12.1 Status

The Eastern U.S. stock (or DPS) of Steller sea lion (*Eumetopias jubatus*) is defined as the population occurring east of 144°W longitude, and it is not listed as threatened or endangered under the ESA (NMFS 2016; Muto et al. 2020). The locations and distribution of the Eastern population's breeding sites along the U.S. Pacific coast have shifted northward, with fewer breeding sites in Southern California and more sites established in Washington and Southeast Alaska (Pitcher et al. 2007; Wiles 2015). Based on a 2017 survey, the Eastern U.S. stock has increased at a rate of approximately 4.25 percent per year over the last 40 years (Muto et al. 2020), but it remains uncertain how many and what trend there will be for Steller sea lions that are occasionally present in small numbers off Central and Southern California.

G.3.12.2 Life History

Steller sea lions range along the north Pacific from northern Japan to California (Perrin et al. 2009), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands (Muto et al. 2020). There have also been reports of Steller sea lions in waters off Mexico as far south as the various islands off the port of Manzanillo in Colima, Mexico (Gallo-Reynoso et al. 2020). San Miguel Island and Santa Rosa Island were, in the past, the southernmost rookeries and haulouts for the Steller sea lions, but their range contracted northward in the 20th century, and now Año Nuevo Island off Central California is currently the southernmost rookery. Steller sea lions pups were known to be born at San Miguel Island up until 1981 (Pitcher et al. 2007; NMFS 2008; Muto et al. 2020), and so, as the population continues to increase, it is anticipated that the Steller sea lions may re-establish a breeding colony on San Miguel Island in the future. In the Channel Islands and vicinity and despite the species' general absence from the area, a consistent but small number of Steller sea lions (one to two individuals at a time) have been sighted in recent years. Approximately one to two adult and subadult male Steller sea lions have been seen hauled out at San Miguel Island each year during the fall and winter over the last decade, and adult and subadult males have occasionally been seen on rocks north of Northwest Point at San Miguel Island during the part of the summer in the past few years (Delong 2019). Aerial surveys for pinnipeds in the Channel Islands from 2011 to 2015 encountered a single Steller sea lion at San Nicolas Island in 2013 (Lowry et al. 2017). A lone adult female who gave birth to and reared a pup on San Miguel Island in the summer of 2017 (Delong 2019).

G.3.12.3 Occurrence in the Action Area

North Rocky Point was used in April and May 2012 by Steller sea lions (Marine Mammal Consulting Group and Science Applications International Corporation [MMCG and SAIC] 2012). This observation was the first time this species had been reported at VSFB during launch monitoring and monthly surveys conducted over the past two decades. Since 2012, Steller sea lions have been observed frequently in routine monthly surveys, with as many as 16 individuals recorded. In 2014, up to 5 Steller sea lions were observed in the affected area during monthly marine mammal counts (MSRS 2015) and a maximum of 12 individuals were observed during monthly counts in 2015 (VSFB, unpublished data). However, up to 16 individuals were observed in 2012 (MMCG and SAIC 2012). Steller sea lions once had two small rookeries on SMI, but these were abandoned after the 1982–1983 El Niño event (DeLong and Melin 2000; Lowry 2002); however, occasional juvenile and adult males have been detected since then. These rookeries were once the southernmost colonies of the eastern stock of this species. The Eastern Distinct Population Segment of this species, which includes the California coastline as part of its range, was de-listed from the federal Endangered Species Act in November 2013.

G.3.13 Pacific Harbor Seal

G.3.13.1 Status

The harbor seal (*Phoca vitulina*) is not listed under the ESA and those present in the ROI have been assigned to the California stock of harbor seals (Carretta et al. 2020).

G.3.13.2 Life History

Harbor seals are generally not present in the deep waters of the open ocean, are rarely found more than 20 km from shore, and frequently occupy bays, estuaries, and inlets (Baird 2001; Harvey & Goley 2011; Jefferson et al. 2014). Data from 180 radio tagged harbor seals in California indicated most remained within 10 km of the location where they were captured and tagged (Harvey & Goley 2011).

Harbor seals generally haul out in greatest numbers at low tides and during the afternoon, when it is usually warmest. The period from late May to early June corresponds with the peak molt season when the maximum number of harbor seals are onshore (Lowry et al. 2017). The most recent (2012) statewide survey of California harbor seal rookeries has indicated that in the Channel Islands the count has been stable or trending as a slight increase since 1995 (Carretta et al. 2020).

G.3.12.3 Occurrence in the Action Area

Pacific harbor seals congregate on multiple rocky haulout sites along the VSFB coastline. Most haulout sites are located between the Boat House and South Rocky Point, where most of the pupping on VSFB occurs (VSFB 2021). Pups are generally present in the region from March through July. Within the affected area on VSFB, up to 332 adults and 34 pups have been recorded in monthly counts from 2013 to 2015 (MSRS 2014, 2015). During aerial pinniped surveys of haulouts located in the Point Conception area by NMFS in May 2002 and May and June of 2004, between 488 to 516 harbor seals were recorded (M. Lowry, NMFS, unpubl. data). Data on pup numbers were not provided. Harbor seals also haul out, breed, and pup in isolated beaches and coves throughout the coast of SMI. During aerial surveys conducted by NMFS in May 2002 and May and June of 2004, between 521 and 1,004 harbors seals were recorded at SMI, between 605 and 972 at SRI, and between 599 and 1,102 Santa Cruz Island (M. Lowry, NMFS, unpubl. data). Again, data on pup numbers were not provided. Lowry et al. (2017b) counted 1,367 Pacific harbor seals at the Channel Islands in July 2015.

G.3.14 Northern Elephant Seal

G.3.14.1 Status

The northern elephant seal (*Mirounga angustirostris*) is not listed under the ESA. There are two distinct populations of northern elephant seals: one that breeds in the Baja Peninsula, Mexico; and a population that breeds in California (Garcia-Aguilar et al. 2018). NMFS considers northern elephant seals in the ROI to be from the California Breeding stock, although elephant seals from the Baja Peninsula, Mexico, frequently migrate through the ROI (Aurioles-Gamboa & Camacho-Rios 2007; Carretta et al. 2020).

G.3.14.2 Life History

Northern elephant seals spend little time nearshore and migrate four times a year as they travel to and from breeding/pupping and molting areas, spending more than 80 percent of their annual cycle at sea (Robinson et al. 2012; Lowry et al. 2014; Lowry et al. 2017; Carretta et al. 2020). Peak abundance in California is during the January–February breeding season and during molting season from April to July (Lowry et al. 2014; Lowry et al. 2017). As presented in the 2019 Stock Assessment Report (Carretta et al. 2020), the population in California continues to increase Lowry et al. (2014).

G.3.14.3 Occurrence in the Action Area

Northern elephant seals haul out sporadically on rocks and beaches along the coastline of VSFB and observations of young of the year seals from May through November have represented individuals dispersing later in the year from other parts of the California coastline where breeding and birthing occur (VSFB 2021). Pupping of this species was observed on south VSFB in January 2017, for the first time in more than 40 years. Eleven northern elephant seals were observed during aerial surveys of the Point Conception area by NMFS in February of 2010 (M. Lowry, NMFS, unpubl. data). Northern elephant seals breed and pup at the rookeries found at Point Bennett on the west end of SMI and at Cardwell Point on the east end of the island (Lowry 2002). Northern elephant seals are abundant at the NCI from December to March (Lowry et al., 2017b). During aerial surveys of the Northern Channel Islands conducted by NMFS in February 2010, 21,192 total northern elephant seals (14,802 pups) were recorded at haulouts on SMI and 8,237 total (5,712 pups) were observed at SRI (M. Lowry, NMFS, unpubl. data). None were observed at Santa Cruz Island (M. Lowry, NMFS, unpubl. data). Lowry (2017b) stated that aerial surveys found 16,208 pups in SMI, 10,882 pups at San Nicolas Island, and 5,946 pups at SRI.

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Appendix H
Cultural Resources Background

H.1 Cultural Setting

The prehistory of California's central coast spans the entire Holocene and may extend back to late Pleistocene times. Excavations on Vandenberg Space Force Base (VSFB) reveal occupations dating to the Pleistocene/Holocene transition, around 11,000 years ago (Lebow et al. 2014, 2015). Occupations during the earliest part of the Holocene (9,000 to 10,000 years) have been identified at several sites on the base (Glassow 1996; Glassow et al. 1990; Lebow et al. 2001; Lebow et al. 2006; Lebow et al. 2007; Stevens 2011). These early occupants are thought to have lived in small groups that had a relatively egalitarian social organization and a forager-type land-use strategy (Erlandson 1994; Glassow 1996; Greenwood 1972; Moratto 1984). Human population density remained low throughout the early and middle Holocene (Lebow et al. 2007). Cultural complexity appears to have increased around 3,000–2,500 years ago (King 1981, 1990). At VSFB, that interval also marks the beginning of increasing human population densities and appears to mark the shift from a foraging to a collecting land-use strategy (Lebow et al. 2006; Lebow et al. 2007). Population densities reached their peak around 600–800 years ago, corresponding to the full emergence of Chumash cultural complexity (Arnold 1992).

People living in the VSFB area prior to historic contact are grouped with the Purisimeño Chumash (Greenwood 1978; King 1984; Landberg 1965), one of several linguistically related members of the Chumash culture. In the Santa Barbara Channel area, the Chumash people lived in large, densely populated villages and had a culture that "was as elaborate as that of any hunter-gatherer society on earth" (Moratto 1984). Relatively little is known about the Chumash in the VSFB region. Explorers noted that villages were smaller and lacked the formal structure found in the channel area (Greenwood 1978). About five ethnohistoric villages are identified by King (1984) on VSFB, along with another five villages in the general vicinity. Diseases introduced by early Euroamerican explorers, beginning with the maritime voyages of Cabrillo in A.D. 1542–1543, substantially impacted Chumash populations more than 200 years before Spanish occupation began (Erlandson and Bartoy 1995, 1996; Preston 1996). Drastic changes to Chumash lifeways resulted from the Spanish occupation that began with the Portolá expedition in A.D. 1769.

H.2 History

VSFB history is divided into the Mission, Rancho, Anglo-Mexican, Americanization, Regional Culture, and Suburban periods. The Mission Period began with the early Spanish explorers and continued until 1820. Mission La Purísima encompassed the VSFB area. Farming and ranching were the primary economic activities at the Mission. The Rancho Period began in 1820 and continued until 1845. Following secularization in 1834, the Alta California government granted former mission lands to Mexican citizens as ranchos. Cattle ranching was the primary economic activity during this period. The Bear Flag Revolt and the Mexican War marked the beginning of the Anglo-Mexican Period (1845–1880). Cattle ranching continued to flourish during the early part of this period, but severe droughts during the 1860s decimated cattle herds. The combination of drought and change in government from Mexico to the United States caused substantial changes in land ownership. Sheep ranching and grain farming replaced the old rancho system. Increased population densities characterize the Americanization Period (1880–1915). Beginning in the late 1890s, the railroad provided a more efficient means of shipping and receiving goods and supplies, which in turn increased economic activity. Ranching and farming continued during the early part of the period of Regional Culture (1915–1945), until property was condemned for Camp Cooke. The Suburban Period (1945–1965) began with the end of World War II. In 1956, the army transferred 64,000 ac. (259 km^2) of North Camp Cooke to the U.S. Air Force, and it was renamed the Cooke Air Force Base. In 1958 the base had its first missile launch, the Thor, and was renamed VSFB (Palmer 1999). The first Intercontinental Ballistic Missile launched from VSFB was the Atlas, on 9 September 1959 (Smallwood and Loetzerich 2020).

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APPENDIX I
Evacuation and Closure Agreement

Negotiated Agreement Under Authority of
Section 2304 (a) (10) of Title 10 U.S.C.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

Agreement No. DACA09-3-98-0008
Vandenberg Air Force Base, CA.
Tract No. 422

THIS AGREEMENT, made and entered into as of 1 April by and between the STATE OF CALIFORNIA, whose interest in the real property, hereinafter described as that of owners in fee simple as their separate property for themselves, their heirs, executors, administrators, successors, and assigns, hereinafter referred to as the "Grantor" and the UNITED STATES OF AMERICA, hereinafter referred to as the "Government,"

WITNESSETH THAT:

WHEREAS, the Government is maintaining and operating a Missile Testing Base at Vandenberg Air Force Base, California, and has determined that it is necessary to implement range safety procedures at said Air Force Base in order to provide for safety to persons on the land adjoining, or adjacent to said base;

NOW THEREFORE, the parties hereto, for consideration hereinafter set forth, covenant and agree as follows:

a. That Grantor and the Occupant hereby grant to the Government the following rights:

(1) The right to require the Grantor, the Occupant, their families, employees, lessees and any other person or persons occupying or using said land by permission or knowledge of the Grantor, the Occupant, vacate said land for intermittent periods, which shall not exceed twelve (12) consecutive hours for each period, provided the Government shall give to said Grantor, the Occupant, and other authorized persons, no less than twenty four (24) hours prior notice of the necessity to vacate said land.

Wing Commander, 30 Space Wing GIP

(2) The right of the ~~Commanding General of the First Strategic Aerospace Division~~, Vandenberg Air Force Base, California, or his duly authorized representative, to notify the Grantor, the Occupant, and such other persons as the Grantor may designate, of the dates said land will be vacated, and the duration of each period that said land is to remain unoccupied by the Grantor, the Occupant, and their families, employees, lessees, and other person or persons occupying or using said land by permission or knowledge of the owners, except that their livestock may remain on the land during each vacation period.

(3) The right to enter upon and pass through said land to give notice of evacuation, and to assure that all human beings have vacated said land.

(4) The right to require the Grantor, the Occupant, their heirs, executors, administrators, successors and assigns to give the Government three (3) months notice in writing, of any intention to enter into any contract or agreement for either residential, commercial or industrial subdivision of all or any part of said land, to be addressed to the District Engineer, U.S. Army Engineer District, Los Angeles, ATTN: CESPL-RE-C, P.O. Box 532711, Los Angeles, California 90053-2325.

b. That the term of this agreement shall be **1 APRIL 1998** to **31 MARCH 1999**, provided that unless and until the Government shall give notice of termination in accordance with provision (d) hereof, this agreement shall remain in force thereafter from year to year for the payment of rentals; and provided further this agreement shall in no event extend beyond **31 MARCH 2003**.

c. That the monetary consideration to be paid by the Government to the Grantor shall be at the following rate:

(1) To the Grantor the sum of NINE HUNDRED AND NO/100 DOLLARS ($900.00) per annum or pro rata amount for fractional period of use thereof.

Payment shall be made at the end of each fiscal year by the DFAS-SB/ARF, 1111 EAST MILL STREET, SAN BERNADINO, CALIFORNIA 92408-1621.

d. That the Government may terminate this agreement at any time by giving ninety (90) days notice in writing, to the Grantor. No payment shall accrue after the effective date of termination.

e. That any notice under the terms of this agreement shall be in writing, signed by the duly authorized representative of the party giving such notice, and if by the Government, it shall be addressed to the State, and if notice is given by the State, or the Occupant, it shall be addressed to the Commander, U.S. Army Engineer District, Los Angeles, ATTN: CESPL-RE-C, P.O. Box 532711, Los Angeles, California 90053-2325.

f. That nothing contained herein shall be construed to be a waiver or release of the Government from any liability for loss or damages to buildings, improvements, growing crops, livestock, or other personal property located on the land, which loss or damage may be caused by activities or negligence of the Government, its employees, or its agent. Written notice of any such loss or damage to any such buildings, improvements, growing crops, livestock or other personal property shall be given to the Government within fifteen (15) days after knowledge of such loss, and shall be directed to the Government as stated in provision (e) hereof.

g. That the land covered by the agreement is identified as Tract No. 422, Vandenberg Air Force Base, California, and is more particularly described as follows:

That certain parcel of land described as Lots 2 and 3 of Section 2, Township 9, Range 36 West, and Lots 1 and 2 of Section 35, Township 10 North, Range 36 West, San Bernardino Meridian, in the County of Santa Barbara, State of California, according to the official plat thereof.

h. That the Grantor hereby warrants that no person or selling agency has been employed or retained to solicit or secure this agreement, upon an agreement or understanding for a commission, percentage, brokerage,or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Grantor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this agreement without liability, or in its discretion, to deduct from the consideration the full amount of such commission, percentage, brokerage, or contingent fee.

i. That no member of, or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

j. This agreement superceeds all previous agreements which hereby become null and void.

IN WITNESS WHEREOF, the parties hereto have hereunto subscribed their names as of the date first above written.

STATE OF CALIFORNIA

STEVE ~~TRENOR~~ TREANOR
District Superintendent,
Channel Coast District,
Department of Parks and Recreation
1933 Cliff Drive, Suite 27
Santa Barbara, California 93109

THE UNITED STATES OF AMERICA

BY: ______________________, Col, USAF
DEPARTMENT OF THE AIR FORCE

GILBERT T. PERRY JR., Colonel, USAF
Deputy Civil Engineer

(To be filled out by someone other than the person signing the agreement)

CERTIFICATE OF AUTHORITY

I, (Enter Name) RICHARD ROZZELLE certify that I
(Name of person certifying)
am the (Enter Title) DISTRICT SUPERINTENDENT of
(Title of person certifying)
STATE OF CALIFORNIA, named as GRANTOR IN AGREEMENT NO. DACA-09-6-98-0009 and that RICHARD ROZZELLE who signed on behalf of the
(Name of person signing license)
GRANTOR, was known to me and was DIST. SUPERINTENDENT ~~of~~ said ORGANIZATION
(Title of person signing license)
That said AGREEMENT was duly signed for and in behalf of said STATE OF CALIFORNIA by authority of its Governing body, and within the scope of its corporate powers.

DATE: 3/26/09 SIGNATURE: [signature]
(Person certifying)

WITNESS;

(To be filled out by someone other than the person signing the agreement)

Negotiated Agreement Under Authority of
Section 2304 (a) (10) of Title 10 U.S.C.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

Agreement No. DACA09-3-98-0009
Vandenberg Air Force Base, CA.
Tract No. 423

THIS AGREEMENT, made and entered into as of 1 April by and between the STATE OF CALIFORNIA, whose interest in the real property, hereinafter described as that of owners in fee simple as their separate property for themselves, their heirs, executors, administrators, successors, and assigns, hereinafter referred to as the "Grantor" and the UNITED STATES OF AMERICA, hereinafter referred to as the "Government,"

WITNESSETH THAT:

WHEREAS, the Government is maintaining and operating a Missile Testing Base at Vandenberg Air Force Base, California, and has determined that it is necessary to implement range safety procedures at said Air Force Base in order to provide for safety to persons on the land adjoining, or adjacent to said base;

NOW THEREFORE, the parties hereto, for consideration hereinafter set forth, covenant and agree as follows:

a. That Grantor and the Occupant hereby grant to the Government the following rights:

(1) The right to require the Grantor, the Occupant, their families, employees, lessees and any other person or persons occupying or using said land by permission or knowledge of the Grantor, the Occupant, vacate said land for intermittent periods, which shall not exceed twelve (12) consecutive hours for each period, provided the Government shall give to said Grantor, the Occupant, and other authorized persons, no less than twenty four (24) hours prior notice of the necessity to vacate said land.

(2) The right of the Wing Commander, 30 Space Wing GT ~~Commanding General of the First Strategic Aerospace Division~~, Vandenberg Air Force Base, California, or his duly authorized representative, to notify the Grantor, the Occupant, and such other persons as the Grantor may designate, of the dates said land will be vacated, and the duration of each period that said land is to remain unoccupied by the Grantor, the Occupant, and their families, employees, lessees, and other person or persons occupying or using said land by permission or knowledge of the owners, except that their livestock may remain on the land during each vacation period.

(3) The right to enter upon and pass through said land to give notice of evacuation, and to assure that all human beings have vacated said land.

(4) The right to require the Grantor, the Occupant, their heirs, executors, administrators, successors and assigns to give the Government three (3) months notice in writing, of any intention to enter into any contract or agreement for either residential, commercial or industrial subdivision of all or any part of said land, to be addresed to the District Engineer, U.S. Army Engineer District, Los Angeles, ATTN: CESPL-RE-C, P.O. Box 532711, Los Angeles, California 90053-2325.

b. That the term of this agreement shall be **1 APRIL 1998** to **31 MARCH 1999**, provided that unless and until the Government shall give notice of termination in accordance with provision (d) hereof, this agreement shall remain in force thereafter from year to year for the payment of rentals; and provided further this agreement shall in no event extend beyond **31 MARCH 2003**.

c. That the monetary consideration to be paid by the Government to the Grantor shall be at the following rate:

(1) To the Grantor the sum of SIX HUNDRED AND NO/100 DOLLARS ($600.00) per annum or pro rata amount for fractional period of use thereof.

Payment shall be made at the end of each fiscal year by the the DFAS-SB/ARF, 1111 EAST MILL STREET, SAN BERNADINO, CALIFORNIA 92408-1621.

d. That the Government may terminate this agreement at any time by giving ninety (90) days notice in writing, to the Grantor. No payment shall accrue after the effective date of termination.

e. That any notice under the terms of this agreement shall be in writing, signed by the duly authorized representative of the party giving such notice, and if by the Government, it shall be addressed to the State, and if given by the State or the Occupant, it shall be addressed to the Commander, U.S. Army Engineer District, Los Angeles, ATTN: CESPL-RE-C, P.O. Box 532711, Los Angeles, California 90053-2325.

f. That nothing contained herein shall be construed to be a waiver or release of the Government from any liability for loss or damages to buildings, improvements, growing crops, livestock, or other personal property located on the land, which loss or damage may be caused by activities or negligence of the Government, its employees, or its agent. Written notice of any such loss or damage to any such buildings, improvements, growing crops, livestock or other personal property shall be given to the Government within fifteen (15) days after knowledge of such loss, and shall be directed to the Government as stated in provision (e) hereof.

g. That the land covered by the agreement is identified as Tract No. 423, Vandenberg Air Force Base, California, and is more particularly described as follows:

That certain parcel of land described as Lots 4, 5 and 6 of Section 3A, Township 10, Range 36 West San Bernadino Meridian, in the County of Santa Barbara, State of California, according to the official plat thereof.

h. That the Grantor hereby warrants that no person or selling agency has been employed or retained to solicit or secure this agreement, upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Grantor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this agreement without liability, or in its discretion, to deduct from the consideration the full amount of such commission, percentage, brokerage, or contingent fee.

i That no member of, or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

j. This agreement superceeds all previous agreements which hereby become null and void.

IN WITNESS WHEREOF, the parties hereto have hereunto subscribed their names as of the date first above written.

STATE OF CALIFORNIA

[signature]

STEVE ~~TRENOR~~ TREADOR
District Superintendent,
Channel Coast District,
Department of Parks and Recreation
1933 Cliff Drive, Suite 27
Santa Barbara, California 93109

THE UNITED STATES OF AMERICA

[signature], COL, USAF
DEPARTMENT OF THE AIR FORCE

GILBERT T. PERRY JR., Colonel, USAF
Deputy Civil Engineer

EVACUATION AGREEMENT NO. SPCVAN-1-93-0006

SUPPLEMENTAL AGREEMENT NO. 3

THIS SUPPLEMENTAL AGREEMENT entered into this 13th day of JAN, 2009, by and between the County of Santa Barbara, State of California ("County") and Secretary of the Air Force ("Government" or "Air Force"). The Government and the County may be referred to jointly as the "Parties," and each separately may be referred to as a "Party."

