CALIFORNIA COASTAL COMMISSION
455 MARKET STREET, SUITE 300
SAN FRANCISCO, CA 94105-2219
FAX (415) 904-5400
Voice (415) 904-5200

W10a

CD-0003-24 (United States Space Force)

June 12, 2024

EXHIBITS

Figure 1-1: Regional Location of Proposed Action Area

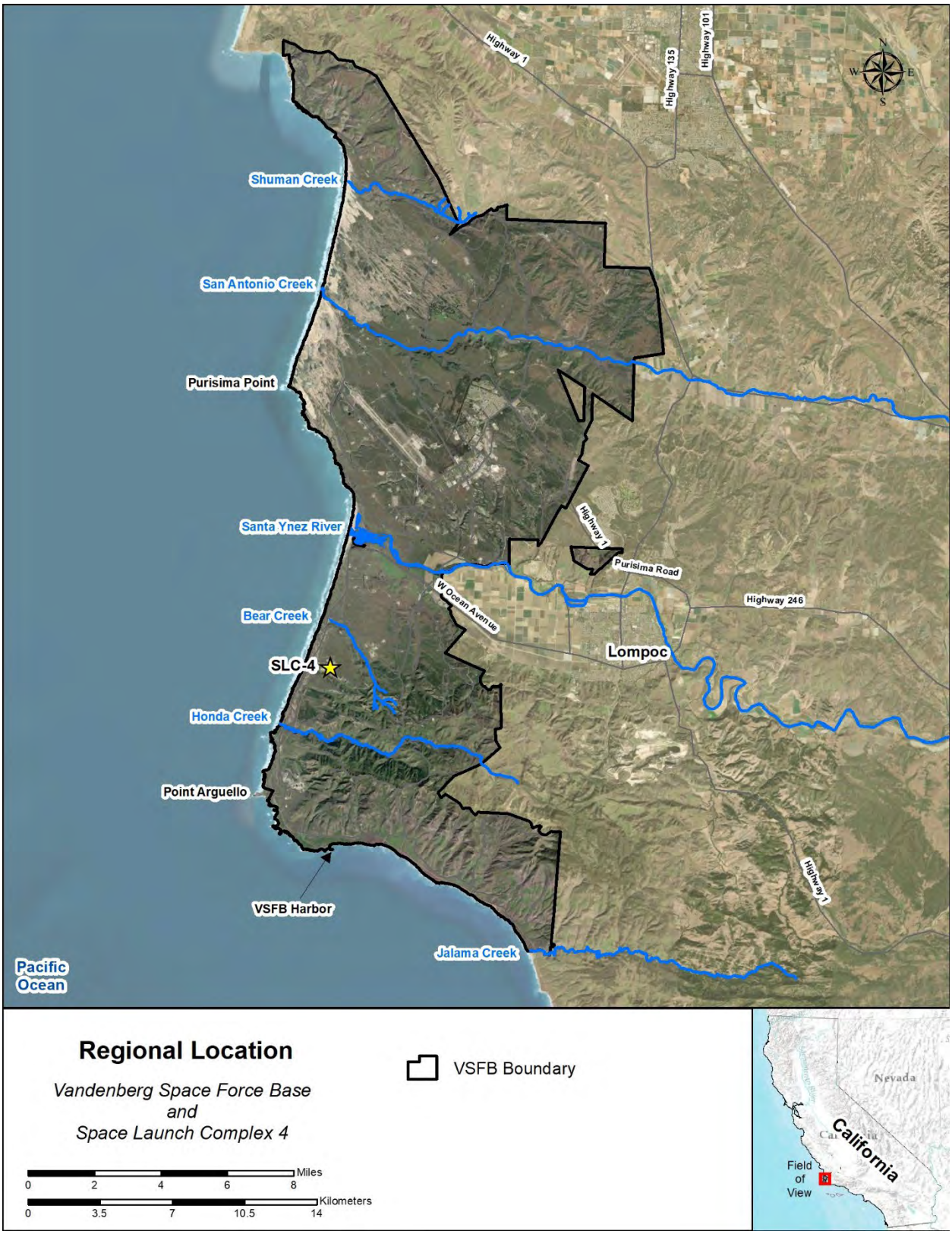


Exhibit 1
CD-0003-24

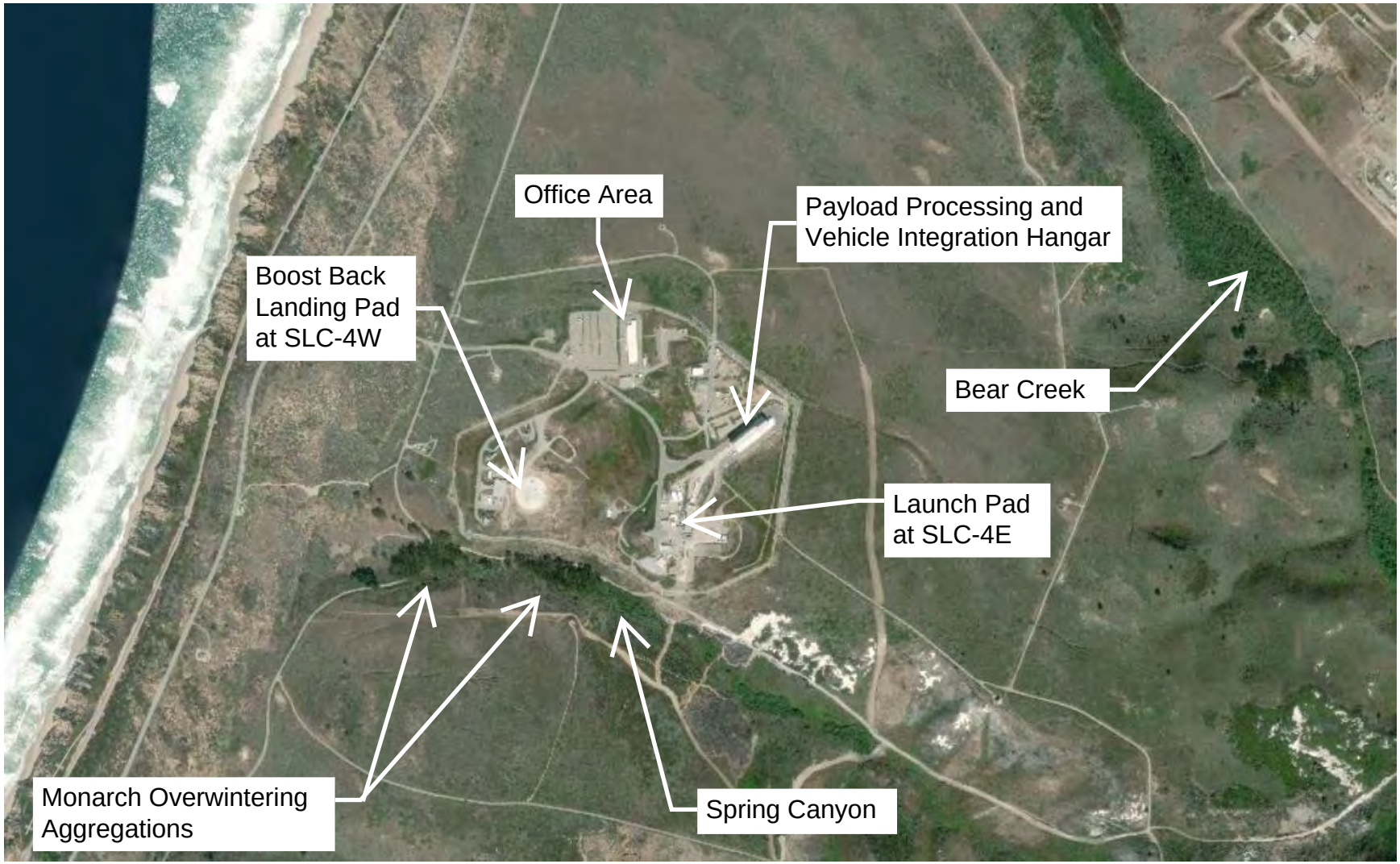


Exhibit 2
CD-0003-24

DEPARTMENT OF THE NAVY
COMMANDER NAVY REGION SOUTHWEST
750 PACIFIC HIGHWAY
SAN DIEGO CA 92132-0058

IN REPLY REFER TO:

5090
Ser N40
October 25, 2022

John Ainsworth
Executive Director
California Coastal Commission
455 Market Street, Suite 300
San Francisco, California 94105-2219

Dear Mr. Ainsworth,

SUBJECT: DEPARTMENT OF DEFENSE POSITION ON REQUESTS FOR COASTAL DEVELOPMENT PERMITS ON FEDERAL PROPERTY IN CALIFORNIA

On behalf of the military Services in California, and consistent with previous communications on this uniquely federal issue, this letter serves as notice that the Department of Defense (DoD) will undertake its federal actions in a manner consistent to the maximum extent practicable with the enforceable policies of California's approved coastal zone management programs through the federal consistency process under the Coastal Zone Management Act (CZMA).

Recently, the DoD has been in receipt of multiple communications from the California Coastal Commission (CCC) requesting that the Coastal Development Permit (CDP) process be utilized where a private entity is involved in the military's federal activity.

Federal activities include "any functions performed by or on behalf of a Federal agency in the exercise of its statutory responsibilities." 15 CFR 930.31(a). Furthermore, under the CZMA (16 USCS § 1453(1)), "lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents" are excluded from the coastal zone.

The question of whether "solely to the discretion of or which is held in trust by the Federal Government" includes the actions of private entities at the direction of the Federal government, was the subject of litigation in *Manchester Pac. Gateway LLC v. Cal. Coastal Comm'n (2008)*. In this case, the Navy had leased the Navy Broadway Complex (NBC) to a private developer in return for a new Navy headquarters building on the property. The court rejected the CCC's argument that the involvement of a private entity negated the Federal government's sole discretion under the statute. Specifically, the California 9th Circuit Court held that:

> "(1) the focus of the statute is on the federal use of federal lands, and not the use of private parties to accomplish federal objectives and (2) the Federal Government, through Congressional and agency action, acted in its sole discretion by legislative mandate and agency action to define the use of the NBC and to permit the Secretary of the Navy to jointly develop the NBC in conjunction with a private developer."

Exhibit 3
CD-0003-24

5090
Ser N40
October 25th, 2022

CDPs are only required for development in the coastal zone as per California Public Resources Code 30600. Any federal activity, lease or project undertaken on a military installation, is by definition not in the coastal zone. All activities taking place on federally owned DoD land, including those that utilize private entities, are done so in a manner exercising our statutory responsibilities. Federal activities include a range of activities where a Federal agency makes a proposal