RECITALS:

A. On 1 December 1992, the Parties entered into an evacuation agreement for the evacuation of County properties Jalama Beach Park, Ocean Beach Park and Point Sal Road in case of certain government operations for purposes of military necessity, security and public safety.

B. On 05 November 1997, the Parties agreed to extend the Agreement for one additional year through 01 December 1998 and to automatically renew the Agreement for a total additional term of five years from December 1, 1997 and added Surf Station Parking Lot to the Agreement.

C. On 13 May 2003, the Parties agreed to extend the agreement for five years though 30 November 2007.

AGREEMENT:

1. The Agreement is hereby modified in the following particulars, but no others:

   a. Paragraph III. 13, page 5 of the Agreement is rescinded and replaced with paragraph 1.b, below, of this Supplement No. 3.

   b. The term of the Agreement was extended for one additional year through 30 November 2008 and will automatically renew annually on 1 December 2008 and on each subsequent 1 December of the following three years for a total additional term of five years from 1 December 2007, unless otherwise amended or terminated pursuant to paragraph 1.b. of this Supplement Agreement No. 3. The Agreement may be modified, amended, revised, or discharged by either Party upon providing advanced written notice to the other Party. Such advanced notice must be provided at least 120 days in advance of the requested modification, amendment, revision, or discharge. Any notice under the terms of this Agreement shall be in writing, signed by a duly authorized representative of the party giving such notice. If notice is given to the County, it shall be addressed to the

County of Santa Barbara, General Services Department, Office of Real Estate Services, 1105 Santa Barbara Street, Santa Barbara, California 93101. If notice is given to the Government, it shall be addressed to the Installation Commander as follows: "30 SW/CC, Vandenberg AFB, California 93437" and a duplicate shall also be mailed and addressed to "30 CES/CECBR, 1172 Iceland Avenue, Bldg 11432, Vandenberg AFB, California, 93437.

2. All other terms and conditions of the Agreement shall be and remain the same, unless otherwise made void by operation of law.

3. This Supplemental Agreement shall be effective immediately.

Project: Evacuation Agreement
SPCVAN-1-93-0006
Vandenberg Air Force Base, CA
Tract No.: Jalama, Ocean, Surf, Pt Sal Rd
Folio: 003375

IN WITNESS WHEREOF, Government and County have executed this Supplemental Agreement No. 3 to Evacuation Agreement SPCVAN-1-93-0006, by the respective authorized officers as set forth below to be effective as of the date executed by Government.

"COUNTY"
COUNTY OF SANTA BARBARA

By: ____________________
Salud Carbajal, Chair,
Board of Supervisors
County of Santa Barbara

Date: 11/18/08

ATTEST
MICHAEL F. BROWN
CLERK OF THE BOARD

By: ____________________
Deputy

APPROVED AS TO FORM:
DENNIS MARSHALL
COUNTY COUNSEL

By: ____________________

APPROVED AS TO FORM
ROBERT W.GEIS, CPA
AUDITOR-CONTROLLER

By: ____________________

APPROVED:

____
Ronn Carlentine,
Real Property Manager

APPROVED:

____
Ray Aromatorio, ARM, AIC
Risk Program Administrator

APPROVED:

____
Daniel Hernandez
Parks Director

APPROVED:

____
Scott McGolpin
Director of Public Works

IN WITNESS WHEREOF, I have set my hand by authority of the Secretary of the Air Force as of the day and year first written above.

DEPARTMENT OF THE AIR FORCE

By: ______________________

DAVID J. BUCK
Colonel, USAF
Commander, 30th Space Wing

No. SPCVAN-1-93-0006

EVACUATION AGREEMENT

I. THE PURPOSE

This AGREEMENT by and between the UNITED STATES OF AMERICA (hereinafter "GOVERNMENT") and the COUNTY OF SANTA BARBARA, STATE OF CALIFORNIA (hereinafter "COUNTY") is made and entered as of 15th Dec 1992.

The GOVERNMENT is maintaining and operating a military installation and conducting government operations including, but not limited to missile testing, at Vandenberg Air Force Base, California. Because of these activities and government interests, GOVERNMENT has determined that military necessity, security, and public safety dictate that the GOVERNMENT must exercise certain controls over the real property herein described. This control shall include the right to evacuate the property and prohibit the use or occupation of said property by COUNTY employees, agents and business invitees, and members of the general public as permitted hereunder.

II. COUNTY INTEREST AFFECTED

The COUNTY'S interest in Jalama Beach Park is that of fee owner. Jalama Beach Park is in the vicinity of Vandenberg Air Force Base, California. The real property identified as Jalama Beach Park is legally described on Exhibit "A" and the area concerned is outlined in red on Exhibit "B," both of which are attached hereto and incorporated herein by reference.

The COUNTY ' S interest in Ocean Beach County Park is that of fee owner. Ocean Beach County Park is in the vicinity of Vandenberg Air Force Base, California. The real property identified as Ocean Beach County Park is known as Assessor's Parcel Number 95-041-01, designated tract 601. Said parcel of real property is legally described on Exhibit "C" and the area concerned is outlined in red on Exhibit "D," both of which are attached hereto and incorporated herein by reference.

The COUNTY ' S interest in Point Sal Road is that COUNTY has a certain road and road rights of way known as the Point Sal Road. Portions of Point Sal Road lie within Vandenberg Air Force Base, California and the remainder is in the vicinity of Vandenberg Air Force Base, California. The real property identified as the Point Sal is identified as Assessor's Parcel Number 095-020-02, and the Point Sal Road area concerned is more fully described on Exhibit "E" attached hereto and incorporated herein by reference.

III. RIGHTS AND RESPONSIBILITIES

IN CONSIDERATION OF THE MUTUAL PROMISES CONTAINED HEREIN, THE PARTIES HEREIN MUTUALLY AGREE AS FOLLOWS:

1. The GOVERNMENT has the following rights and responsibilities :

a. The right to evacuate and close Jalama Beach park and Ocean Beach County Park during government operations for intermittent periods as required by said operations. The right to evacuate will apply to all occupants and users. The term "all" specifically includes, but is not limited to all COUNTY employees, their families and guests, concessionaires and members of the public. The Term "government operations" as used herein shall be defined as those non-commercial launch-related operations of government which tend to endanger the health and safety of persons present in the area of Jalama Beach Park or Point Sal Road or Ocean Beach Park.

During any period of closure which extends between the hours of 9:00 P.M. and 7:00 A.M., Government shall, and at its own expense, supply temporary substitute quarters either on or off base at the Government's option for resident Park employees who are displaced from their homes. At the present time there are four park rangers and their families who will be affected by this provision. County shall notify Government of the number of persons who will be displaced by government operations within 24 hours following advance written notification of closure.

b. The right to evacuate and close Jalama Road, with the exception of allowing access to the owners (or the agents of the owners) of adjacent privately owned land requiring access to their property for residential, ranching or agricultural purposes via Jalama Road, during intermittent periods as required.

c. The right to evacuate and close those portions of Point Sal Road lying within the military reservation either intermittently or completely for short periods of time (not to exceed 48 consecutive hours), because of the government operations at military facilities near said road right-of-way. During operations the GOVERNMENT shall have exclusive use and control of that portion of Point Sal Road and road rights-of-way between a point where the said road intersects the easterly boundary of the military reservation of the Vandenberg Air Force Base (1.75 miles west of Lompoc-Casmalia Road) and the easterly edge of the said Point Sal Road at its intersection with the Point Sal Beach State Park Road.

d. The right to regulate and control traffic, including the right to close the road entirely to use by the public or use by any persons other than those authorized by the GOVERNMENT, for short periods of time (not to exceed 48 consecutive hours) prior to and during missile launches on that portion of Point Sal Road between a point where the said road intersects the Point Sal Beach State Park Road and the northerly boundary of the military reservation of the Vandenberg Air Force Base.

e. The right of the Installation Commander of Vandenberg Air Force Base, California or the Installation Commander's duly authorized representative to notify any occupants of the real property and such other persons as the occupants may designate, of the dates said land will be vacated and the duration of each period that said land is to remain unoccupied. This includes the right to enter upon or pass through said land to give notice of evacuation and to assure that all human beings have evacuated said land. Livestock may remain on the land during the evacuation period. The particular requirements of the advance notice shall be contained in supplements to this AGREEMENT. Said notice shall be given not less than seventy-two (72) hours in advance of any closure or evacuation undertaken pursuant to this agreement.

f. The right and responsibility to post and remove signs at the following locations for the purpose of giving notice of advance park and road closure dates. The particular requirements of the advance notice shall be contained in supplements to this agreement. The signs may be posted:

(1) At the entrance of Jalama Beach Park,

(2) At the junction of Jalama Road and California State Highway Number 1,

(3) At the entrance to Ocean Beach County Park,

(4) At the junction of Ocean Avenue (formerly "Highway 246") and Ocean Park Road.

g. The right to construct and operate temporary barricades across the following roads to control access to areas evacuated:

(1) On Jalama Road near the intersection of California State Highway Number 1 and said Jalama Road.

(2) On Ocean Avenue near the intersection of Ocean Park Road and Ocean Avenue.

h. The right to require the COUNTY or any successor in interest to give to the GOVERNMENT six (6) months notice, in writing, of any intention to enter into any contract or agreement for residential, commercial or industrial subdivision of all or any part of said land addressed herein that is presently owned by the COUNTY.

2. The COUNTY has the following rights and responsibilities:

a. To advise Government, in writing, to the Installation Commander or the Commander's duly authorized representative, of the name and address of the Director of County Parks and of any changes of the same during this agreement.

b. The right to authorize the attendance of a County Deputy Sheriff on site to assist in the evacuation of human beings from Jalama Beach Park, Ocean Beach County Park and the County road rights-of-way.

3. The GOVERNMENT will be solely responsible for the negligent and wrongful acts of GOVERNMENT'S agents or employees as such liability is established and specified under the Federal Tort Claims Act, Title 28, United States Code, as amended, and under other laws which may apply as determined by appropriate federal authority.

4. The COUNTY will be solely responsible for the negligent and wrongful acts of COUNTY'S agents or employees as such liability is established and specified under the law of the State of California or other applicable laws.

5. Nothing contained herein shall be construed to be a waiver or release of the GOVERNMENT from any liability for loss or damage to buildings, improvements, growing crops, livestock, other personal property, or other public rights, located on the land, which loss or damage may be caused by the activities or negligence of the GOVERNMENT, its agents or its employees. Written notice of any such loss or damage to any such buildings, improvements, growing crops, livestock or other personal property shall be given to the GOVERNMENT within ninety (90) days after the party discovers or reasonably should have discovered the existence of the act that resulted in the claimed loss, and shall be directed to the GOVERNMENT as required of written notices herein.

6. No government official, nor any member of their families dependent upon the government official for support, shall receive any personal economic benefit, of any kind from this AGREEMENT. However, if this AGREEMENT happens to benefit a corporation so that in general, the shareholders of the corporation receive an economic benefit because of their status of being a shareholder, and if a government official is a shareholder and receives such benefit, the prohibition against personal economic benefit is not violated.

7. GOVERNMENT is not aware of any government official receiving a personal economic benefit, gift or gratuity (in the form of entertainment, gifts, gratuities or otherwise). However, if GOVERNMENT later discovers that such benefits were offered or given to any officer or employee of the GOVERNMENT with a view toward securing an agreement or securing favorable treatment from the GOVERNMENT, then the Secretary of the Air Force or his duly authorized representative shall make such findings as are in issue and may terminate this agreement. These findings and termination may be reviewed in any federal court of competent jurisdiction.

8. In the event this AGREEMENT is terminated as provided in paragraph 7 above, the GOVERNMENT shall be entitled to take all legal remedies against the COUNTY and such other persons as may be responsible for violations of the above prohibitions. These remedies expressly include appropriate penalties as well as any and all damages to which GOVERNMENT may be entitled by law.

9. The rights and remedies of the parties provided herein shall not be exclusive and are in addition to any other rights and remedies provided by law.

10. All terms and conditions of this AGREEMENT relating to expenditures of money by the GOVERNMENT are subject to and contingent upon the availability of and adequate appropriations of funds. This section is included in this AGREEMENT for the purpose of meeting the requirements of the Anti-Deficiency Act, 31 United States Code, Section 1341. All terms and conditions of this AGREEMENT relating to expenditures of money by the COUNTY are likewise subject to and contingent upon the availability of and adequate appropriations of funds.

11. This AGREEMENT does not create any additional cause of action which does not otherwise exist under the law. This AGREEMENT does not grant jurisdiction not already in existence under applicable law. This AGREEMENT does not constitute a waiver of federal supremacy or sovereign immunity as such principles of law exist and are applicable.

12. The GOVERNMENT shall permit the installation and maintenance by the County of water tanks and pipelines drawing water from GOVERNMENT lands in an amount sufficient to supply the water needs of the County Park located at Jalama Beach. The specific quantity and source of the water supply is fully set forth as a special purpose water and pipeline agreement in a separate Memorandum of Agreement. Nothing contained herein obligates the GOVERNMENT to provide an alternative water supply should the spring which is the existing source under the pipeline agreement become insufficient.

The following are currently approved public access areas on Vandenberg Air Force Base:

a. One & one-half miles north of Jalama Beach; beach access only.

b. Three & one-half miles south and one & one-half miles north of Ocean Park Beach; beach access only.

c. Beginning from the one & one-half mile mark north of Ocean Beach Park to the five mile mark (three & one-half miles total) is designated permit fishing only; access is granted by permit only through the Solvang Gate, Highway 246, with a specified route through the base.

The parties shall continue to negotiate in good faith to open additional areas of coastline for public use to include coordination with all other federal, and State and local agencies.

13. This agreement shall automatically renew annually on 1 December 1992 and 1 December of the following four years for a term of 5 years. This agreement may be terminated by GOVERNMENT by written notice to COUNTY of cessation of mission requirement. This agreement may be terminated by County by written notice to government 90 days in advance of 1 December of each year beginning in 1992. If such notice is given, this agreement will terminate on 1 December of that year. Any notice under the terms of this AGREEMENT shall be in writing, signed by a duly authorized representative of the party giving such notice. If notice is given to the COUNTY, it shall be addressed to the County of Santa Barbara, Public

Works Department, Real Property Division, 123 East Anapamu Street, Santa Barbara, California 93101. If notice is given to the GOVERNMENT, it shall be addressed to the Installation Commander as follows: "30th SPW/CC, Vandenberg AFB, California 93437-5000."

THE DULY AUTHORIZED GOVERNMENT REPRESENTATIVE SIGNED THIS AGREEMENT THIS 11th DAY OF December, 1992.

THE UNITED STATES OF AMERICA

BY Sebastian F Coglitore
SEBASTIAN F. COGLITORE, Brig Gen, USAF
Commander, 30th Space Wing
Vandenberg Air Force Base, California 93437-5000

THE DULY AUTHORIZED COUNTY REPRESENTATIVE SIGNED THIS AGREEMENT THIS 15th DAY OF December, 1992.

THE COUNTY OF SANTA BARBARA, STATE OF CALIFORNIA

BY W.B. Wallace

Chairman, Board of Supervisors

ATTEST: ZANDRA CHOLMONDELEY
CLERK OF THE BOARD

BY ____________________
Deputy Clerk

APPROVED AS TO FORM:
DAVID NAWI, COUNTY COUNSEL

BY ____________________

APPROVED AS TO FORM:
CHARLES A. MITCHELL, RISK MANAGER

BY ____________________

APPROVED AS TO FORM:
ROBERT GEIS, AUDITOR-CONTROLLER

BY ____________________

IT IS HEREBY ORDERED AND RESOLVED, that the Deeds from the following grantors, bearing the dates set forth herein, be and the same are hereby accepted for the uses and purposes therein mentioned, subject to the conditions therein contained:

GRANTOR	DATE OF DEED
Hubbard S. Russell	January 7, 1943
Adolf Kirschenmann and Bertha Kirschenmann	June 7, 1943
Chester Wylie	April 6, 1943
William J. Wylie	May 15, 1943
Chester K. Wylie	May 15, 1943
Martha H. Carlson	March 27, 1943

BE IT FURTHER ORDERED AND RESOLVED that the Clerk of this Board cause said Deeds to be recorded in the office of the Recorder of the County of Santa Barbara.

The foregoing Resolution was passed and adopted by the Board of Supervisors of the County of Santa Barbara, State of California, this 14th day of June, 1943, by the following vote, to wit:

Ayes: Clifford W. Bradbury, Paul E. Stewart,
J. Monroe Rutherford, Ronald M. Adam and
T. A. Twitchell.

Nays: None

Absent: None

J. MONROE RUTHERFORD
Chairman, Board of Supervisors

Attest: J. E. LEWIS
Clerk (SEAL)

State of California,)
) ss.
County of Santa Barbara,)

I, J. E. LEWIS, County Clerk and ex-officio Clerk of the Board of Supervisors in and for the County of Santa Barbara, do hereby certify that the foregoing is a true and correct copy of the original Resolution No. 4655, in the Matter of Acceptance of Deeds Conveying Rights of Way for Public Road Purposes in the Fifth Road District, and the endorsement's thereon, now remaining on file and of record in this office.

WITNESS my hand and the seal of said Board this 14th day of June A. D. 1943

(SEAL OF BOARD OF SUPERVISORS) J. E. LEWIS, Clerk,
By Bernell Warren, Deputy Clerk

RECORDED AT THE REQUEST OF County Clerk, Jun. 16, 1943, A. D. at 30 Min. past 8 o'clock A. M.
File No. 4623 YRIS COVARRUBIAS, County Recorder
Compared by:- [illegible] By [signature] Deputy Recorder

RICHFIELD OIL CORPORATION, ET AL.
TO
COUNTY OF SANTA BARBARA

DMA/md 4/12/43 ORIGINAL L & L 504
DEED

THIS INDENTURE, dated the 28th day of May, 1943, by and between RICHFIELD OIL CORPORATION, a corporation, party of the First Part, hereinafter referred to as "Richfield," and the COUNTY OF SANTA BARBARA, a body politic and corporate, created and existing under and by virtue of the laws of the State of California, party of the Second Part, hereinafter referred to as the "County,"

Jalama Beach Park Exhibit A & B

Exhibit A

Official Record 571

W I T N E S S E T H:

That Richfield, in consideration of the sum of One Dollar ($1.00) lawful money of the United States of America, to it in hand paid, the receipt of which is hereby acknowledged, does by these presents grant, bargain, sell, convey and confirm unto the County for all of the uses and purposes of a county park, subject to the conditions, exceptions and reservations herein expressed, all that certain piece or parcel of land situate in the County of Santa Barbara, State of California, more particularly described as follows:

Beginning at the NW corner of Tract No. 20 as same is shown on Map of Subdivision of Concepcion Ranch on Sheet No. 6 of 8 Sheets in Book 9, Page 6, of Maps and Surveys, Santa Barbara County Recorder's Office, said NW corner being at the mouth of Jalama Creek;

thence, along the northerly boundary of said Tract No. 20, N 88° 25' E 1207.3 feet to a point on the center line of the Southern Pacific Railroad at the Southern Pacific Engineer's Station 12855+00 as same station is described in the deed recorded in Book 63, Page 617 of Deeds in the County Recorder's Office of Santa Barbara County;

thence, southerly along said center line of said Southern Pacific Railroad to Southern Pacific Railroad Engineer's Station 12865+25.0 of Southern Pacific Railroad;

thence, N 80° 54' W 275.0 feet to a point;

thence, N 9° 06' E 75.0 feet to a point;

thence, N 80° 54' W 275.0 feet to a point;

thence, S 3° 30' E 450.0 feet to a point;

thence, S 21° 24' W 252.0 feet to a point on the westerly boundary of above mentioned Tract No. 20, said point being S 24° 49' E 1644.6 feet from the NW corner of said Tract No. 20;

thence, N 24° 49' W along the west boundary of said Tract No. 20, 1644.6 feet to the point of beginning;

EXCEPTING THEREFROM portions of those parcels of said Tract No. 20 deeded to the Southern Pacific Railroad lying within the boundaries herein described, said parcels being designated as Numbers 1 and 3 as recorded in Book of Deeds 63, Page 617, in the County Recorder's Office of the County of Santa Barbara.

EXCEPTING THEREFROM all of the minerals, oil, gas, petroleum, nap_tha and other hydrocarbon substances in, on or under the above described real property, or recoverable thereon or therefrom, together with the right to prospect for, extract, produce and remove said substances from said real property; provided, however, that said minerals, oil, gas, petroleum, nap_tha and other hydrocarbon substances may be prospected for, extracted, produced and removed only by means of wells, tunnels, or excavations drilled, bored or dug into, through or under said real property from the surface of land other than said real property, or by wells, tunnels or excavations drilled wholly upon land other than said real property so as to drain said substances from under said real property, in a manner which will not utilize the surface.

AND FURTHER EXCEPTING all springs of water on said land and the water therein and produced thereby, provided, however, that the County shall be entitled to use for public park purposes so much of the water from said springs as said springs may produce in excess of any amounts which Richfield may use or desire to use; the right to use and consume such additional water as may be developed by the County hereafter on the land hereby conveyed in excess of the needs of the County for public park purposes, but without duty or obligation on the County to develop any such additional water; the right to one-fourth (¼) of all the water and flow of the spring known as "Las Animas Spring," referred to in that certain

Exhibit A

EXHIBIT A

agreement dated July 6, 1896, between P. W. Murphy, et al., and The Commercial Land Company, et al., recorded in Book 68 at Page 269, Deed Records, Santa Barbara County, California.

AND FURTHER EXCEPTING the right to use the surface of said land for all lawful purposes, including grazing, and to receive and accept rent for such use, during the period ending

(1) when the County elects to occupy said land for public park purposes and erects the fence hereinafter referred to; or

(2) upon the termination of an existing lease executed by Richfield, as lessor, and F. Elizabeth Bixby, as lessee, whichever occurs last.

THIS GRANT IS MADE UPON THE EXPRESS CONDITION that said land shall be used for public park purposes only, commencing not later than one (1) year after the complete cessation of hostilities between the United States and all belligerents with whom the United States is now, or may in the course of the present conflict become, at war, and if not so used for any continuous period of three (3) months thereafter, said land shall revert to Richfield, its successors or assigns, who thereupon shall have the right to re-enter and take and hold possession of said land and exclude all persons therefrom.

AND UPON THE FURTHER EXPRESS CONDITION that the County shall immediately upon termination of said grazing lease and/or before occupying said land for park purposes, erect and thereafter maintain a stockproof fence equipped with no fewer than two (2) gates or cattle guards that permit the use and exercise of the easement expressed and reserved in paragraph numbered 2 of the reservations hereinafter set forth, around all the exterior boundaries of said land except those portions of said boundaries which are common to said land and the Pacific Ocean and except where the natural configuration of the surface is such that live stock cannot pass across the boundary between said land and adjacent land.

AND UPON THE FURTHER EXPRESS CONDITION that in the event the county, at any time after the acceptance of this grant, should prohibit, by zoning ordinance or otherwise, the exploration for, drilling for, or production of minerals, oil, gas, petroleum, naptha or other hydrocarbon substances upon all or any part of Tract No. 20, as same is shown on map of Subdivision of Concepcion Ranch on Sheet No. 6 of 6 Sheets in Book 9, Page 6 of Maps and Surveys, Santa Barbara County Recorder's Office, then said land shall revert to Richfield, its successors or assigns, who thereupon shall have the right to re-enter and take and hold possession of said land and exclude all persons therefrom.

Each of the conditions hereinabove stated as conditions upon which the above described land is granted is hereby declared to be a condition and not a personal covenant.

THERE IS RESERVED to Richfield, its successors and assigns, the following:

1. The right and right of way to construct, reconstruct, renew, repair, change the size of, maintain, operate, remove and abandon pipes and pipe lines for the transportation of petroleum, oil, gas and other hydrocarbons and the products and derivatives thereof, air and water in, over, along and across said land, together with telegraph, telephone and electric power lines necessary or convenient to the operations of Richfield or its successors or assigns.

2. An easement to ride, drive, herd, haul and otherwise transport or convey horses, cattle, sheep, swine and other live stock through, over, upon and across said land by all reasonable routes, which easement shall be appurtenant to and for the benefit of the following described land:

All of Tracts Numbers 4, 15 and 16; also portions of Tracts Numbers 17, 19 and 20 as shown upon the map entitled "Map of The Subdivision of Concepcion Ranch, in 6 sheets, being a portion of the Rancho El Cojo, owned by Del Norte Land Co. in the County of Santa Barbara,

Exhibit A

Official Record 571

State of California, surveyed by Frank F. Flournoy, County Surveyor," and recorded December 7, 1914, in Book 9, at Pages 1 to 8 inclusive, of Maps and Surveys, in the office of the County Recorder of said County; said portions of Tracts Numbers 17 and 19 being those portions thereof lying Southerly and Westerly of the following described line:

Beginning at the most Northerly corner of said Tract No. 16; thence Northwesterly in a direct line to a point on the Northwesterly line of said Tract No. 17, distant thereon 1640 feet Southwesterly from the most Northerly corner thereof; thence Northwesterly in a direct line to a point on the Northerly line of said Tract No. 19, distant thereon 1550 feet Easterly from the most Northerly corner of said Tract No. 19, which corner is also the most Easterly corner of said Tract No. 20; and further, said portion of Tract No. 20, being all of said Tract 20 excepting therefrom that portion thereof being herein described as being conveyed to Santa Barbara County for park purposes.

EXCEPTING from all of said Tracts above mentioned, any portions thereof conveyed to Southern Pacific Railroad Company by deed dated July 19, 1898, and recorded in Book 63 at Page 617 of Deeds; and by deed dated June 30, 1910, and recorded in Book 128 at Page 126 of Deeds; and by deed dated February 6, 1918, and recorded in Book 167 at Page 133 of Deeds, all records of said Santa Barbara County.

3. The right to protect the springs hereinbefore excepted from this grant and to keep and have the same protected by all reasonable means from contamination or pollution; and the right to install, construct, maintain and remove pipe lines, pumps, tanks and other facilities for producing, storing and transporting water and to connect said facilities to and to take and consume water from all pipes and tanks which may be installed, operated or maintained by or for the County to the extent that the same may be necessary to the full exercise by Richfield, its successors or assigns, of the rights herein reserved.

4. The right of ingress and egress to, from, upon and across said land by all reasonable routes.

SUBJECT TO:

1. Any unpaid taxes, assessments, charges or liens due or delinquent upon the date hereof.

2. All valid, existing leases, conditions, restrictions, reservations, rights of way and easements.

IN WITNESS WHEREOF, Richfield has caused this indenture to be executed by its officers thereunto duly authorized, and its corporate seal to be affixed.

(CORPORATE SEAL OF RICHFIELD)
(OIL CORPORATION)

RICHFIELD OIL CORPORATION

By Frank A. Morgan
Frank A. Morgan Vice President

By Cleve B. Bonner
Cleve B. Bonner Secretary

APPROVED FOR EXECUTION
TERMS C. E. R. R.D.M.
FORM G.G.
DESCRIPTION C. J. F.

STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) SS.

On this 4th day of June, 1943, before me CHAS. A. ROOT a Notary Public in and for the said County and State, personally appeared FRANK A. MORGAN, known to me to be the Vice President, and CLEVE B. BONNER, known to me to be the Secretary of RICHFIELD OIL CORPORATION, the corporation that executed the within instrument, known to me to be the persons who executed the within instrument on behalf of the corporation herein named, and acknowledged

EXHIBIT A

to me that such corporation executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

CHAS. A. ROOT
NOTARY PUBLIC in and for the County of Los Angeles, State of California.
My Commission Expires Mar. 29, 1944.

(NOTARIAL SEAL)

C O N S E N T

June 2, 1943

For and in consideration of the sum of One Dollar ($1.00) to her in hand paid, the receipt whereof is hereby acknowledged, F. ELIZABETH BIXBY JANEWAY, formerly F. Elizabeth Bixby, holding a grazing lease covering the premises described in the annexed grant, does hereby approve of, join in and consent to said grant.

F. ELIZABETH BIXBY JANEWAY
F. Elizabeth Bixby Janeway

Executed in the presence of:

Arden T. Jensen
Subscribing Witness

STATE OF CALIFORNIA)
) ss
COUNTY OF Santa Barbara)

On this 2nd day of June, 1943, before me, Arden T. Jensen, a Notary Public in and for the said County and State, residing therein, duly commissioned and sworn, personally appeared F. ELIZABETH BIXBY JANEWAY, known to me to be the person whose name is subscribed to the within instrument, and acknowledged to me that she executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal in the County and State aforesaid the day and year in this certificate first above written.

(NOTARIAL SEAL)
My Commission Expires 10/21/46.

ARDEN T. JENSEN
Notary Public in and for said County and State.

RESOLUTION OF THE BOARD OF SUPERVISORS OF THE
COUNTY OF SANTA BARBARA, STATE OF CALIFORNIA

RESOLUTION NO. 4631

IN THE MATTER OF ACCEPTANCE OF DEED FROM RICHFIELD OIL CORPORATION TO
THE COUNTY OF SANTA BARBARA

WHEREAS, on May 26, 1943, the Richfield Oil Corporation executed a deed in favor of the County of Santa Barbara, which deed was acknowledged on the 4th day of June, 1943, which deed described the following property:

Beginning at the NW corner of Tract No. 20 as same is shown on Map of Subdivision of Concepcion Ranch on Sheet No. 6 of 8 Sheets in Book 9, Page 6, of Maps and Surveys, Santa Barbara County Recorder's Office, said NW corner being at the mouth of Jalama Creek;

thence, along the northerly boundary of said Tract No. 20, N 88° 25' E 1207.3 feet to a point on the center line of the Southern Pacific Railroad at the Southern Pacific Engineer's Station 12855+00 as same station is described in the deed recorded in Book 63, Page 617 of Deeds in the County Recorder's Office of Santa Barbara County;

thence, southerly along said center line of said Southern Pacific Railroad to Southern Pacific Railroad Engineer's Station 12865+25.0 of Southern Pacific Railroad;

Official Record 571

thence, N 80° 54' W 275.0 feet to a point;

thence, N 9° 06' E 75.0 feet to a point;

thence, N 80° 54' W 275.0 feet to a point;

thence, S 3° 30' E 450.0 feet to a point;

thence, S 21° 24' W 252.0 feet to a point on the westerly boundary of above mentioned Tract No. 20, said point being S 24° 49' E 1644.6 feet from the NW corner of said Tract No. 20;

thence, N 24° 49' W along the west boundary of said Tract No. 20, 1644.6 feet to the point of beginning;

EXCEPTING THEREFROM portions of those parcels of said Tract No. 20 deeded to the Southern Pacific Railroad lying within the boundaries herein described, said parcels being designated as Numbers 1 and 3 as recorded in Book of Deeds 63, Page 617, in the County Recorder's Office of the County of Santa Barbara.

WHEREAS, it appears to be for the best interests of the County of Santa Barbara that said deed be accepted, and

WHEREAS, it appears that it is legal and proper for the Board of Supervisors of the County of Santa Barbara to accept such deed,

NOW, THEREFORE, BE IT RESOLVED that the aforesaid deed be and the same is hereby accepted by the County of Santa Barbara; and

BE IT FURTHER RESOLVED that J. E. Lewis, the clerk of the Board of Supervisors of the County of Santa Barbara, be and he is hereby authorized to record said deed.

Passed and adopted by the Board of Supervisors of the County of Santa Barbara, State of California, this 14th day of June, 1943, by the following vote:

Ayes: Clifford W. Bradbury, Paul E. Stewart, J. Monroe Rutherford, Ronald M. Adam and T. A. Twitchell.

Nays: None

Absent: None

J. MONROE RUTHERFORD
Chairman, Board of Supervisors

Attest:

J. E. LEWIS (SEAL)
Clerk.

State of California, }
County of Santa Barbara, } ss.

I, J. E. LEWIS, County Clerk and ex-officio Clerk of the Board of Supervisors in and for the County of Santa Barbara, do hereby certify that the foregoing is a true and correct copy of the original Resolution No. 4631, in the Matter of Acceptance of Deed from Richfield Oil Corporation to the County of Santa Barbara, and the endorsements thereon, now remaining on file and of record in this office.

WITNESS my hand and the seal of said Board this 14th day of June A. D. 1943

(SEAL OF BOARD OF SUPERVISORS) J. E. LEWIS, Clerk,
By Bernell Warren, Deputy Clerk

RECORDED AT REQUEST OF County Clerk, Jun. 16, 1943, at 30 Min. past 8 o'clock A. M.

File No. 4629 E. J. Hor. — TRIS COVARRUBIAS, County Recorder

Compared by: E. COVARRUBIAS — By [signature] Deputy Recorder

Exhibit A

EXHIBIT B

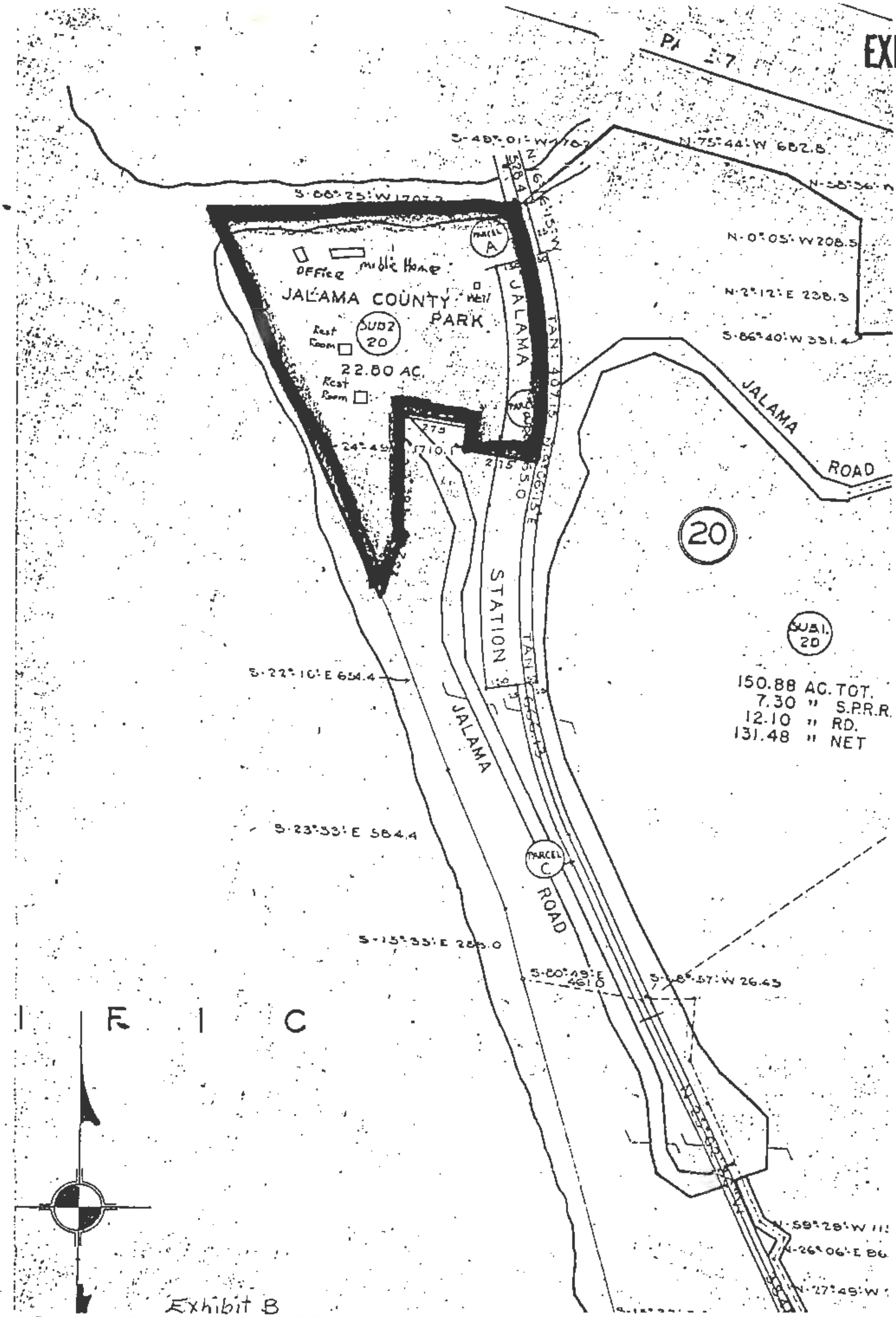


Exhibit B

Jalama Beach Park

EXHIBIT C

DEEDS
142

of the Ranchos Lompoc and Mission Viejo.

Together with all and singular the tenements, hereditaments and appurtenances thereunto belonging or in anywise appertaining, and the reversion and reversions, remainder and remainders, rents, issues and profits thereof.

To have and to hold all and singular the said premises, together with the appurtenances, unto the said party of the second part, and to its successors and assigns forever.

IN WITNESS WHEREOF the said parties of the first part have hereunto set their hands and seals, the day and year first above written.

J.C. Maretti

Anita Maretti

Joseph C. Maretti

State of California }
County of Santa Barbara } ss

On this 30th day of December, in the year nineteen hundred and thirteen, A.D., before me Stephen V.Campodonico, a Notary Public in and for the said county of Santa Barbara, state of California, residing therein, duly commissioned and sworn, personally appeared J.C.Maretti and Anita Maretti, personally known to me to be the persons whose names are subscribed to the within instrument, and acknowledged to me that they executed the same.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal, the day and year in this certificate first above written.

Stephen V.Campodonico, Notary Public in and for Santa Barbara county, state of California.

(Notarial Seal)

My commission expires Oct. 9th, 1916.

State of California }
County of Santa Barbara } ss

On this 7th day of January, in the year one thousand nine hundred and fourteen A.D., before me Fred E. Schauer, Notary Public in and for said county of Santa Barbara, state of California, residing therein, duly commissioned and sworn, personally appeared Joseph C. Maretti, personally known to me to be the person whose name is subscribed to the within instrument, and acknowledged to me that he executed the same.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal, the day and year in this certificate first above written.

Fred E. Schauer, Notary Public in and for Santa Barbara county, state of California

(Notarial Seal)

RECORDED AT REQUEST of County Auditor at 30 min. past 9 o'clock A.M. Jan 7, 1914.

Mark Bradley
County Recorder

Exhibit 1

EXHIBIT C

Witnesseth:- That the said parties of the first part, for and in consideration of the sum of seven thousand dollars, lawful money of the United States of America, to them in hand paid by the said party of the second part, the receipt whereof is hereby acknowledged, have granted, bargained and sold, conveyed and confirmed and by these presents do grant, bargain and sell, convey and confirm unto the said party of the second part, and to its successors and assigns forever, all that certain lot, piece or parcel of land situate, lying and being in the county of Santa Barbara, state of California, and bounded and particularly described as follows, to wit:-

Commencing at a point in the center of the Southern Pacific Railroad bridge and in the center of the Santa Ynez River where said river empties into the Pacific Ocean, from which the southerly end of bridge in center of tract (steel structure) bears S. 26° 49' W. 274.2 feet; said point being Engineer's Station L 11876+93.7 of said Southern Pacific Railroad; thence 1st at right angles with the center line of said railroad N. 63° 11' W. 100 feet; thence 2nd, S. 26° 49' W. parallel with said center line of Railroad, 1000 feet; thence 4th at right angles, S. 63° 11' E., 100 feet to center of said Railroad; thence 5th, N. 26° 49' E., along the center line of said Railroad 302.2 feet; thence 6th, S. 23° 25' W. leaving the main line of said Southern Pacific Railroad and along the center line of the branch road to Lompoc, 80.5 feet to center of tract and northerly side of steel switch board; thence 7th, on an angle to the left 2° 59', 220 feet to a point in the center of track; thence 8th, 2° 39' to the left, 100 feet to the center of track; thence 9th, 9° 09' to the left, 100 feet to the center of track;; thence 10th, 9° 52' to the left, 100 feet to the center of track; thence 11th 9° 41' to the left, 100 feet to the center of track; thence 12th, 10° 12' to the left, 100 feet to the center of track; thence 13th, 10° 15' to the left, 100 feet to the center of track; thence 14th, 9° 25' to the left, 100 feet to the center of track; thence 15th, 11° 04' to the left, 100 feet to the center of track; thence 16th, 9° 11' to the left, 100 feet to the center of track; thence 17th, 10° 06' to the left, 100 feet to the center of track; thence 18th 6° 24' to the left, 100 feet to the center of track; thence 19th, 2° 03' to the left, 100 feet thence 20th, 1° 11' to the left along the tangent to the "Y" curves of said branch road, 1131 feet; thence 21st at right angles S. 9° 15' W., 50 feet to the southerly side of said railroad; thence 22nd, at right angles along the southerly side of said Railroad track, S. 80° 45' E., 80 feet to a point from which a 2" pipe with brass cap bears S. 9° 15' W., 2 feet; thence 23rd at right angles N. 9° 15' E., 150 feet to a 2" pipe with brass cap; thence 24th, at right angles, N. 80° 45' W. parallel with the northerly line of said branch railroad to Lompoc and 50 feet therefrom 675.0 feet to another 2" pipe with brass cap; thence 25th, at right angles N. 9° 15' E., at 1063.6 feet passing through a 2" pipe with brass cap about 20 feet southerly from the southerly side of Santa Ynez River, at 1463.0 feet to center of said river; thence 26th, N. 78° 11' W., 969.3 feet to the point of commencement, which leaving out the Southern Pacific right of way, contains 40 acres, as more fully shown on map entitled "Map of Survey made by F.F.Flournoy of Lompoc Ocean Park near Surf, Santa Barbara Co., Cal., containing 40 acres, owned by the County of Santa Barbara, June, 1913. Scale one inch-100 feet," which map was filed in the office of the County Recorder of said County of Santa Barbara on the 13th day of June, 1913, and pasted in book 7 of maps and surveys at page 26, Santa Barbara County Records, said land being a part of Farm Lot No. 96 of the Subdivisions

Exhibit C & D Ocean Beach Park

Exhibit 1

EXHIBIT D

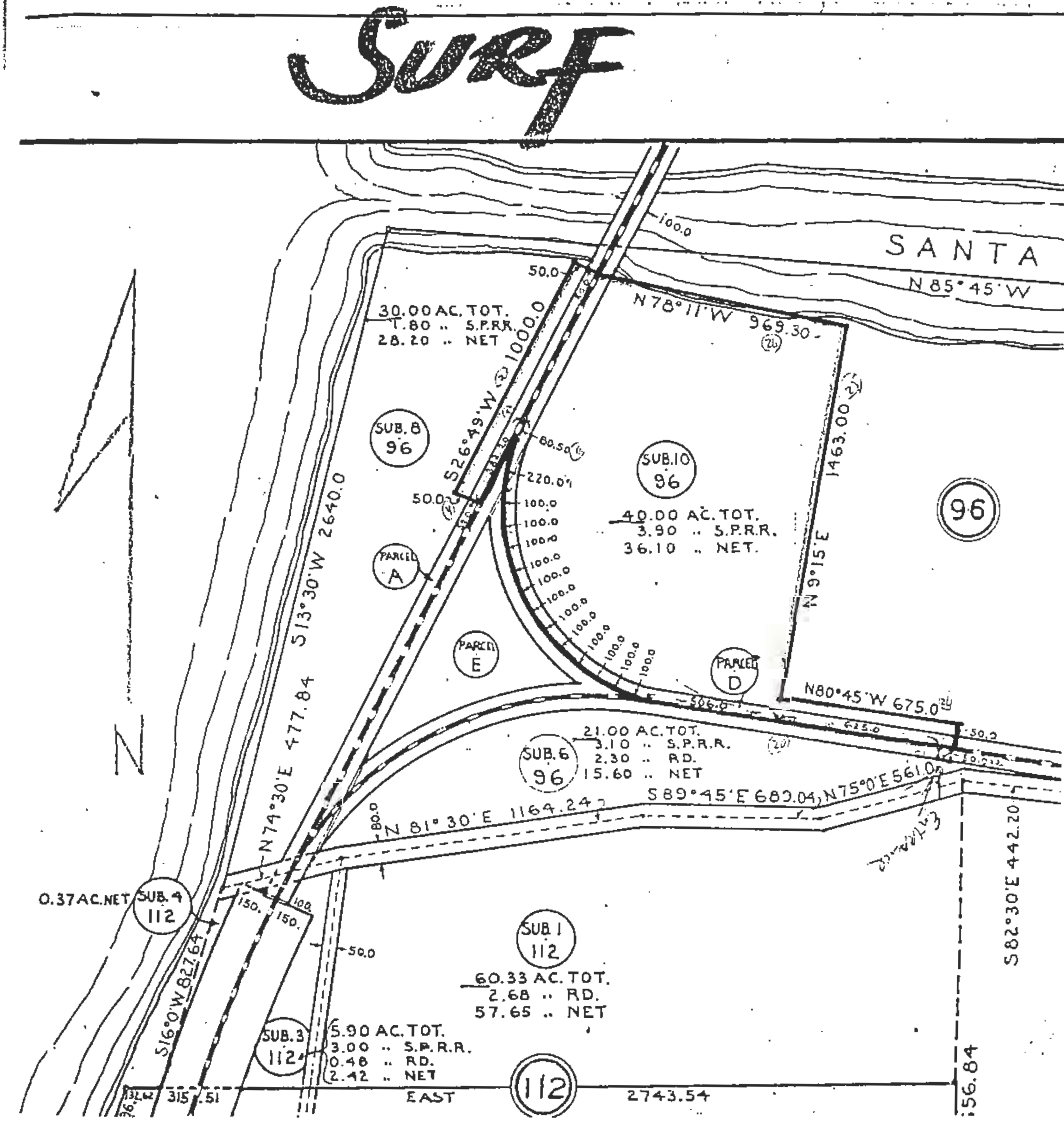
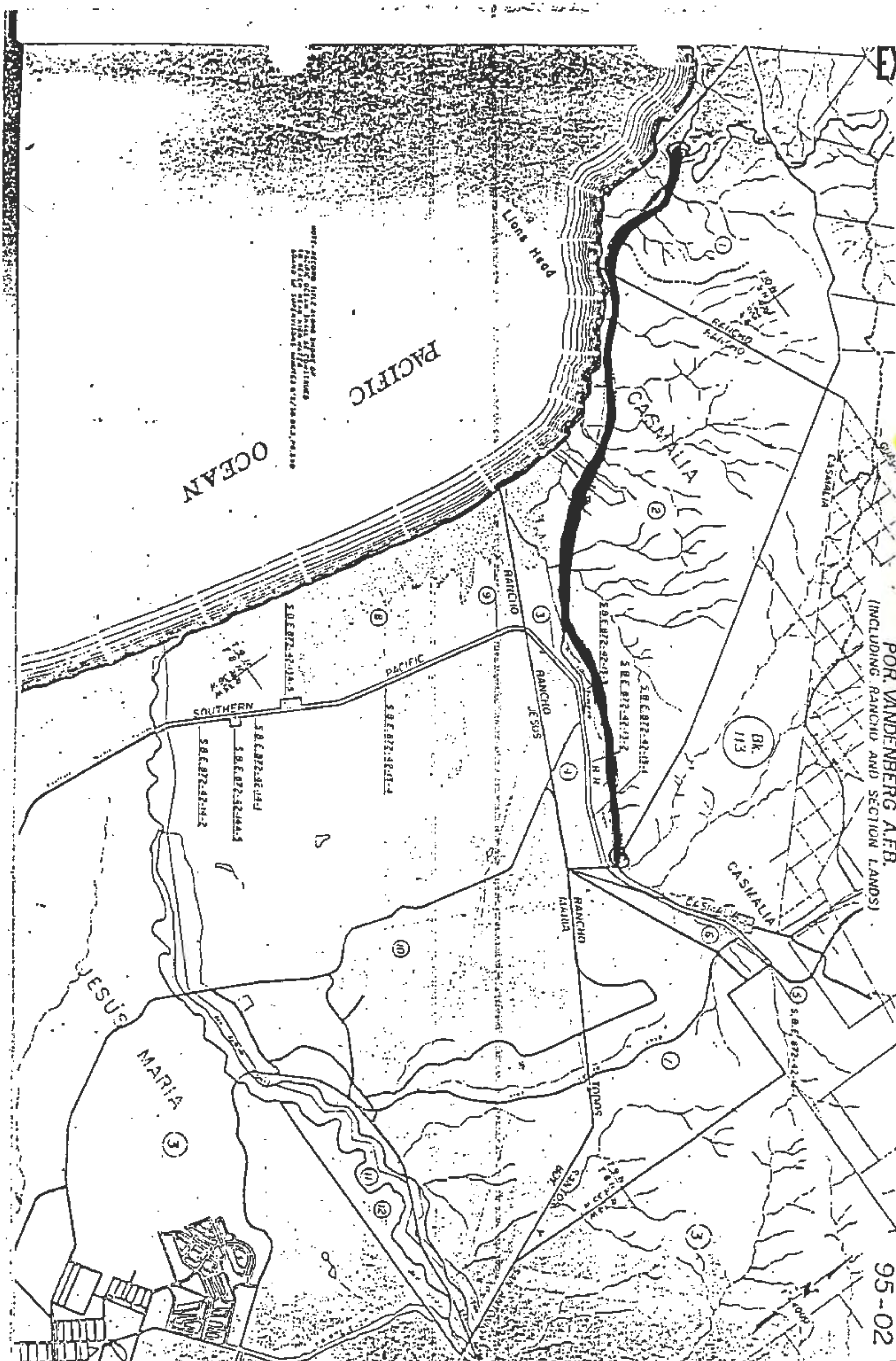


Exhibit 2

Ocean Bch Park

EXHIBIT E



Pt Sal
Exhibit E

Pt Sal

FOR INFORMATION ONLY

Expired 7 Feb 1990

A G R E E M E N T

LA-2503

THIS AGREEMENT IS MADE between the

COUNTY OF SANTA BARBARA, California,
hereinafter called "COUNTY"

and the

UNITED STATES OF AMERICA
hereinafter called
"UNITED STATES"

as follows:

WHEREAS, the United States has activated the Vandenberg Air Force Base in Santa Barbara County and has constructed missile installations on said base;

and

WHEREAS, the County has a certain road and road rights of way known as the Point Sal Road, portions of which lie within the military reservation of the Vandenberg Air Force Base;

and

WHEREAS, it is necessary that portions of said Point Sal Road lying within the military reservation be closed to travel by the public, either permanently or intermittently, because of the operation of the military facilities near said road right-of-way in order to protect the public health and safety and also because of military necessity and for security reasons;

and

LA-2503

WHEREAS, because of the compelling military necessity, the United States must acquire control of said portions of Point Sal Road; and

WHEREAS, the parties hereto desire to avoid a condemnation action to condemn said road.

NOW, THEREFORE, in consideration of the foregoing premises, the parties hereto promise, covenant and agree as follows:

1. The County agrees that during the term of this agreement, the United States shall have exclusive use and control of that portion of Point Sal Road and road rights-of-way between a point where the said road intersects the easterly boundary of the military reservation of the Vandenberg Air Force Base (1.75 miles west of Lompoc-Casmalia Road) and the easterly edge of the said Point Sal Road at its intersection with the Point Sal Beach State Park Road.

2. The County agrees that during the term of this agreement the United States shall have the right to regulate and control traffic including the right to close the road entirely to use by the public or use by any persons other than those authorized by the United States, for short periods of time prior to and during missile firings, on that portion of Point Sal Road between a point where the said road intersects the Point Sal Beach State Park Road and the northerly boundary of the military reservation of the Vandenberg Air Force Base.

3. The United States shall have the right of construct, reconstruct, maintain, realign, relocate and use said portions of Point Sal Road described in Paragraph 1 of this agreement.

4. Provided that adequate appropriations are available, the United States shall have the obligation to maintain for vehicular use and in a safe condition said portion of Point Sal Road described in Paragraph 2 of this agreement.

5. The term of this agreement shall be five (5) years commencing February 8, 1980, with an option in the United States to renew the agreement for an additional five (5) years. Said option may be exercised by delivery or mailing of notice of exercising said option to:

Board of Supervisors
County of Santa Barbara
105 East Anapamu Street
Santa Barbara, California 93101

Attn: HOWARD C. MENZEL
Clerk of the Board

on or before thirty (30) days prior to the expiration of the term hereof.

03-0020

LA-2503

COUNTY OF SANTA BARBARA

Dated: 9-4-79 By: ______________________
Chairman, Board of Supervisors

ATTEST:

County Clerk

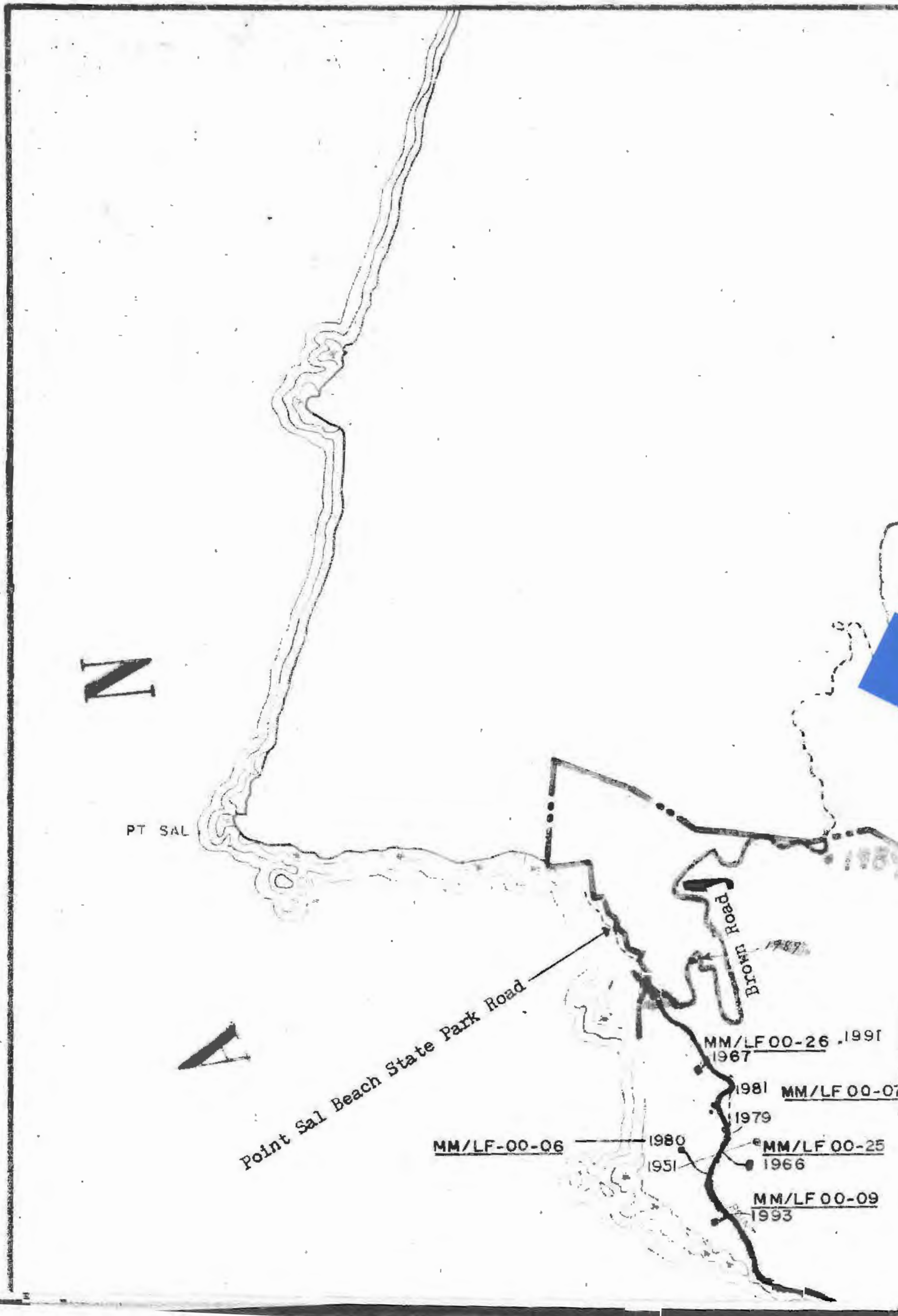
By: ______________________
Deputy County Clerk

UNITED STATES OF AMERICA

Dated: 79 AUG 23 By: ______________________
DOUGLAS E. GLASS
Chief, Real Estate Division
U.S. Army Engineer District, Los Angeles

APPROVED AS TO FORM:
GEORGE P. KADING
COUNTY COUNSEL

By: ______________________
Assistant Co. Counsel



PT SAL
Point Sal Beach State Park Road
Brown Road
MM/LF 00-26
1967
1991
1981
MM/LF 00-07
1979
MM/LF-00-06
1980
1951
MM/LF 00-25
1966
MM/LF 00-09
1993

No. SPCVAN-1-93-0006

SUPPLEMENTAL EVACUATION AGREEMENT NO. 1
(Extended Term)

THIS SUPPLEMENTAL AGREEMENT NO. 1, entered into by and between the UNITED STATES OF AMERICA, hereinafter referred to as the GOVERNMENT, and the COUNTY OF SANTA BARBARA, STATE OF CALIFORNIA, hereinafter referred to as the COUNTY, WITNESSETH:

WHEREAS, there exists an evacuation agreement between the parties for the evacuation of County properties Jalama Beach Park, Ocean Beach Park, and Point Sal Road in case of certain government operations for purposes of military necessity, security, and public safety; and

WHEREAS, the agreement dated 1 December 1992, having been automatically renewed annually since that date, expires 1 December 1997; and

WHEREAS, the parties desire to extend the agreement for an additional five years with certain modifications and with the addition of the Surf Train Station Parking Lot.

NOW THEREFORE, in consideration of these premises, the parties hereto do mutually agree that the evacuation agreement be extended and modified in the following particulars:

1. That the agreement be extended one year through 1 December 1998 and shall automatically renew annually on 1 December 1998 and on each subsequent 1 December of the following three years for a total additional term of five years from 1 December 1997.

2. That Part III., paragraph 1., subparagraph a., be modified such that the term "government operations" be defined to include commercial launch-related operations as well as non-commercial launch operations, the government having public safety responsibility for all launch related operations, whether commercial or non-commercial.

3. That the Surf Train Station Parking Lot, owned jointly by the County and the City of Lompoc in fee and located in the vicinity of Ocean Beach County Park, the Parking Lot legally described in Exhibit "F", and outlined in red on Exhibit "G", both of which are attached hereto and incorporated by reference, shall be added to this evacuation agreement in like measure as other County properties named above.

4. That in all other respects the evacuation agreement terms conditions remain in full force and effect.

THE DULY AUTHORIZED GOVERNMENT REPRESENTATIVE SIGNED THIS AGREEMENT THIS 5th DAY OF November, 1997.

THE UNITED STATES OF AMERICA

C. Robert Kehler

C. ROBERT KEHLER
Colonel, USAF
Commander

THE DULY AUTHORIZED COUNTY GOVERNMENT REPRESENTATIVE SIGNED THIS AGREEMENT THIS 2nd DAY OF December, 1997.

THE COUNTY OF SANTA BARBARA, STATE OF CALIFORNIA

Thomas B. Urbanske

Chairman, Board of Supervisors

APPROVED AS TO FORM:

STEPHEN SHANE STARK
COUNTY COUNSEL

By: M Ledbetter
DEPUTY

ATTEST: MICHAEL F. BROWN
CLERK OF THE BOARD

By Joanna Bisher
Deputy Clerk

APPROVED AS TO FORM:
CHARLES A. MITCHELL, RISK MANAGER

By

APPROVED AS TO FORM:
ROBERT GEIS, AUDITOR-CONTROLLER

By Jo Goll CPA

EXHIBIT "F"

Being a portion of the most easterly parcel of land, I.K. Fisher to Southern Pacific Railroad Company Recorded Febuary 27, 1901 in Book 76, at Page 327, of Deeds, County of Santa Barbara, State of California, more particularly described as follows:

Commencing at a T-bar and cap stamped CL (centerline) Sta. 2+44.53, Pt. Arguello, as shown on Sheet 2 of 6, Santa Barbara County Road Map, Route 149, on file at the Santa Barbara County Surveyors Office; Thence northerly along said centerline North 0° 23' 03" East, 38.28 feet to a point which bears South 9° 13' 02" East 1191.81 feet from a U.S.C. and G.S. Survey Monument stamped "Surf 2"; Thence continuing northerly along said centerline, North 0° 23' 03" East 819.46 feet to the beginning of a curve, said point bears South 28° 49' 04" East 407.44 feet from said U.S.C. and G.S. monument; Thence curving to the right with a radius of 1200.00 feet, through an angle of 7° 53' 04", for a distance of 165.13 feet to a point on said curve; Thence radial to the centerline of Route 149, (now called Ocean Avenue), North 81° 43' 53" West 234.41 feet to a point on a curve in the easterly line of said parcel, and the **POINT OF BEGINNING;**

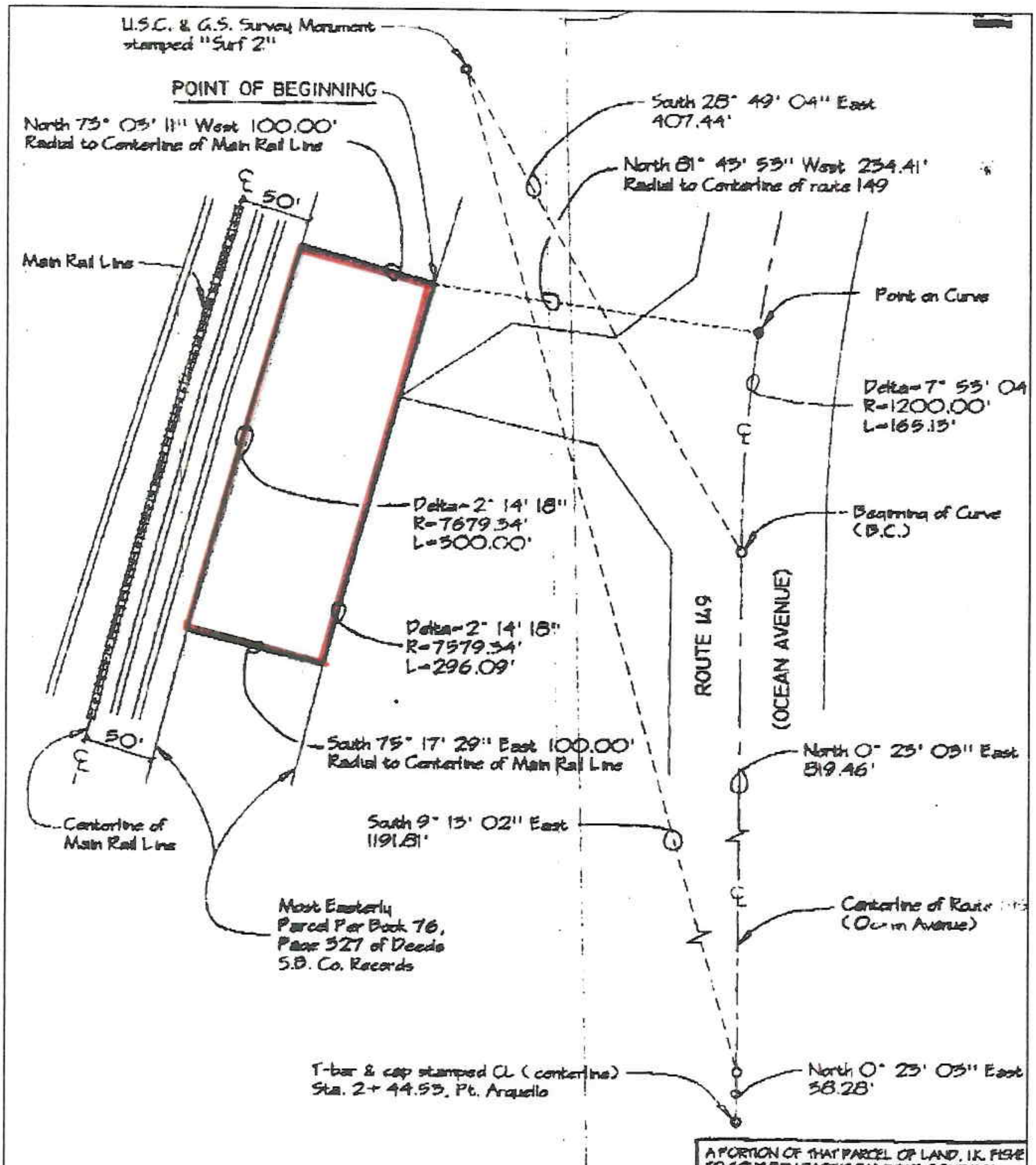
Thence 1; Radial to the centerline of the main rail line, North 73° 03' 11" West, 100.00 feet to a point on a curve in the westerly line of said Parcel, said point being 50.00 feet easterly of the centerline of the main rail line;

Thence 2; southerly along said westerly line, and curving to the left with a radius of 7679.34 feet, through an angle of 2° 14' 18", for a distance of 300.00 feet;

Thence 3; Radial to the centerline of the main rail line, South 75° 17' 29" East, 100.00 to a point on a curve in the easterly line of said parcel;

Thence 4; northerly along the easterly line of said parcel and curving to the right, with a radius of 7579.34 feet, through an angle of 2° 14' 18", for a distance of 296.09 feet, to the Point of Beginning, and containing 29804.67 square feet of land.

EXHIBIT "G"


U.S.C. & G.S. Survey Monument stamped "Surf 2"
POINT OF BEGINNING
North 73° 03' 11" West 100.00' Radial to Centerline of Main Rail Line
South 28° 49' 04" East 407.44'
North 81° 43' 53" West 234.41' Radial to Centerline of route 149
50'
Main Rail Line
Point on Curve
Delta=7° 55' 04 R=1200.00' L=165.13'
Delta=2° 14' 18" R=7679.34' L=300.00'
Beginning of Curve (B.C.)
Delta=2° 14' 18" R=7579.34' L=296.09'
ROUTE 149
(OCEAN AVENUE)
50'
South 75° 17' 29" East 100.00' Radial to Centerline of Main Rail Line
North 0° 23' 03" East 519.46'
Centerline of Main Rail Line
South 9° 13' 02" East 1191.81'
Most Easterly Parcel Per Book 76, Page 327 of Deeds S.B. Co. Records
Centerline of Route
T-bar & cap stamped CL (centerline) Sta. 2+44.53, Pt. Arguello
North 0° 23' 03" East 38.28'
A PORTION OF THAT PARCEL OF LAND, I.K. FISHE TO SOUTHERN PACIFIC RAILROAD COMPANY RECORDED FEBUARY 27, 1901 IN BOOK 76, AT PAGE 327, OF OFFICIAL RECORDS, COUNTY OF SANTA BARBARA, STATE OF CALIFORNIA
J.B. DIXON ENGINEERING & SURVEYING, INC

EVACUATION AGREEMENT NO. SPCVAN-1-93-0006

SUPPLEMENTAL AGREEMENT NO. 2

THIS SUPPLEMENTAL AGREEMENT entered into this 13th day of May, 2003, by and between the County Of Santa Barbara, State of California ("County") and Secretary of the Air Force ("Government" or "Air Force"). The Government and the County may be referred to jointly as the "Parties," and each separately may be referred to as a "Party."

RECITALS:

A. On 1 December 1992, the Parties entered into an evacuation agreement for the evacuation of County properties Jalama Beach Park, Ocean Beach Park and Point Sal Road in case of certain government operations for purposes of military necessity, security and public safety.

B. On 05 November 1997, the parties agreed to extend the agreement for one additional year through 01 December 1998 and to automatically renew the agreement for a total additional term of five years from December 1, 1997 and added Surf Station Parking Lot to the agreement.

AGREEMENT:

1. This PERMIT is hereby modified in the following particulars, but no others:

   a. The term of the PERMIT is extended for five (5) years beginning 01 December 2002 through 30 November 2007.

2. All other terms and conditions of the PERMIT shall be and remain the same.

3. This Supplemental Agreement shall be effective immediately.

Project: Evacuation Agreement
No. SPCVAN-1-93-0006:
Supplemental Agreement No. 2
Jalama Beach Park; (WC2044)
Ocean Beach Park; (WC1165)
Point Sal Road; (WC3223)
Surf Train Station Parking Lot,
WC3775)

IN WITNESS WHEREOF, County and Government have executed this Supplemental Agreement No. 2 to Evacuation Agreement No. SPCVAN-1-93-0006, by the respective authorized officers as set forth below to be effective as of the date executed by the Government.

"COUNTY"
COUNTY OF SANTA BARBARA

By: Naomi Schwartz
Chair, Board of Supervisors

Date: 2/11/03

ATTEST:
MICHAEL F. BROWN
CLERK OF THE BOARD

By: Wendy Ayala
Deputy

APPROVED:

By: Terri Maus-Nisich
Terri Maus-Nisich, Parks Director

APPROVED AS TO FORM:
STEPHEN SHANE STARK
COUNTY COUNSEL

By: Patricia J. Clancy

APPROVED:

By:
John Forner
Supervising Risk Analyst

APPROVED AS TO FORM:
ROBERT W. GEIS, CPA
AUDITOR-CONTROLLER

By:

APPROVED:

By: Ronn Carlentine
Ronn Carlentine, SR/WA
Real Property Supervisor

G:\REALPROP\WINWORD\LEASEREV\Evac Agree 4-2002 jjh.doc

IN WITNESS WHEREOF, I have set my hand by authority of the Secretary of the Air Force as of the day and year first written above.

DEPARTMENT OF THE AIR FORCE

By: ____________________

Robert M. Worley II
Colonel, USAF
Commander, 30th Space Wing

SUPPLEMENTAL AGREEMENT NO. 3
to
EVACUATION AGREEMENT NO. DACA-09-3-98-0008
Between
THE STATE OF CALIFORNIA
and
THE UNITED STATES OF AMERICA

WITNESSETH:

WHEREAS, The State of California granted to United States of America an evacuation agreement commencing 01 April 1998 and ending 31 March 2003 for an evacuation agreement between the parties for the evacuation of Tract 422 in order to provide for the safety of persons on land in the proximity of Vandenberg Air Force Base in connection with launch operation activities, and

WHEREAS, Supplemental Agreement No. 1 executed on 21 April 2003 to extend the term for a period of years ending 31 March 2009, and

WHEREAS, Supplemental Agreement No. 2 executed on 01 April 2009 to extend the term for a period of years ending 31 March 2014, and

WHEREAS, The parties would like to now extend the agreement for an additional one year with four one year periods.

NOW, THEREFORE, in consideration of these premises, the parties hereto do mutually agree that the evacuation agreement be extended and modified in the following particulars:

1. That the evacuation agreement be extended one year from 01 April 2014 through 31 March 2015 and each option, subject to the availability of funds, shall automatically renew annually on each subsequent 01 April of the following four years for a total additional term of five years to 31 March 2019

All other terms and conditions of the aforesaid evacuation agreement are hereby ratified and, except as modified by this Supplemental Agreement, shall remain in full force and effect.

SUPPLEMENTAL AGREEMENT NO. 3
to
EVACUATION AGREEMENT NO. DACA-09-3-98-0008

THIS SUPPLEMENTAL AGREEMENT is also executed by The Government under the authority of the Secretary of the Air Force this 20 day of Oct, 2017.

UNITED STATES OF AMERICA

MICHAEL S. HOUGH, Colonel, USAF
Commander, 30th Space Wing

IN WITNESS WHEREOF, I have hereunto set my hand by authority of the State of California this 29th day of August, 2017.

STATE OF CALIFORNIA

DRodriguez

DANITA RODRIGUEZ, Superintendent
Channel Coast District
California State Parks
California Department of Parks and Recreation
1933 Cliff Drive, Suite 27
Santa Barbara, CA 93109

SUPPLEMENTAL AGREEMENT NO. 3
to
EVACUATION AGREEMENT NO. DACA-09-3-98-0009
Between
THE STATE OF CALIFORNIA
and
THE UNITED STATES OF AMERICA

WITNESSETH:

WHEREAS, The State of California granted to United States of America an evacuation agreement commencing 01 April 1998 and ending 31 March 2003 for an evacuation agreement between the parties for the evacuation of Tract 432 in order to provide for the safety of persons on land in the proximity of Vandenberg Air Force Base in connection with launch operation activities, and

WHEREAS, Supplemental Agreement No. 1 executed on 21 April 2003 to extend the term for a period of years ending 31 March 2009, and

WHEREAS, Supplemental Agreement No. 2 executed on 01 April 2009 to extend the term for a period of years ending 31 March 2014, and

WHEREAS, The parties would like to now extend the agreement for an additional one year with four one year periods.

NOW, THEREFORE, in consideration of these premises, the parties hereto do mutually agree that the evacuation agreement be extended and modified in the following particulars:

1. That the evacuation agreement be extended one year from 01 April 2014 through 31 March 2015 and each option, subject to the availability of funds, shall automatically renew annually on each subsequent 01 April of the following four years for a total additional term of five years to 31 March 2019

All other terms and conditions of the aforesaid evacuation agreement are hereby ratified and, except as modified by this Supplemental Agreement, shall remain in full force and effect.

SUPPLEMENTAL AGREEMENT NO. 3
to
EVACUATION AGREEMENT NO. DACA-09-3-98-0009

IN WITNESS WHEREOF, I have hereunto set my hand by authority of the State of California this 29th day of August, 2017.

STATE OF CALIFORNIA

DRodriguez

DANITA RODRIGUEZ, Superintendent
Channel Coast District
California State Parks
California Department of Parks and Recreation
1933 Cliff Drive, Suite 27
Santa Barbara, CA 93109

SUPPLEMENTAL AGREEMENT NO. 3
to
EVACUATION AGREEMENT NO. DACA-09-3-98-0009

THIS SUPPLEMENTAL AGREEMENT is also executed by The Government under the authority of the Secretary of the Air Force this 20 day of Oct, 2017.

UNITED STATES OF AMERICA

MICHAEL S. HOUGH, Colonel, USAF
Commander, 30th Space Wing

EVACUATION AGREEMENT NO. SPCVAN-1-93-0006

SUPPLEMENTAL AGREEMENT NO. 4

THIS SUPPLEMENTAL AGREEMENT entered into this____day of **_________, 2020,** by and between THE County of Santa Barbara, State of California ("County") and Secretary of the Air Force ("Government" or "Air Force") The Government and the County may be referred to jointly as the "Parties," and each separately may be referred to as a "Party."

RECITALS

A. On 1 December 1992, the Parties entered into an evacuation agreement for the evacuation of County properties Jalama Beach Park, Ocean Beach Park, Surf Station Parking and Brown/Point Sal Road in case of certain government operations for purposes of military necessity, security and public safety.

B. On 05 November 1997, the Parties agreed to extend the Agreement for one additional year through 01 December 1998 and to automatically renew the Agreement for a total additional term of five years from December 1, 1997 and added Surf Station Parking Lot to the Agreement.

C. On 13 May 2003, the Parties agreed to extend the agreement for five years through 30 November 2007.

D. On 18 November 2008 the Parties agreed to extend the agreement for an additional total term of five years through 30 November 2012.

AGREEMENT

1. The Agreement is hereby modified in the following particulars, but no others:

   a. The term of the Permit is extended for an additional twenty (20) years, beginning 1 December 2012 to and including 30 November 2032.

2. All other terms and conditions of the agreement shall be and remain the same.

3. This Supplemental Agreement shall be effective immediately.

IN WITNESS WHEREOF, I have set my hand by authority of the Secretary of the Air Force as of the day and year first written above.

DEPARTMENT OF THE AIR FORCE

BY: ____________________________________

ROBERT E. MORIARTY, P.E
Director
Installations Directorate
Air Force Civil Engineer Center

IN WITNESS WHEREOF, Government and County have executed this Supplemental Agreement No. 4 to Evacuation Agreement SPCVAN-1-93-0006, by the respective authorized officers as set forth below to be effective as of the date executed by Government.

COUNTY:

COUNTY OF SANTA BARBARA

By:______________________________
Gregg Hart, Chair
Board of Supervisors

ATTEST:
MONA MIYASATO
CLERK OF THE BOARD

By:______________________________
Deputy Clerk

Dated:______________________________

APPROVED AS TO FORM:
MICHAEL C GHIZZONI
COUNTY COUNSEL

By:______________________________
Scott Greenwood
Deputy County Counse

APPROVED AS TO ACCOUNTING FORM:
BETSY M. SCHAFFER, CPA
AUDITOR-CONTROLLER

By:______________________________
Deputy

APPROVED:

By:______________________________
Carlo Achdjian
Real Property Manager

APPROVED:

By:______________________________
Ray Aromatorio, ARM, AIC
Risk Manager


1967
1981
2002
1999
1990
1976
1974
1978
1986
1886
2001
1970
1937
1926
1930
1987
23235
23225
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23229
23205
1894
1900
1899
1905
23101
23100
1887
1895
1819
1865
1847
22010
1833
1836
1350
22114
1797
1788
1800
21308
21330
22409
22405
1793
1805
21155
21200
22396
22398
1762
21150
20224
21204
1670
1682
16170
1628
1619
1768
14300
31033
31036
1611
1032
1740
12000
11237
11777
1053
11439
1595
1735
8173
9320
15032
1555
1559
8310
8500
5500
1546
3000
6816
11488
6846
6842
1280
990
1230
980
960
984
861
852
945
907
874
831
836
799
753
763
761
639
660
731
770
760
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644
738
707
621
701
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466
444
561
490
475
441
425
525
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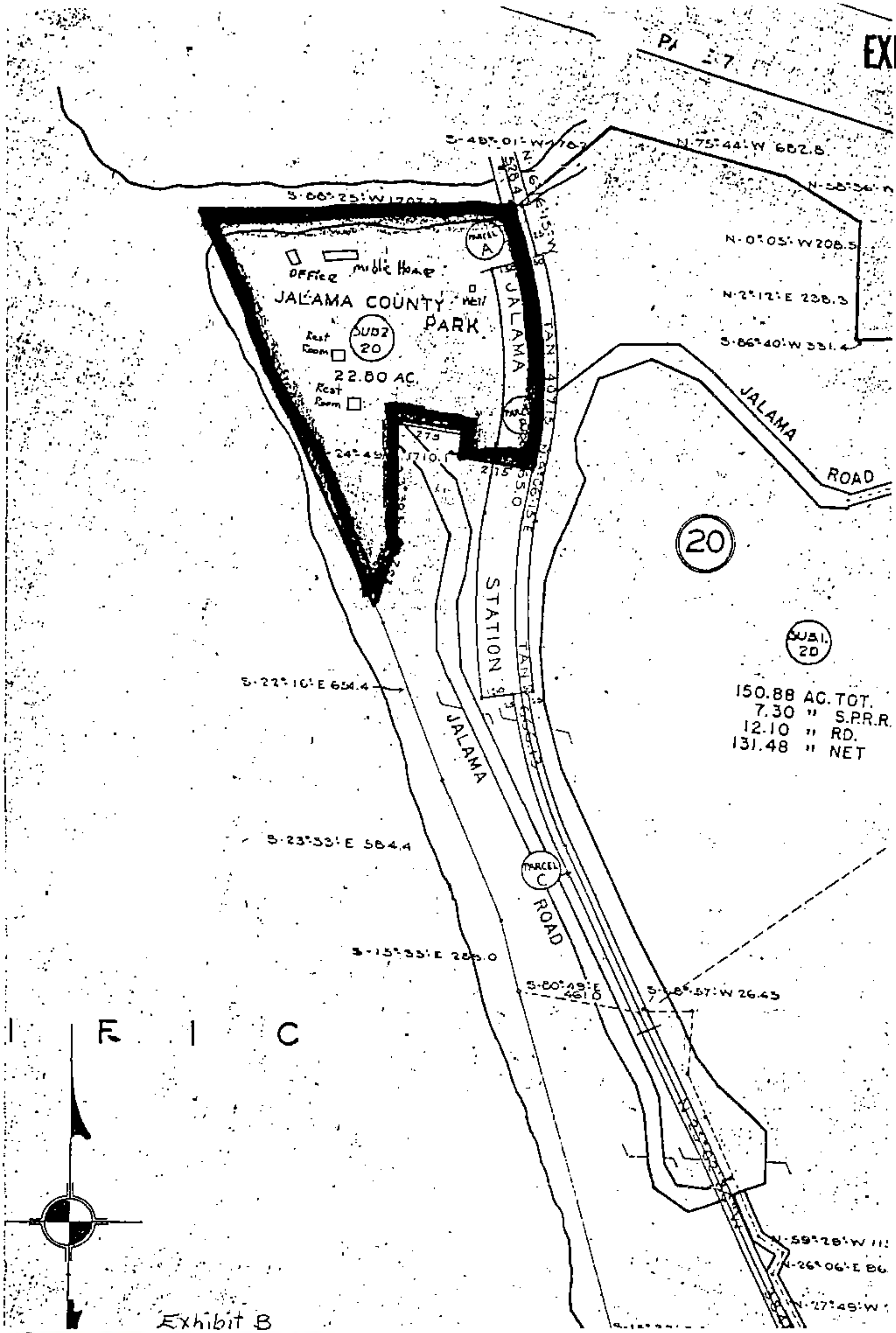
431
510
398
521
420
185
392
502
500
175
305
178
331
330
75
64
70
302
304
308
65
51
40
Approx. location of Jalama Beach Park
Approx. location of Jalama Beach Park
Jalama Beach

EXHIBIT B



Jalama Beach Park


Approx. location of Ocean Beach Park
Approx. location of Surf Station Parking Lot
Approx. location of Ocean Beach Park
Surf/Ocean Beach
Surf Station
Approx. location of Surf Station Parking Lot

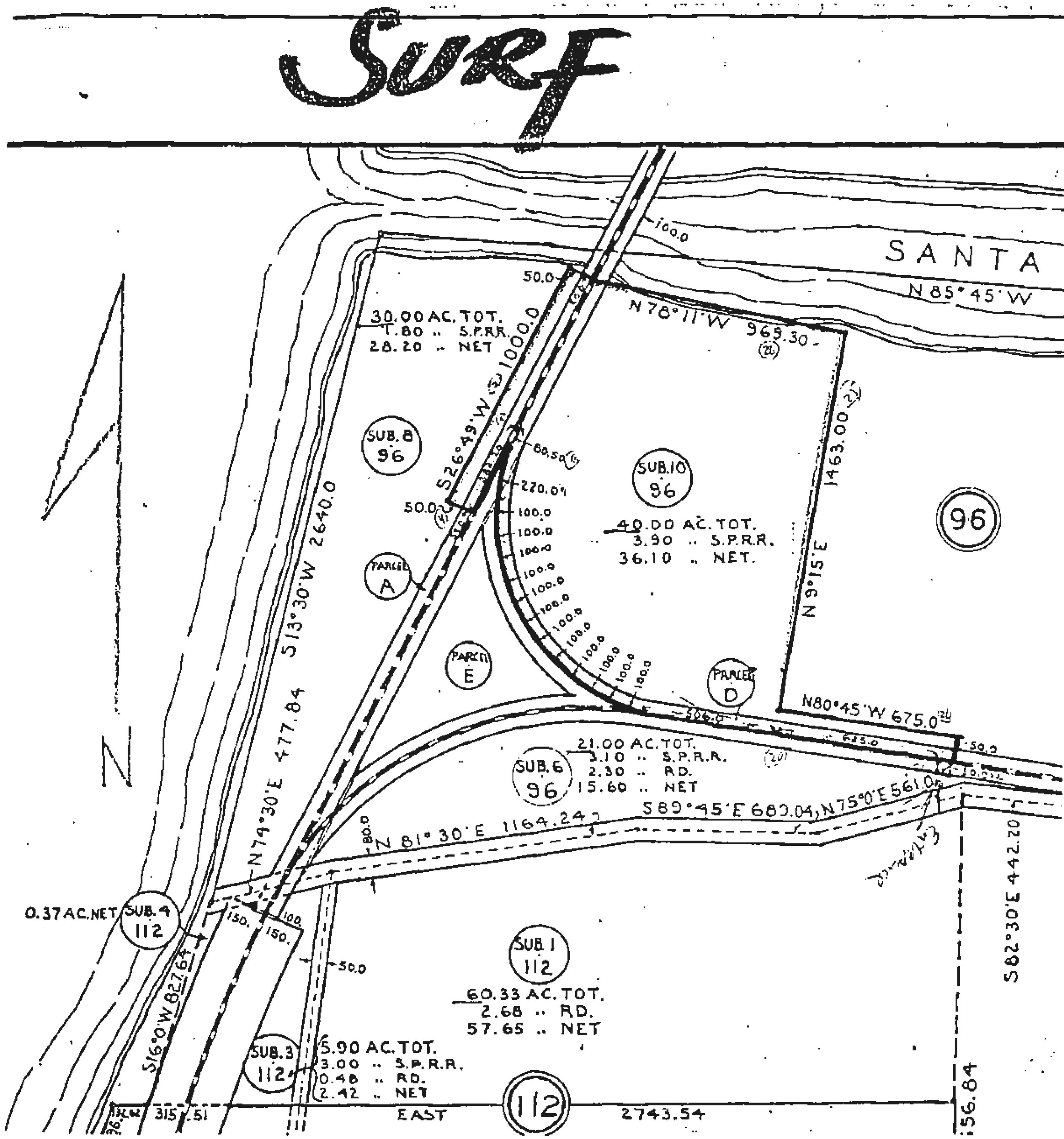
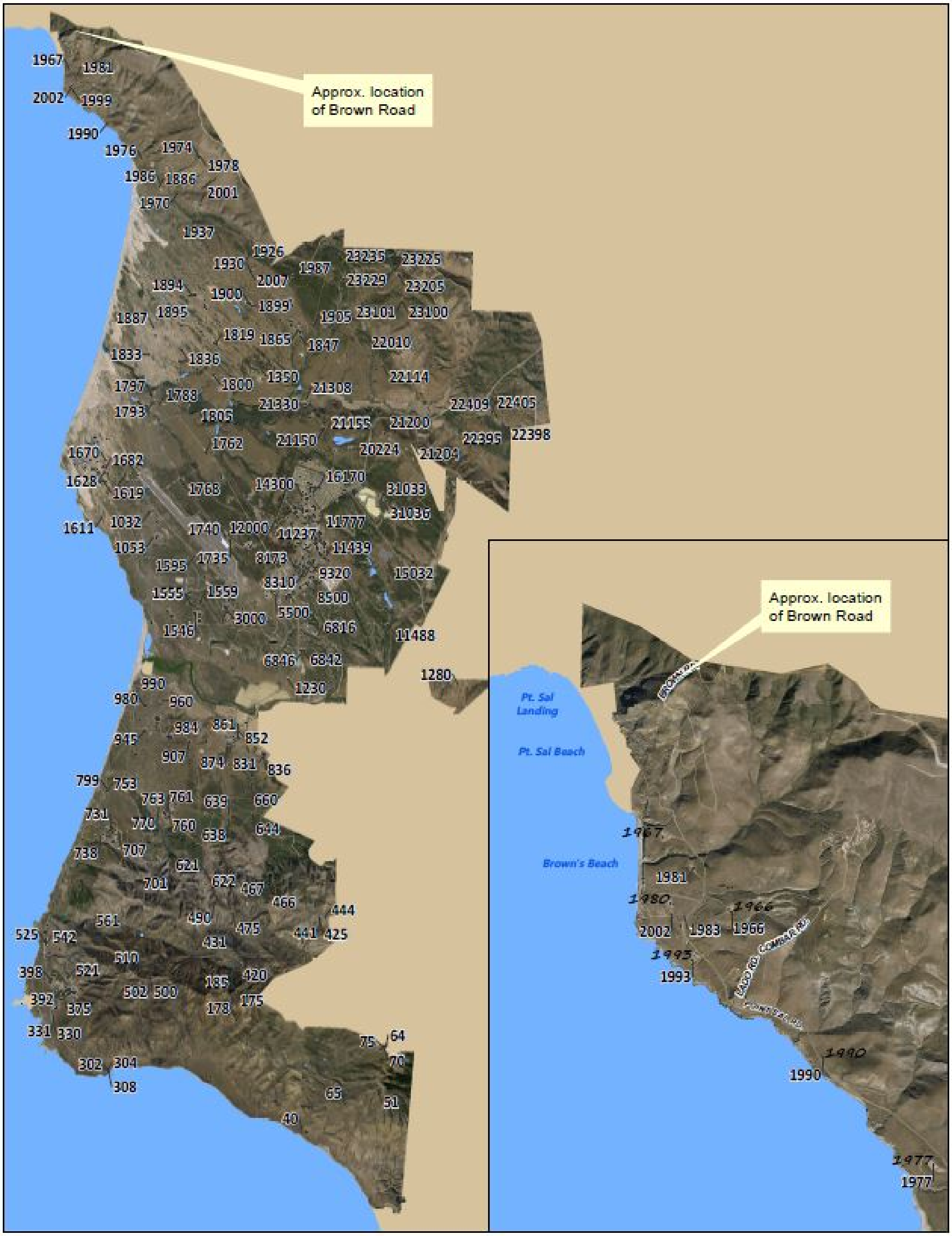


Exhibit 2

Ocean Bch Park


Approx. location of Brown Road
1967
1981
2002
1999
1990
1976
1974
1978
1986
1886
2001
1970
1937
1926
1930
1987
23235
23225
2007
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23205
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1900
1899
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23101
23100
1819
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1847
22010
1833
1836
22114
1797
1800
1350
21308
1788
21330
22409
22405
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21200
1762
21150
20224
22395
22398
21204
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16170
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11237
11777
1053
11439
1595
1735
8173
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1559
8310
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15032
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11488
6846
6842
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861
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907
874
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799
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763
761
639
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731
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760
638
644
738
707
621
701
622
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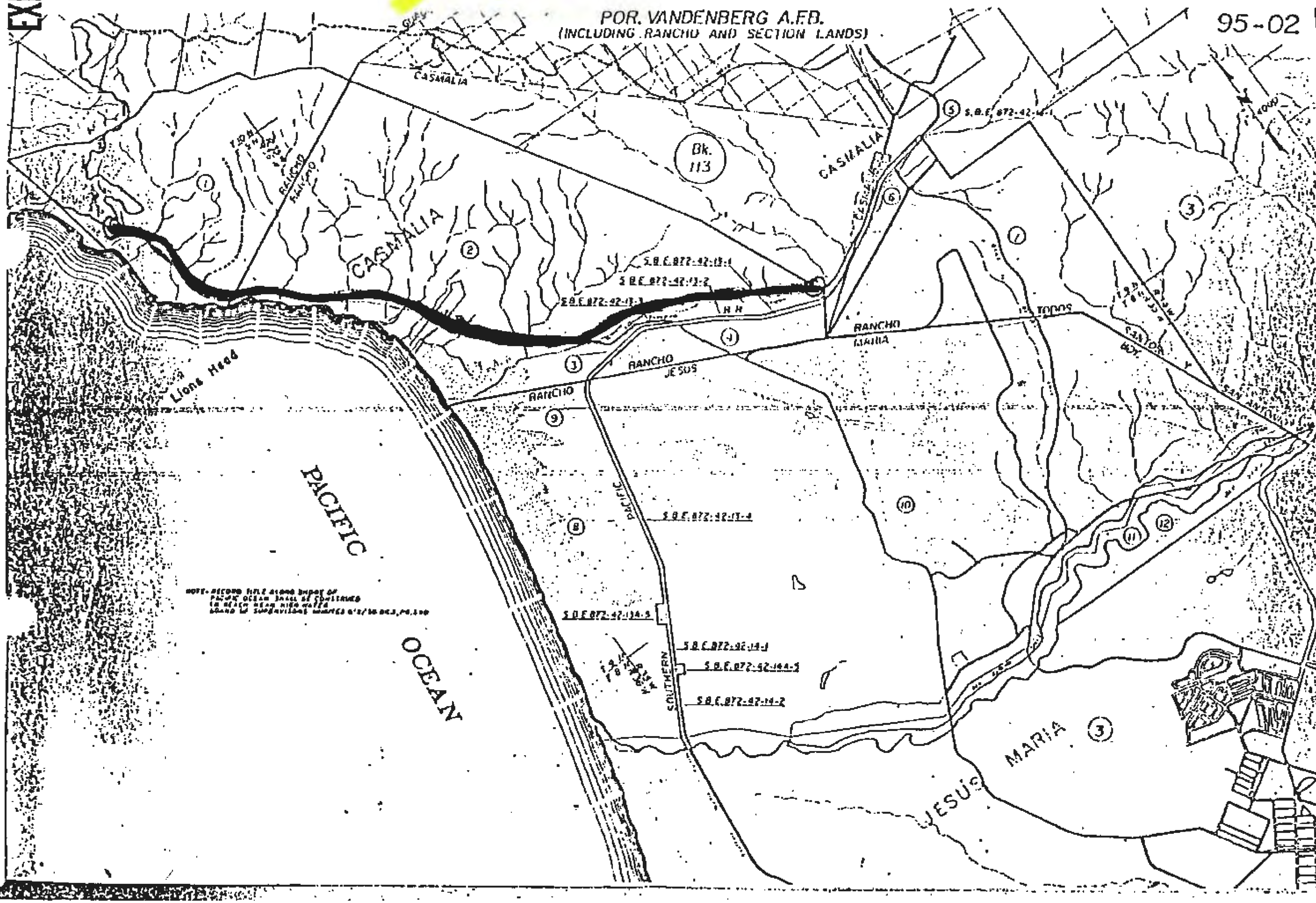
466
444
561
490
475
441
425
525
542
431
510
398
521
420
185
502
500
392
375
175
178
331
330
75
64
70
302
304
308
65
51
40
Approx. location of Brown Road
Pt. Sal Landing
Pt. Sal Beach
Brown's Beach
1967
1981
1980
1966
2002
1983
1966
1995
1993
1990
1990
1977
1977

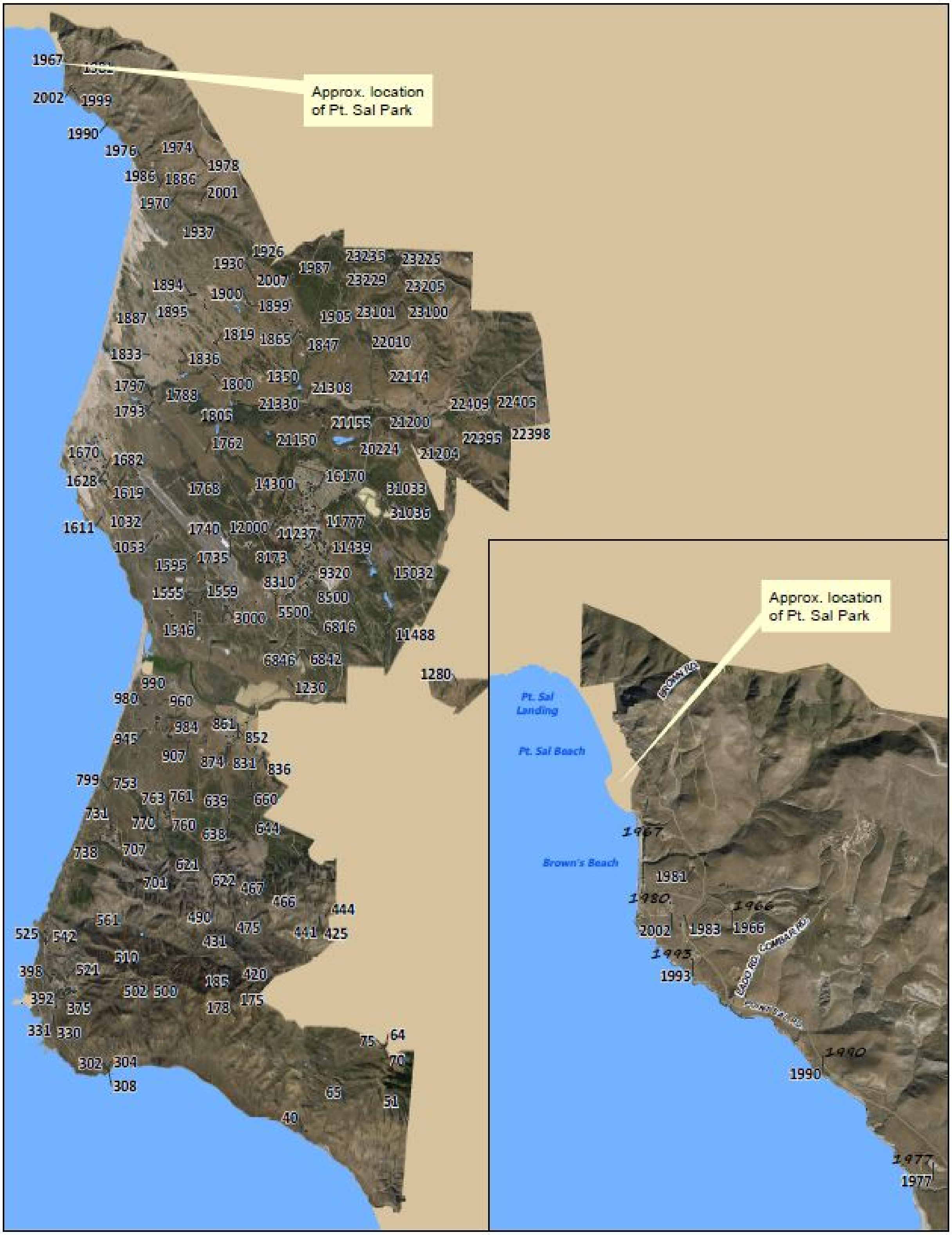
EXHIBIT E

Pt Sal Exhibit E

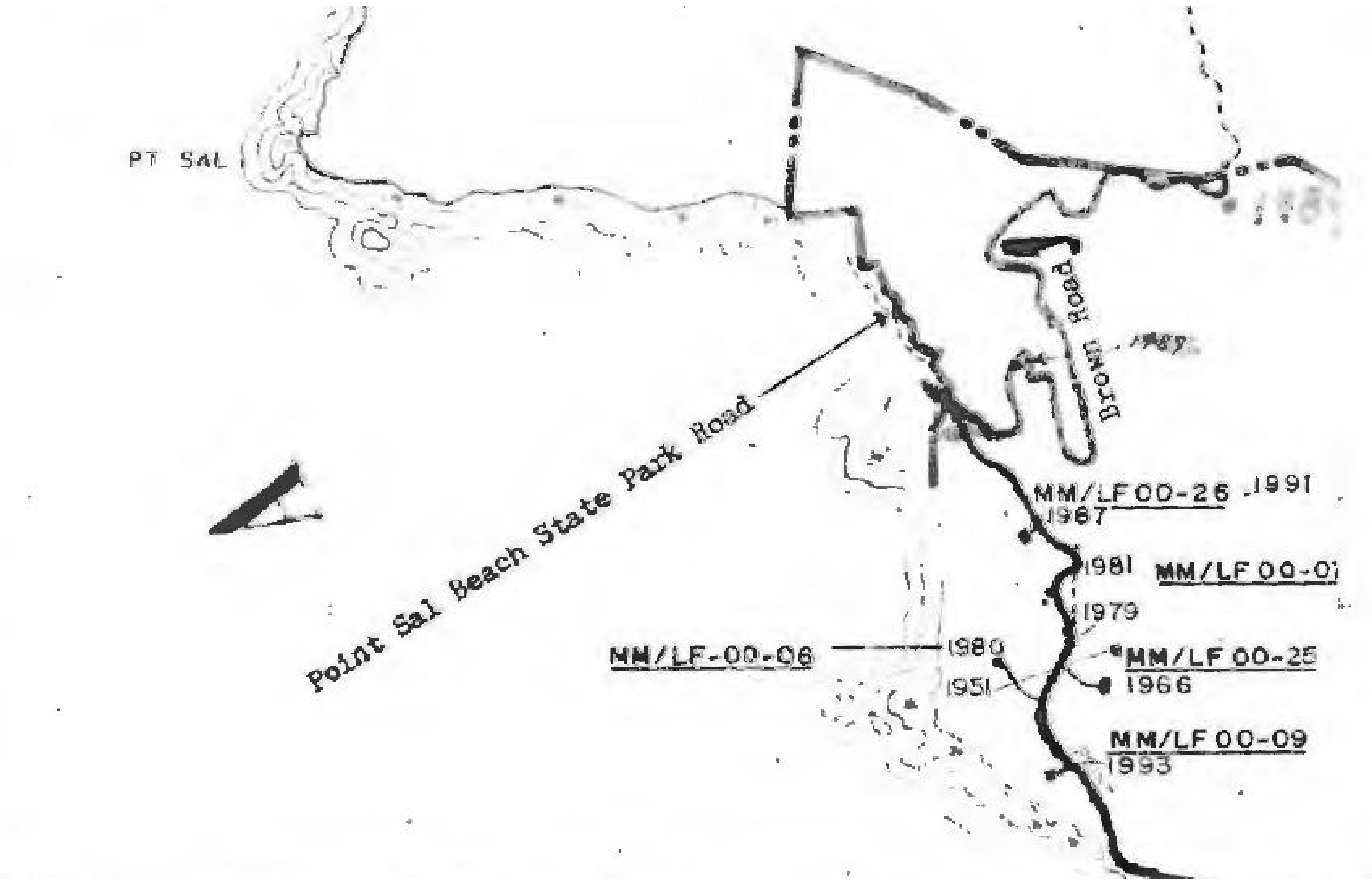


FOR INFORMATION ONLY

Pt Sal


Approx. location of Pt. Sal Park
Approx. location of Pt. Sal Park
Pt. Sal Landing
Pt. Sal Beach
Brown's Beach

Brown Road on North Base
To
Point Sal State Beach



APPENDIX J
Notice of Availability for Public Review, Proof of Publication, and Proof of Delivery/Publication

DEPARTMENT OF THE AIR FORCE
UNITED STATES SPACE FORCE
SPACE LAUNCH DELTA 30

5 Apr 2023

MEMORANDUM FOR ALL INTERESTED GOVERNMENT AGENCIES, PUBLIC OFFICIALS, ORGANIZATIONS, AND INDIVIDUAL PARTIES

FROM: 30 CES/CEI
1028 Iceland Avenue
Vandenberg SFB, CA 93437-6010

SUBJECT: Draft Supplemental Environmental Assessment (SEA) and Finding of No Significant Impact (FONSI) for the Falcon 9 Cadence Increase at Vandenberg Space Force Base, California, and Offshore Landing Locations.

1. Attached as public and agency notification, to comply with the National Environmental Policy Act of 1969 and the President's Council on Environmental Quality's implementing regulations, is the Draft SEA/FONSI for the Falcon 9 Cadence Increase at Vandenberg Space Force Base, California and Offshore Landing Locations.

2. This Draft SEA/FONSI is available at the Lompoc, Santa Maria, and Santa Barbara Public Libraries, and Vandenberg SFB Library. The purpose of the Proposed Action is to provide greater mission capability to the Department of Defense, National Aeronautics and Space Administration, and commercial customers by increasing Falcon 9 launch capacity. Resources analyzed in the Draft SEA include air quality, climate, noise, biological resources, water resources, cultural resources, coastal zone management, Department of Transportation Section 4(f) properties, utilities, socioeconomics, and transportation. The Draft SEA/FONSI concludes that there will be no significant environmental impacts resulting from the Proposed Action.

3. The public comment period for this Draft SEA/FONSI will be from April 7, 2023 through May 7, 2023. Comments may be sent to Space Launch Delta 30, Installation Management Flight Environmental Assets Section, Building 11146, 1028 Iceland Ave, Vandenberg SFB, California 93437, Attention: Ms. Tiffany Whitsitt-Odell; e-mailed to tiffany.whitsitt-odell@spaceforce.mil; or faxed to (805) 606-6137. If you have any questions, please contact Ms. Tiffany Whitsitt-Odell at (805) 606-2044.

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:

Draft SEA/FONSI for the Falcon 9 Cadence Increase at Vandenberg Space Force Base, California, and Offshore Landing Locations.

Distribution Instructions: Please distribute NEPA documents, including the corresponding notice of availability (NOA), to the following points of contact (POCs) as indicated below. Send NOA only when indicated. Distribute hard copies to the libraries via personal delivery and obtain signed receipt. Please inform VSFB of any "return to sender" issues with any of the listed POCs or change of preference for document type or delivery. Finally, please inform VSFB of any POC that would like to be removed from this list.

Federal

NOAA – Channel Islands National Marine Sanctuary
Attn: Chris Mobley
113 Harbor Way, Suite 150
Santa Barbara, CA 93l09
NOA Only

NOAA - National Marine Fisheries Service
Southwest Regional Office
Attn: For Distribution
501 West Ocean Blvd
Long Beach, CA 90802-4213
NOA Only

National Park Service
Channel Islands National Park
Attn: Superintendent
1901 Spinnaker Drive
Ventura, CA 93001
NOA Only

U.S. Army Corps of Engineers
Attn: David A. Jorgenson, P.E.
1318 New Mexico Avenue, Building 9360
Vandenberg AFB, CA 93437
Email: David.A.Jorgenson@usace.army.mil
Electronic Copy

U.S. Army Corps of Engineers
Regulatory Division, Los Angeles District
Attn: Aaron O. Allen, PhD.
60 South California Street, Suite 201
Ventura, CA 93001-2598
Email: Aaron.O.Allen@usace.army.mil
Electronic Copy

Mr. Tyrone Conner
Deputy Chief, Waterways Management
Eleventh Coast Guard District
Bldg. 50-2, C.G. Island
Alameda, CA 94501-5100
Email: Tyrone.L.Conner@uscg.mil
NOA Only

U.S. Department of Transportation
Federal Aviation Administration (FAA)
Attn: Planning and Environmental Division
800 Independence Avenue
Washington, DC 20591
NOA Only

U.S. Environmental Protection Agency, Region 9
Environmental Review Branch
Attn: Karen Vitulano
Tribal, Intergovernmental and Policy Division
75 Hawthorne St. TIP-2
San Francisco, CA 94105
Email: Vitulano.Karen@epa.gov
NOA Only

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Attn: Stephen P. Henry
2493 Portola Road, Suite B
Ventura, CA 93003-7726
Email: steve_henry@fws.gov
Electronic Copy

State

California Coastal Commission - Energy, Ocean Resources and Federal Consistency Division
Attn: Cassidy Teufel
455 Market Street, Suite 228
San Francisco, CA 94105-2219
Email: cassiday.teufel@coastal.ca.gov
Electronic Copy

Central Coast Regional Water Quality Control Board
Attn: Sheila Soderberg
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401-7906
Email: Sheila.soderberg@waterboards.ca.gov
Electronic Copy

Central Coast Regional Water Quality Control Board - Central Coast Ambient Monitoring Program (CCAMP)
Attn: Mary Hamilton
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401
Email: Mary.Hamilton@waterboards.ca.gov
NOA Only

California Department of Fish & Wildlife
South Coast Region
Attn: Kelly Schmoker-Stanphill
E-mail: Kelly.Schmoker@wildlife.ca.gov
Electronic Copy

California Environmental Protection Agency
Attn: For Distribution
1001 I Street
P.O. Box 2815
Sacramento, CA 95812-2815
NOA Only

California Office of Historic Preservation
Attn: Julianne Polanco
State Historic Preservation Officer
1725 23rd Street, Suite 100
Sacramento, CA 95816
Email: carol.roland-nawi@parks.ca.gov
Hardcopy

Office of the Governor
Office of Planning and Research
Attn: State Clearinghouse
1400 10th Street
Sacramento CA 95814
Electronic Copy

Santa Barbara County Air Pollution Control District
Attn: Molly Pearson
260 N. San Antonio Road, Suite A
Santa Barbara, CA 93110-1315
Email: pearsonm@sbcapcd.org
Electronic Copy

Tribes

Santa Ynez Band of Chumash Indians
Elders Council
Attn: Sam Cohen & Freddie Romero
P.O. Box 517
Santa Ynez, CA 93460
Emails: FRomero@santaynezchumash.org
SCohen@santaynezchumash.org
Electronic Copy

Local

Santa Barbara County Board of Supervisors
C/O: Santa Barbara County Planning & Development
Attn: David Villalobos
123 E. Anapamu Street
Santa Barbara, CA 93101
Email: dvillalo@co.santa-barbara.ca.us
Electronic Copy

Santa Barbara County Planning & Development
Attn: David Lackie
123 East Anapamu Street
Santa Barbara CA 93101-2058
Email: dlackie@countyofsb.org
Electronic Copy

City of Lompoc
Economic & Community Development
Attn: Brian Halvorson or Cherridah Weigel
100 Civic Center Plaza
Lompoc CA 93436
Email: b_halvorson@ci.lompoc.ca.us
c_weigel@ci.lompoc.ca.us
Hardcopy

Libraries

Santa Barbara Public Library
40 East Anapamu Street
Santa Barbara, CA 93101-2000
Hardcopy

Lompoc Public Library
501 East North Avenue
Lompoc, CA 93436
Hardcopy

Santa Maria Public Library
421 S. McClelland Street
Santa Maria, CA 93454
Hardcopy

Requesting Entities

California Native Plant Society
Channel Islands Chapter
P.O. Box 6
Ojai, CA 93024-006
Email: cnpschannelislands@gmail.com
Electronic Copy

California Trout
Attn: Russell Marlow
21 S. California Street #305
Ventura, CA 93001
NOA Only

Environmental Defense Center
Attn: Brian Trautwein
906 Garden Street
Santa Barbara, CA 93101
Email:
BTrautwein@EnvironmentalDefenseCenter.org
Electronic Copy

La Purisima Audubon Society
Attn: Tamarah Taaffe
4036 Muirfield Place
Vandenberg Village, CA
93436-1307
Email: bima55@msn.com
Hardcopy

Santa Barbara Museum of Natural History
Attn: Luke J. Swetland
2559 Puesta del Sol
Santa Barbara, CA 93105
Email: lswetland@sbnature2.org
Electronic Copy

Sierra Club
Los Padres Chapter
Attn: Gerry Ching
P O Box 31241
Santa Barbara, CA 93130-1241
Email: gching@cox.net
Electronic Copy

Appendix K
Airspace

K.1 Introduction

Airspace management considers how airspace is designated, used, and administered to best accommodate the individual and common needs of military, commercial, and general aviation. The FAA considers multiple and sometimes competing demands for airspace in relation to airport operations, federal airways, jet routes, military flight training activities, commercial space operations, and other special needs to determine how the National Airspace System (NAS) can be best structured to address all user requirements.

The FAA designs and manages the NAS based on the Code of Federal Regulations (CFR) (14 CFR Part 71). The FAA has designated four types of airspace above the United States: controlled airspace, Special Use Airspace (SUA), other airspace, and uncontrolled airspace.

- **Controlled airspace** is a generic term that covers the different classifications of airspace and defined dimensions within which air traffic control service is provided in accordance with the airspace classification. Controlled airspace consists of five classes: A, B, C, D, and E (Figure K-1).

- **Class A** airspace is generally the airspace from 18,000 feet mean sea level (MSL) up to and including flight level 600, including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous states and Alaska. Unless otherwise authorized, all operation in Class A airspace is conducted under instrument flight rules (IFR).

- **Class B** airspace is generally airspace from the surface to 10,000 feet MSL surrounding the nation's busiest airports in terms of airport operations or passenger enplanements.

- **Class C** airspace is generally airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and have a certain number of IFR operations or passenger enplanements.

- **Class D** airspace is generally airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower.

- **Class E** airspace is the controlled airspace not classified as Class A, B, C, or D airspace. A large amount of the airspace over the United States is designated as Class E airspace.

- **SUA** is the designation for airspace in which certain activities must be confined, or where limitations may be imposed on aircraft operations that are not part of those activities. The FAA has designated SUA areas that are listed in FAA Order 7400.10C and 7400.2N. SUA usually consists of prohibited areas, restricted areas, warning areas, military operation areas, alert areas, and controlled firing areas. Most SUA areas have specific hours of operations, and users must remain clear of or obtain permission from the using agency or the controlling agency before flight through the defined areas.

- **Other airspace areas** is a general term referring to the majority of the remaining airspace. Examples include local airport advisory areas, military training routes, temporary flight restriction (TFR) areas, parachute jump aircraft operations areas, published visual flight rules routes, terminal radar service areas, and national security areas.

- **Uncontrolled airspace or Class G airspace** is the portion of the airspace that has not been designated as Class A, B, C, D, or E. Class G airspace extends from the surface to the base of the overlying Class E airspace.

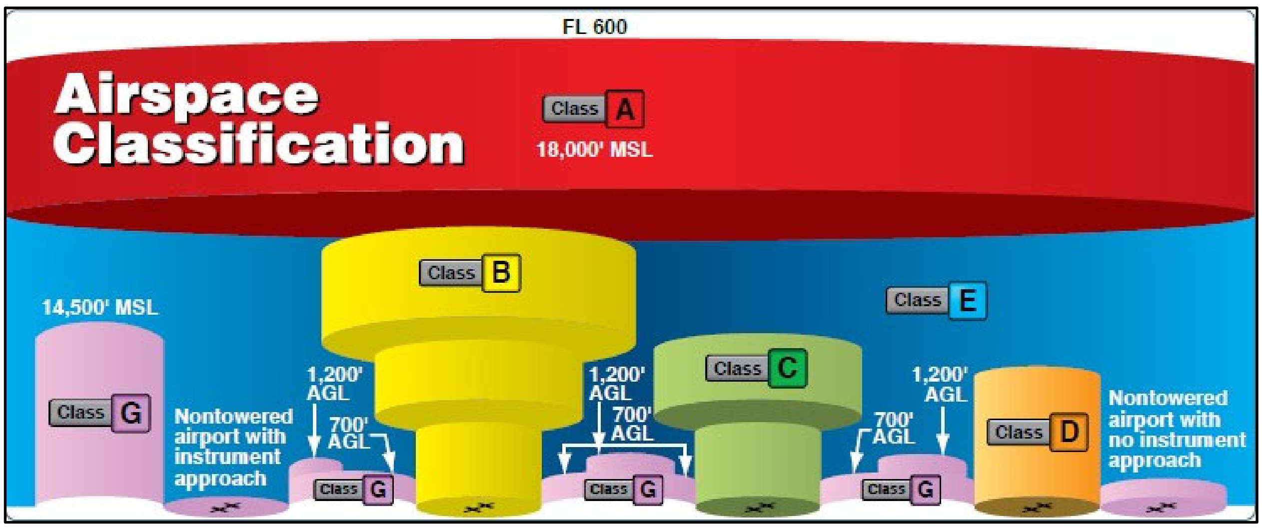


Figure K-1. Airspace Profile

K.2 Study Area

The airspace study area includes the airspace above Vandenberg Space Force Base (VSFB), the airspace surrounding the launch trajectory, and the airspace associated with any hazard areas that must be protected to ensure public safety. All launch trajectories would be over the Pacific Ocean. The study area's airspace is controlled primarily by the Los Angeles Air Route Traffic Control Center (ARTCC), and for northern trajectories, both Los Angeles and Oakland Centers.

Additionally, for missions involving reentry of the launch vehicle's second stage, the study area includes a downrange airspace hazard area (e.g., south Pacific Ocean or Indian Ocean). These airspaces could be controlled by the FAA, such as Los Angeles ARTCC, or another air navigation service provider.

K.3. Existing Conditions

The study area consists of airspace made up of SUA (Warning Areas and Restricted Areas) as well as an Altitude Reservation (ALTRV) area (Figure K-2). The SLD 30 is the using agency for the Warning Areas and Restricted Areas when these areas are activated by a Notice to Air Missions (NOTAM). The Los Angeles ARTCC controls the airspace around the Warning Areas , Restricted Areas, and the ALTRV. An ARTCC does not allow any air traffic they are controlling to enter these areas when active. The study area contains published aviation routes (Figures K-3 and K-4). The specific routes that would be impacted are identified prior to each launch and vary by mission.

Range Special Use Airspace and Published Aviation Routes

Table K-1: Restricted Areas, Warning Areas, and Altitude Reservation Area (Reference Figure K-2)

Designation	Altitude	Active Time
R-2517	Unlimited	Continuous
R-2534A	500 feet above the surface to unlimited	Intermittent by NOTAM at least 4 hours in advance
R-2534B	500 feet above the surface to unlimited	Intermittent by NOTAM at least 4 hours in advance
R-2535A	Surface to 100,000 feet MSL	0600-2200 local time Monday-Friday; other times by NOTAM at least 24 hours in advance
R-2535B	Surface to 100,000 feet MSL	0600-2200 local time Monday-Friday; other times by NOTAM at least 24 hours in advance
W-537	Surface to unlimited	Intermittent by NOTAM
W-289N	Surface to FL240	Intermittent by NOTAM
W-289	Surface to unlimited	Intermittent by NOTAM
W-412	Surface to 3,000 feet MSL	Intermittent by NOTAM
W-532	Surface to unlimited	Intermittent by NOTAM
ALTRAV (Southern Trajectory)	Surface to unlimited	Intermittent by NOTAM

Note: FL = Flight level,: MSL = Mean Sea Level; NOTAM = Notice to Air Missions

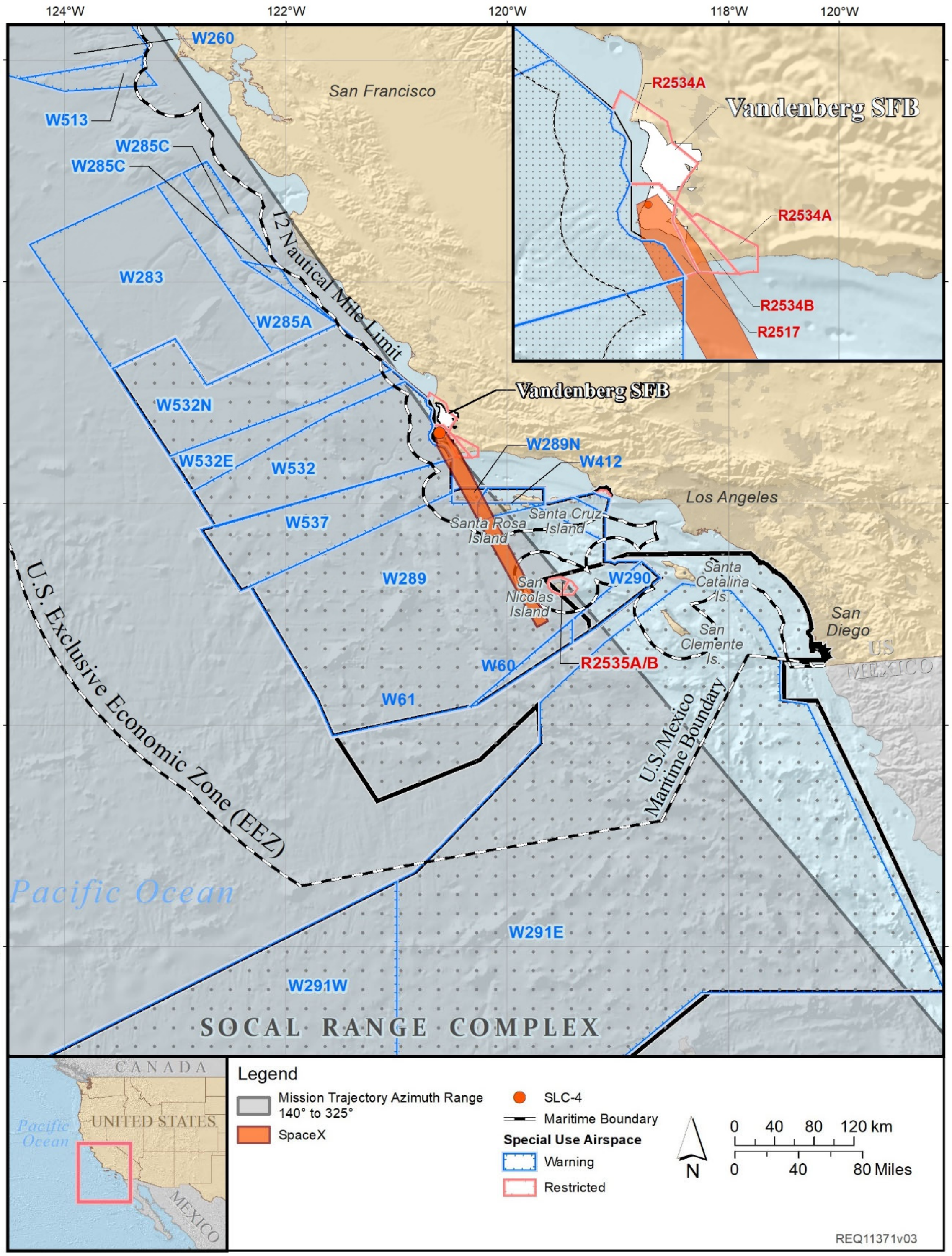


Figure K-2 Restricted Areas, Warning Areas, and Altitude Reservation Area

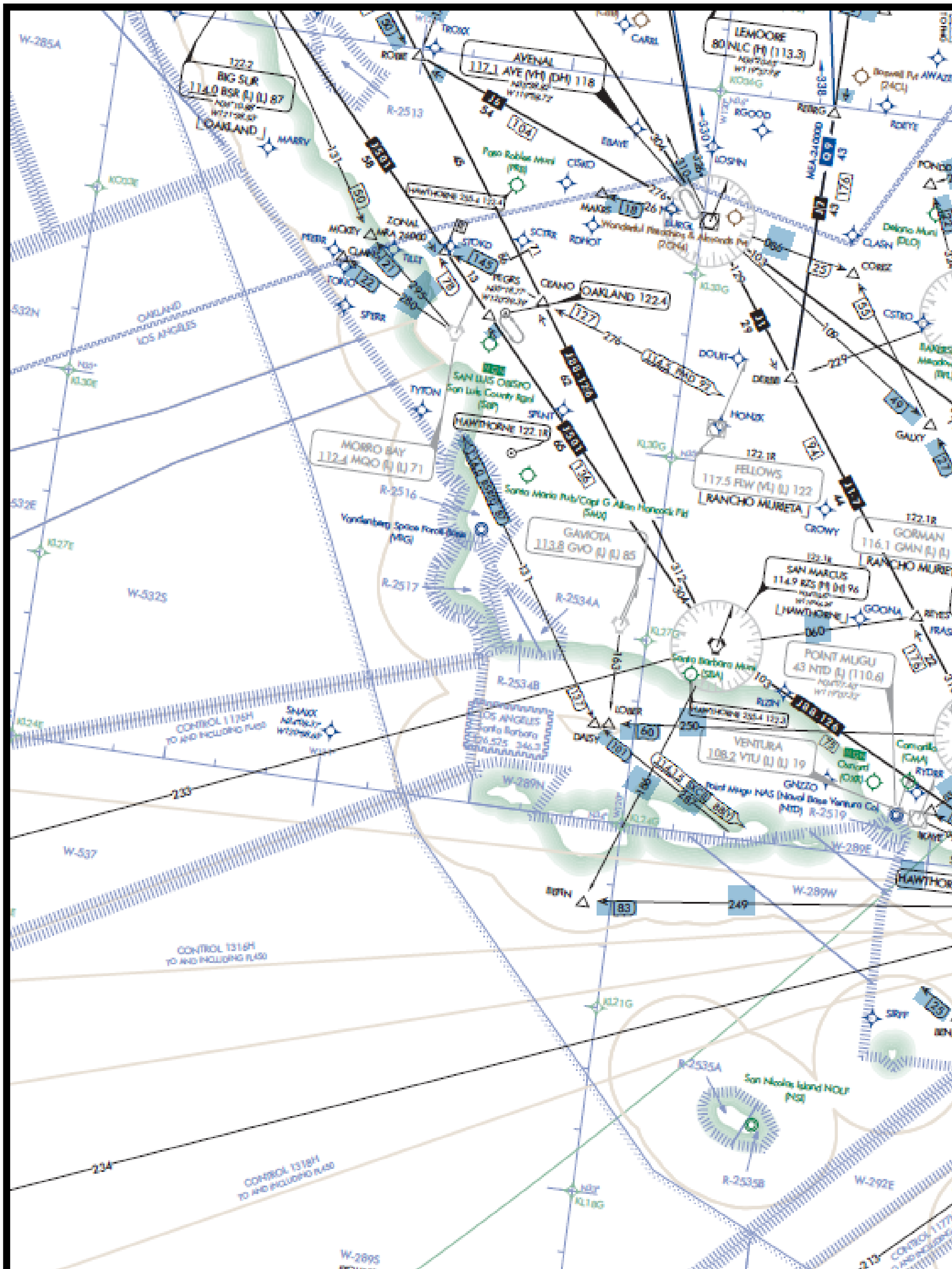


Figure K-3 Published Aviation Routes (Enroute High Altitude, Panel H-4)

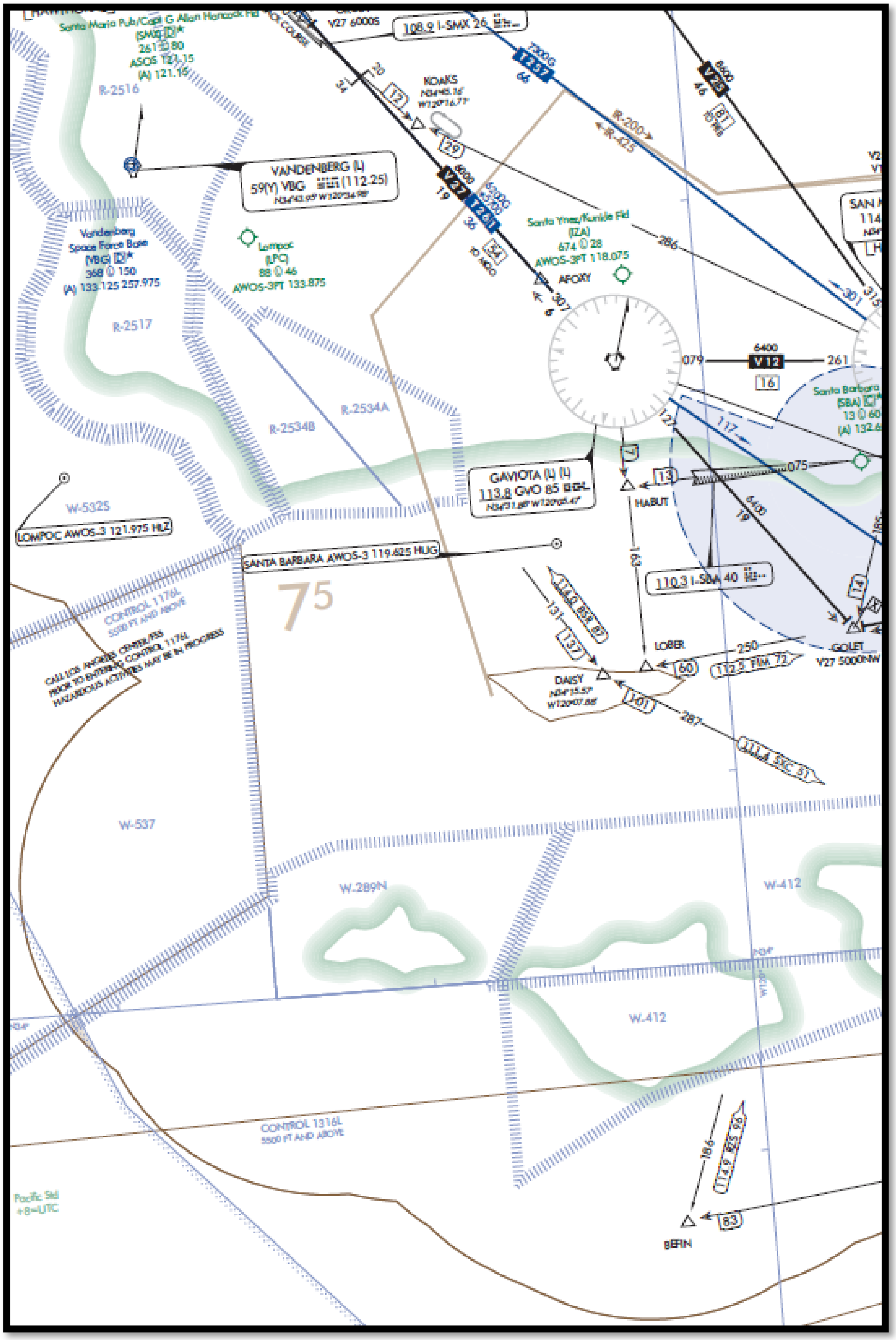


Figure K-4 Published Aviation Routes (Enroute Low Altitude, Panel L-4)

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

LETTER OF AGREEMENT

EFFECTIVE: 07 APR 2020

SUBJECT: Vandenberg Space Vehicle Launch/Reentry Communications and Coordination

1. PURPOSE: This agreement establishes communication, coordination between the Federal Aviation Administration (FAA), and the 30th Space Wing (30 SW) for launch and/or reentry operations in to or through the national airspace system in accordance with 14 CFR Part 400-1199, AFI 13-201, and FAA JO 7610.4. Procedures defined in this Letter of Agreement (LOA) are part of and supplemental to all Air Force Safety requirements and agreements and are not intended to circumvent the terms or conditions of a space operator license.

2. CANCELLATION: The agreement between Western Space and Missile Center and FAA Oakland Air Route Traffic Control Center, subject "Interagency Coordination for Western Space and Missile Center Operations", is cancelled with the implementation of this agreement.

3. DISTRIBUTION: This agreement is distributed to the signatories, FAA office of Commercial Space and the Western Service Area.

4. RESPONSIBILITIES:

a. All signatories must ensure personnel operating within the scope of this agreement are knowledgeable of, understand, and comply with the provisions of this agreement.

b. 30 SW will notify ATCSCC, ZLA and ZOA of mission status at 3 hours and at 60 minutes prior to launch/deorbit burn. SBA must be notified according to this timeline when operational.

c. 30 SW will notify ATCSCC, ZLA ZOA and SBA, of any freezes or changes to launch times, or deorbit burn prior to T -30 minutes.

d. All signatories and the contracting space operator will communicate on the mission hotline, hosted by ATCSCC, no less than Target Launch Time T-30 minutes or Deorbit Burn -30 minutes. The hotline will remain active at least until the vehicle has entered earth orbit, returned to earth, completed the mission, or the mission is cancelled. The 30 SW will notify the participants to the hotline of any changes to hotline start times.

e. Deviations from responsibilities or procedures, established in this agreement must be effected only after prior coordination is accomplished, and responsibilities are clearly defined in each case.

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

5. PROCEDURES:

a. 30th Space Wing must:

(1) Email the Altitude Reservation (ALTRV) request (per FAA Directives) to Central Altitude Reservation Function (CARF), no less than 12 days prior to a scheduled space operation (with cc. addresses, ZOA, ZLA, Fleet Area Control and Surveillance Facility (FACSFAC), ATCSCC Space Operations, Pacific Military Altitude Reservation Function (PACMARF), and others as appropriate.

(a) Include an operation name/number.

(b) Scheduled Primary and Backup dates/times of commencement and completion in Coordinated Universal Time (UTC).

(c) The altitudes requested.

(d) When aircraft hazard areas are contained in more than one area, the areas will be identified by name(s)/number(s)/letters.

(e) Request non-published airspace described by at least four fixes based on latitude and longitude (Degrees, Minutes).

(f) When the hazard areas fall in several Flight Information Regions (FIR), the portion CARF is responsible for will be indicated in a separate paragraph. In the event the hazard area falls within a FIR (ex. Auckland) which has an LOA with CARF, they will be included as an addressee in the message, and an additional paragraph indicating EUCARFs portion of the hazard area will be included in the message.

(2) Provide ZOA, ZLA, SBA and ATCSCC Space Ops a copy of the “Launch Airspace Safety Sheet” & “FOUO -11 Safety Sheet”, at least 12 days prior to the planned launch.

(3) 30 minutes prior to launch (L-30)/or deorbit burn start (DB-30), participate on the ATC real-time hotline. Be prepared to communicate the following information:

(a) Launch status, delays or other information affecting the launch/reentry/fly-back time.

(b) Countdown status, delays or other information affecting the liftoff/deorbit burn ignition time.

(c) Verbal confirmation of critical mission events, including “Lift off” declaration.

(d) Vehicle health until the vehicle has entered earth orbit, returned to earth, touched down or otherwise completed the mission.

(4) For any unplanned events, particularly those which could produce debris, immediately advise via mission hotline which areas are affected, which are not, provide last known position and vector (if available), and provide the airspace opening times of the hazard areas if they differ from times included in the Launch Airspace Safety Sheet.

(5) Notify CARF of mission completion, cancellation, and/or the time per the Hazard Safety Sheet when the ALTRV(s) and/or Backup ALTRV(s) are no longer necessary. When CARF is closed, notify the ATCSCC National Operations Manager (NOM) 540-359-3100. Verbal notification on the hotline is preferred; however, verbal notification must be followed in writing, to include all identified areas of the ALTRV.

b. ZOA and ZLA must:

(1) Collaborate and formulate the airspace management plan and intended Notice to Airmen (NOTAMs) with ATCSCC Space Ops in advance of the space operation in accordance with JO 7400.2.

(2) Notify local facilities and other appropriate affected agencies of the proposed space operation and the pre-planned airspace mitigation strategies as required.

(3) Issue and distribute required local NOTAMs, as appropriate or required.

***NOTE** – Local NOTAMs may be issued based on CARF ALTRV approval request and may need to be modified based on revisions from CARF.*

(4) Cancel local NOTAMs when the mission is complete, cancelled, or the airspace is no longer required.

c. ATCSCC must:

(1) Share appropriate mission data including the operational impact analysis and collaborate with ATC facilities to develop the airspace management plan.

(2) Publish requested traffic management initiatives, not issued by NOTAMs, via Command Center Advisories, when necessary.

(3) Activate and host the mission hotline, no less than 30 minutes prior to the scheduled target launch time or reentry deorbit burn.

***NOTE** - Activation of the hotline could occur more than 30 minutes prior to mission, if so requested by 30SW/or Space Operator designee. Supporting air traffic facilities will not be required to be on the call until 30 minutes prior to launch time or deorbit burn.*

(4) Coordinate any additional safety or hazard mitigations relevant to the launch or reentry vehicle as needed.

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

d. CARF must:

(1) Upon receipt of an ALTRV, coordinate the request in accordance with current FAA Orders.

(2) Coordinate ALTRVs with foreign countries in which CARF has written agreements, for missions which depart from the U.S.

(3) Approve ALTRVs at all altitudes for the space operation. Airspace requests that lie wholly within activated SUA will not be included in the ALTRV approval.

(4) Issue the approved ALTRV to 30SW, and applicable air traffic facilities, no less than three business days prior the proposed operation.

(5) Process updates and changes per FAA Orders.

(6) Issue CARF NOTAMs for the approved ALTRV airspace.

(7) Cancel ALTRV NOTAMS upon notification from the Project Officer, Range Scheduling Representative, or designee.

6. ATTACHMENT: Contact Information

JEFF B HUBERT
Digitally signed by JEFF B HUBERT
Date: 2020.02.13 14:21:41 -08'00'

Jeff B. Hubert
Air Traffic Manager
Oakland ARTCC

LISA MARIE JONES
Digitally signed by LISA MARIE JONES
Date: 2020.02.18 17:04:02 -08'00'

Lisa Jones
Air Traffic Manager
Los Angeles ARTCC

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

CARRIE L DRAPER
Digitally signed by CARRIE L DRAPER
Date: 2020.02.19 10:01:37 -08'00'

Carrie Draper
Air Traffic Manager
Santa Barbara ATC/TRACON

JENNIFER A ROSS
Digitally signed by JENNIFER A ROSS
Date: 2020.03.03 08:59:06 -05'00'

Jennifer Ross
Acting Air Traffic Manager
Air Traffic Control System Command Center

MASTALIR.ANTHONY.J.1101714930
Digitally signed by MASTALIR.ANTHONY.J.1101714930
Date: 2020.04.07 14:10:45 -07'00'

Anthony J. Mastalir
Col., USAF
Commander, 30 SW

MARK G KUCK
Digitally signed by MARK G KUCK
Date: 2020.02.19 10:29:43 -08'00'

Mark Kuck
FAA Air Traffic Representative
Western Service Center

Attachment

Contact Information

Name/Office/Function	Email	Phone
Oakland Center Operations Manager Oakland Center MOS	 9-AWP-ZOA-MOS@faa.gov	510 745-3331 510 745-3334
Los Angeles Center MOS Los Angeles Center Traffic Management Los Angeles Center Operations Manager	9-AWP-ZLA-MOS@faa.gov 9-AWP-ZLA-TMU@faa.gov	661-265-8249 661-575-2066 661 265-8205
Santa Barbara TRACON (SBA) SBA Airspace Spec.	AJT-SBA-ATM@faa.gov AJT-SBA-OS@faa.gov	805 681-0166 Recorded Line 805 681-0116 805 681-0534 ask for Airspace
30 Space Wing/2ROPS Airspace/Offshore Mgmt 30 SW Scheduling Office	2ROPS.DON@us.af.mil 2ROPS.DOS@us.af.mil	805-606-0002 805-606-8825
ATCSCC Space Operations Central Altitude Reservation Function (CARF) Challenger Space Operations Room Launch/Reentry Hotline National Operations Manager (NOM) (after hours, weekends and holidays)	9-AWA-AJR-Space.Ops@faa.gov 7-AWA-CARF@faa.gov	 540-422-4212 540-422-4053 540-359-3200, 2456# 540-359-3100 540-422-4100

APPENDIX L
United States Space Force, Space Launch Delta 30 and United States Coast Guard Memorandum of Agreement

MEMORANDUM OF AGREEMENT

BETWEEN THE

U.S. SPACE FORCE, SPACE LAUNCH DELTA 30

AND

U.S. COAST GUARD DISTRICT ELEVEN

FOR

SPACE VEHICLE AND MISSILE LAUNCH SUPPORT

APPROVED FOR SPACE LAUNCH DELTA 30:

STEVENS.THOMAS.E.1230451784 Digitally signed by STEVENS.THOMAS.E.1230451784 Date: 2022.12.08 16:46:59 -08'00'

THOMAS E. STEVENS
NH-04, DAF, USSF
Executive Director, SLD 30

Date: 8 Dec 22

APPROVED FOR U.S. COAST GUARD DISTRICT ELEVEN:

Andrew Sugimoto

ANDREW M. SUGIMOTO
Rear Admiral, USCG
Commander, Eleventh CG District

Date: 19 Sept 2022

1. PURPOSE:

This Memorandum of Agreement (MOA) between the Space Launch Delta 30 (SLD 30) and the U.S. Coast Guard (USCG) District Eleven, contains the provisions, procedures for implementing USCG liaison, patrol, and maritime warning assistance in support of space vehicle and missile launches on the Western Launch and Test Range (WR). The USCG District Eleven support mission to aid in mitigating risk on the high seas for marine traffic within the SLD 30 identified launch hazard areas. USCG support also includes broadcast notice to mariners (BNM), local notice to mariners (LNM), and limited access areas (LAA) authority under Captain of the Port. This MOA does not alter the jurisdiction or responsibilities of any agency. The MOA is intended only to improve the internal management of existing responsibilities within each agency and enhance interagency coordination and communication. Neither this MOA, nor any actions to implement it, shall be construed to create any right or benefit, substantive or procedural, legally enforceable by any party or person. The Parties retain discretion to deviate from the provisions of the MOA after prior notification to the other Party.

2. AUTHORITY:

The USCG's authority to enter into this Agreement can be found in the following sources: 14 U.S.C. § 504(a), 14 CFR § 431.75, 14 CFR § 450.147, 14 CFR § 417.111 and USCG Commandant Instruction 5216.18.

3. PARTIES:

The SLD 30 is responsible for the safe conduct of launch and test operations from the WR. The Launch Risk Analysis Section within the SLD 30 Launch Safety Office (SLD 30/SEL) is responsible for determining the launch hazard areas for each launch from the WR. The 2nd Range Operations Squadron (2 ROPS) conducts air and sea surveillance of these launch hazard areas for each launch from the WR. The 2 ROPS Area Surveillance Officer (ASO) is responsible for the conduct of surveillance operations within the identified launch hazard area and for reporting the location of any seaborne vessels to the SLD 30/SEL Surveillance Control Officer (SCO) and Sea Surveillance Officer (SSO). The SCO and SSO are responsible for determining the launch risk to seaborne vessels and providing vessel redirect instructions, as required, to the ASO in order to minimize the hazards to the general public and remain within established risk criteria (individual and collective).

USCG District Eleven (D11) represents the U.S. Government on matters of maritime control. They are also the interface for all USCG/USCG Auxiliary launch support for safety and security operations within the USCG District Eleven area of responsibility.

4. POINTS OF CONTACT (POC):

a. The SLD 30 Points of Contact are the 2 ROPS/DON Flight Chief, 805-606-4761 or 805-606-0002, 1602 California Blvd STE 248, Vandenberg SFB, CA 93437 and SLD 30/SE 805-605-7168.

b. The USCG POC is the District Waterways Management Office (dpw), U.S. Coast Guard District Eleven, (510) 437-5984, Coast Guard Island, Bldg. 50-2, Alameda, CA 94501-5100.

5. RESPONSIBILITIES:

Space Launch Delta 30 agrees to the following:

a. Contingency Plans: SLD 30 will provide, or ensure commercial entities provide current copies of the following plans to the Coast Guard:

(1) Ship Hazard Areas as defined through RCC-321 section 3.4 to match 14 CFR 450.135 and 14 CFR 417.111(i) requirements:

(a) A Ship Hazard Area accounting for the impact area of l debris fragments in a catastrophic failure event;

(2) Mishap Investigation Plan as prepared IAW 14 CFR 450.173(d) and 14 CFR 417.111 (h) including the following provision:

(a) Immediate notification to the National Response Center (800) 424-8802 and Coast Guard Pacific Area / District Eleven Command Center (510) 437-3701 in the event of a launch site accident over or adjacent to navigable waters.

b. Response Plans: SLD 30 will provide, or ensure commercial entities provide current copies of the following plan to Coast Guard District Eleven, Sector LA/LB, and Sector San Diego:

(1) Response Plan as prepared IAW 14 CFR 450.173(c) and 14 CFR 417.111 (h) including the following provision:

(a) The plan should include procedures to ensure the consequences of a launch accident, launch incident, reentry accident, reentry incident, or other mishap occurring in the conduct of a reusable launch vehicle mission are contained and minimized so that it does not affect a navigable waterway. The plan should include response measures for impacts that cannot be avoided, including procedures to mitigate hazards to public health and safety, and the contamination of waterways.

c. Scheduling and Notification Activities:

(1) SLD 30 will provide D11 an annual launch schedule forecast for the fiscal year by 30 September each year.

(2) (L-30 days) SLD 30 will submit launch information to D11 to request a LNM article via D11-SMB-D11-LNM@uscg.mil with a goal of at least 30 days prior to scheduled launch. It is understood that with the emerging commercial launch industry, some launch programs may provide flight trajectory updates to accommodate late breaking launch

vehicle performance reviews requiring revisions to hazardous areas or provide launch trajectory data within 30 days because of a high frequency of launch.

SLD 30 shall provide all updates as received from launch developers due to modification or changes.

Launch information should include the following:

(a) Operation Number;
(b) Vehicle type and launch description;
(c) Primary and secondary launch date and time in local and GMT;
(d) Launch Hazard Areas, perimeter coordinates in degrees, minutes, and seconds to three decimal places, if applicable;
(e) Launch/Re-entry risk evaluation, type of debris, pollution risk, safety POC's;
(f) Perimeter coordinates shall be minimized to 4 coordinate positions per area box to limit maritime confusion and charting requirements.

(3) At L-20 days or as soon as SLD30 receives the launch inf ormation, BNM request is sent: D11SPACE@uscg.mil

(4) (L-72 hours) SLD 30 shall contact the following:

(a) D11 to confirm launch information for the LNM and Local Sector BNM, NAVTEX, and SMIB notifications are scheduled and distributed.

(b) National Geospatial-Intelligence Agency (NGA) to request Navigation Area XII warning notifications for launch activities occurring over water from 150 nautical miles offshore to deep-ocean. Launch information should be sent to navsafety@nga.mil and/or (571) 557-5455.

(c) Launch information shall be sent to D11SPACE@uscg.mil and RCCAlameda1@uscg.mil.

Coast Guard District Eleven agrees to the following:

a. Scheduling and Notification Activities:

(1) Review annual forecast of scheduled launches and provisions of this agreement each year;

(2) (L-90 days) Review scheduled launch operations, coordinate waterways risk, and make determination if LAA is recommended;

(3) (L-15 days) Publish launch information in the Local Notice to Mariners;

(4) (L-72 hours) Coordinate Local Broadcast Notice to Mariners (BNM) and NAVTEX prior to launch with respective operational USCG Sector;

(5) (L-day) Confirm local Safety Marine Information Broadcast (SMIB) via VHF-FM is scheduled to be distributed 3 hours before and during launch;

(6) Fulfill any other statutory responsibility pertaining to USCG jurisdiction and authorities;

(7) Coast Guard may communicate directly with the various providers launching out of Vandenberg in support of meeting its statutory obligations to the maritime community.

6. EFFECTIVE DATE AND TERMINATION:

This MOA becomes effective upon signature by an authorized agent from each organization. It may be terminated at any time by mutual agreement or by one party upon giving the other 180 days written notice.

7. MODIFICATIONS AND REVIEW:

This MOA may be modified by mutual agreement at any time. It will be reviewed triennially to determine whether it should be continued as is, modified, or terminated.

8. OTHER FEDERAL AGENCIES:

This MOA does not bind any federal agency, other than the Parties, nor waive required compliance with any law or regulation.

9. FINANCIAL DETAILS:

This MOA does not authorize the expenditure or reimbursement of any funds, nor does it obligate the partners to expend appropriations or enter into any contract or other obligation. All obligations of the partners under this MOA shall be subject to the availability of funds and resources for such purposes. No provision in this MOA will be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, Section 1341 of Title 31, United States Code.

10. OTHER PROVISIONS:

Nothing in this MOA is intended to conflict with current laws or regulations or the directives of the PARTIES. If a term of this MOA is inconsistent with such authority, then that term shall be invalid, but the remaining terms and conditions of this MOA shall remain in full force and effect.

Distribution:

SLD 30 SW/FM, JA, SE
SLD 30 MSG/CC (CES, CONS, FSS/MOF, SFS, Det 1)
SLD 30/CV (RANS, SCS, WS, 2 SLS)
HQ AFSPC(A4/A7 USSF SPOC SpOC/S3/6RA, AFSOC/A3OU, HAF/A3, AF/A3T /A3)
USCG District Eleven (DXO, DRMC, DRE, DL, DM, and DMF)
USCG Sector Los Angeles/Long Beach
USCG Sector San Diego

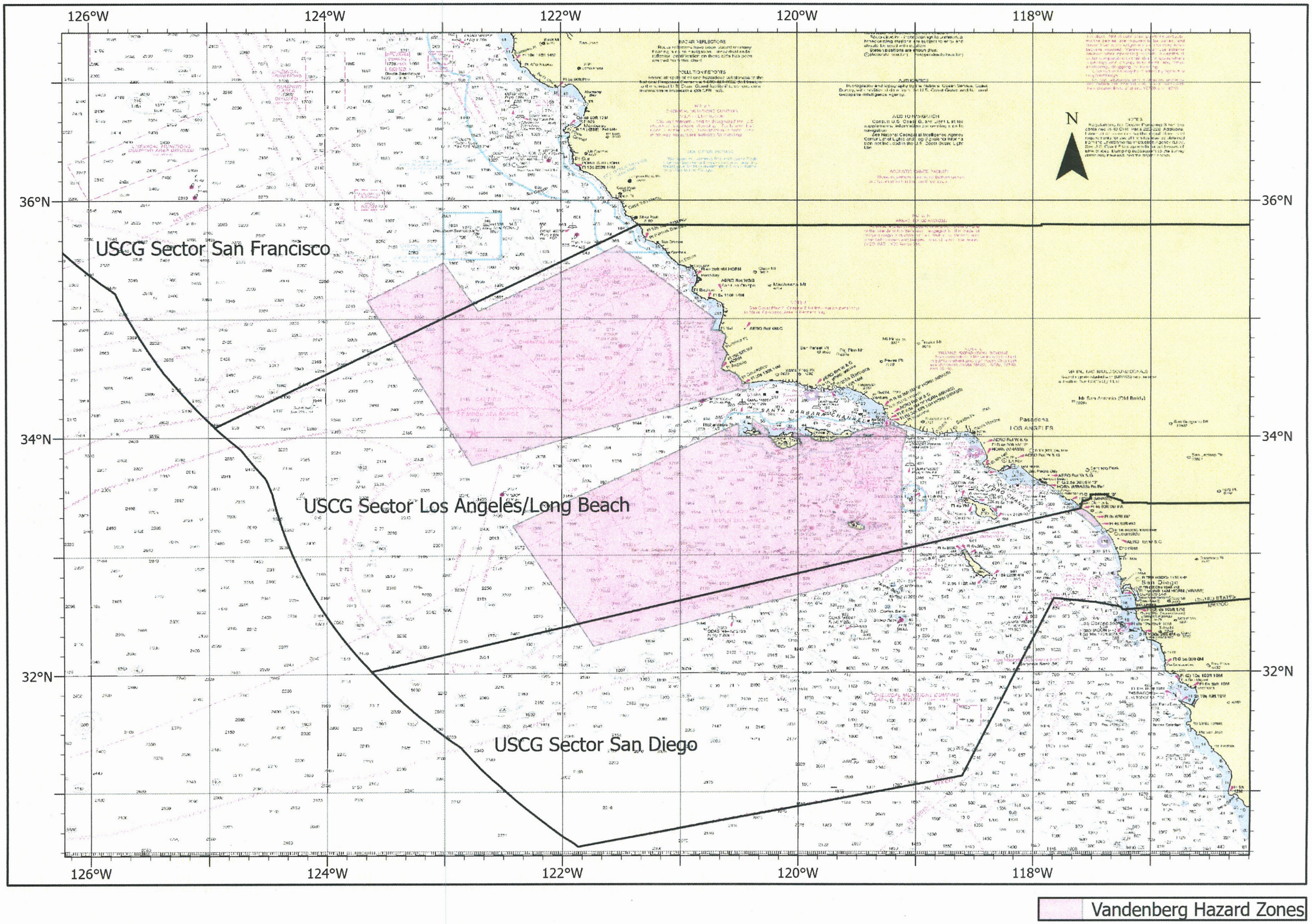
Appendix A – Specific Points of Contact

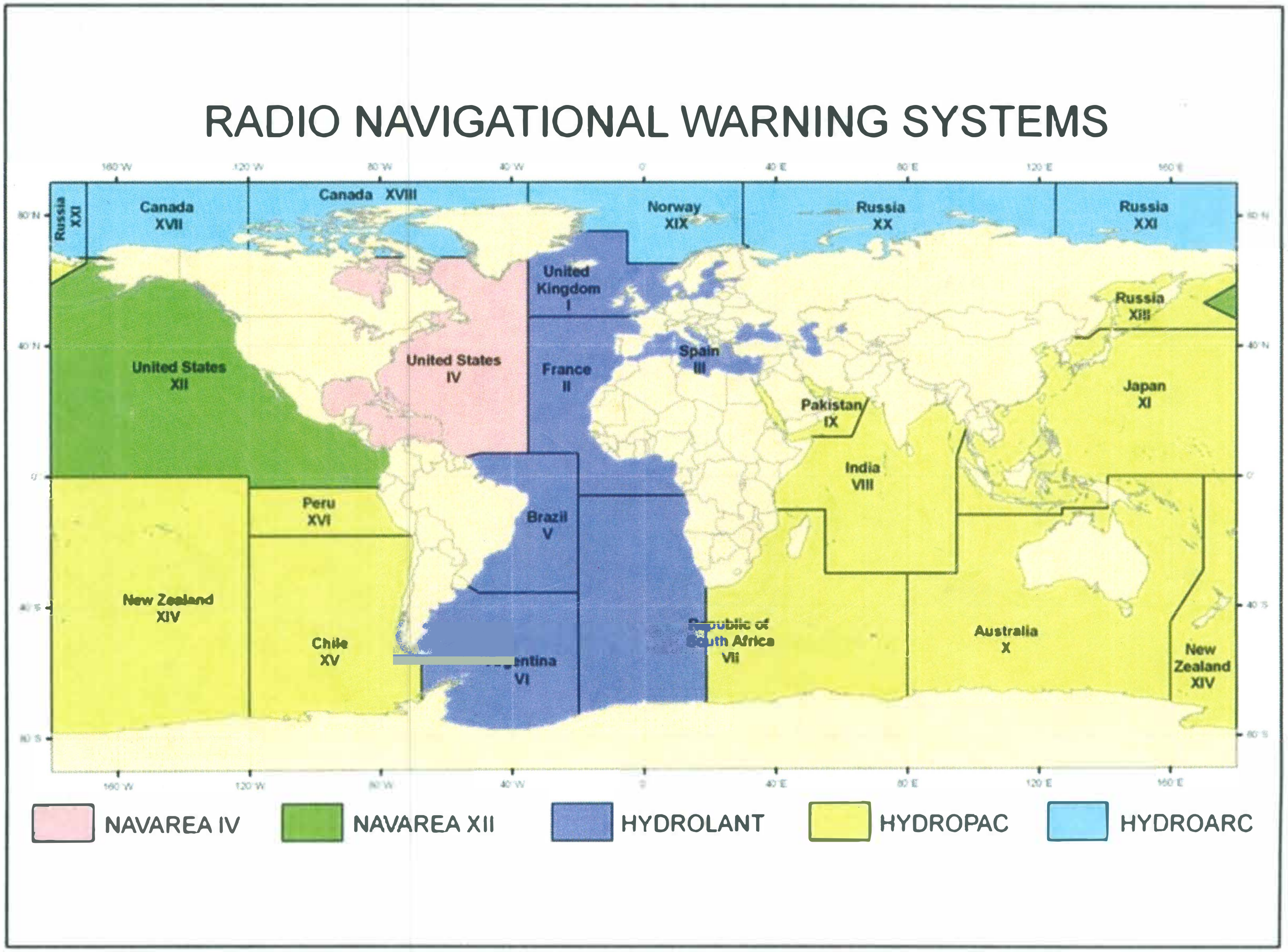
OFFICE	NUMBER	RESPONSIBILITY
Coast Guard District Eleven Waterways Management D11-DG-D11-Waterways@uscg.mil	510-437-2968	Chief, Waterways Management
Coast Guard District Eleven Marine Transportation System Officer D11-DG-D11-Waterways@uscg.mil	510-437-5984	Space Liaison Officer
Space Launch Delta 30 2ROPSDOSMailbox@us.af.mil	805-605-8011	Operations
Coast Guard District Eleven LNM Editor D11-SMB-D11-LNM@uscg.mil	510-437-2929	Publication of Local Notice to Mariners
Coast Guard Sector LA-LB Command Center D11-SMB-SECTORLALB-SCC@uscg.mil	310-521-3801	Emergency contact number for all Search and Rescue in COTP zone
Coast Guard Sector San Diego Command Center jhoc@uscg.mil	619-278-7033	Emergency contact number for all Search and Rescue in COTP zone
Coast Guard District Eleven Command Center RCCAlameda1@uscg.mil	510-437-3701	Emergency contact number for all Search and Rescue in D11

Appendix B – List of Acronyms

2ROPS 2nd Range Operations Squadron
ASO Area Surveillance Officer
BNM broadcast notice to mariners
CFR Code of Federal Regulations
COTP Captain of the Port
D11 Coast Guard District Eleven
DPW District Waterways Management Office
IAW In accordance with
LA/LB Los Angeles/Long Beach
LAA limited access areas
LNM local notice to mariners
MOA Memorandum of Agreement
NAVTEX Navigational Telex
POC Point of contact
SLD Space Launch Delta
SMIB Safety Marine Information Broadcast
SSO Sea Surveillance Officer
USCG United States Coast Guard
USSF Unites States Space Force
WR Western Launch and Test Range

Appendix C – Vandenberg Hazard Zones




RADIO NAVIGATIONAL WARNING SYSTEMS
Russia XXI
Canada XVII
Canada XVIII
Norway XIX
Russia XX
Russia XXI
United Kingdom I
Russia XIII
United States XII
United States IV
France II
Spain III
Japan XI
Pakistan IX
India VIII
Peru XVI
Brazil V
New Zealand XIV
Chile XV
VI
Africa
VII
Australia X
New Zealand XIV
NAVAREA IV
NAVAREA XII
HYDROLANT
HYDROPAC
HYDROARC

3.3.3 Aircraft Hazard Volumes for Planned Debris Releases

The range must confirm that Notices to Airmen are issued that encompass the volume and duration necessary to protect aircraft from debris capable of causing an aircraft accident due to all planned events.[22]

NOTE	Federal law[23] defines an aircraft accident as “an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.” As described in the glossary, federal law also defines death, serious injury, and substantial damage for the purposes of accident reporting.

3.3.4 Mishap Response

The range must coordinate with the FAA to ensure timely notification[24] of any expected air traffic hazard associated with range activities. In the event of a mishap, the range must immediately inform the FAA of the volume and duration of airspace where an aircraft hazard is predicted.

3.4 Ship Protection[25]

The term “ship” includes boats and watercraft of all sizes.

3.4.1 Non-Mission Ship Criteria

a. Ship Warning Areas. Notices to Mariners (NOTMARs) shall be issued to warn non-mission ships of regions defined by one of the following approaches:[26]

(1) where the probability of debris capable of causing a casualty impacting on or near a vessel exceeds 10E−6 (1E−5), accounting for all relevant hazards; or

(2) the union of the areas where the individual probability of casualty for any person onboard exceeds the criteria in a of Subsection 3.2.1, the collective casualty expectation for an individual ship would exceed the criterion in b of Subsection 3.2.1, and the catastrophic risk for an individual ship would exceed the provisional criteria outlined in Section 3.8.

In some situations, warnings may be optional when expected ship traffic in the affected area is low and adequate observation will be performed.

b. Non-Mission Ship Risk Criteria. People on observed non-mission ships shall be included[27] in the determination of compliance with collective risk criteria in b of

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[22] Planned debris releases include intercept debris, jettison stages, nozzle covers, fairings, inter-stage hardware, etc.

[23] 49 C.F. R. 830.2. 1 October 2011.

[24] This may be accomplished through preflight analyses and coordination as described in Chapter 4 of the supplement.

[25] Chapter 4 of the supplement provides important guidelines on the proper implementation of ship protection measures.

[26] The warning area may be expanded to provide additional mitigation so that risk criteria (3.2.1) are met, as discussed in Chapter 4 of the supplement.

[27] Mission risk shall include all members of the GP on land, on ships, and on aircraft.

Subsection 3.2.1 and provisional catastrophic criteria in c of Subsection 3.2.1. Observation to locate non-mission ships is an acceptable method to ensure compliance, provided that suitable observation techniques are used to include the region(s):

(1) where the individual probability of casualty exceeds the criteria in a of Subsection 3.2.1; and

(2) where the collective casualty expectation or provisional catastrophic risk criteria (b or c of Subsection 3.2.1, respectively) would be exceeded given a conservative estimate of typical ship traffic.

3.4.2 Mission-Essential Ship Criteria

a. Mission-Essential Ship Hazard Areas. Mission-essential ships will be restricted from hazard areas defined by either:

(1) the region where the probability of debris capable of causing a casualty impacting on or near a vessel exceeds 100E−6 (1E−4), accounting for all relevant hazards; or

(2) The union of the areas where the individual probability of casualty for an exposed person onboard exceeds the criteria in a of Subsection 3.2.2, the collective risk criteria in b of Subsection 3.2.2, or the catastrophic risk criteria in c of Subsection 3.2.2.

b. Mission-Essential Ship Risk Criteria. Ship-board MEP shall be included in the assessment of compliance with the collective risk criteria in b of Subsection 3.2.2 and catastrophic risk criteria in c of Subsection 3.2.2.

3.4.3 Ship Hazard Areas for Debris Releases

The range must confirm that NOTMARs are issued for each planned debris release event that encompasses the areas and durations necessary to satisfy the risks as described in a of Subsection 3.4.1 or contain, with 99% probability of containment, all resulting debris impacts capable of causing a casualty.[28]

3.4.4 Mishap Response

The range must coordinate with the United States Coast Guard or other appropriate authorities to ensure timely notification of any ship traffic hazard associated with range activities. In the event of a mishap, the range must promptly inform the appropriate authority(s) of the area and duration of navigable waters where a ship hazard is predicted.

3.5 Infrastructure Protection

3.5.1 Mission-Essential Infrastructure Criteria

Mission-essential infrastructure (such as radar equipment) is treated separately as critical assets.

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[28] This 99% probability of containment region corresponds to a 3-sigma dispersion region for a single impact if the impact uncertainty can be characterized by a bivariate normal impact probability distribution.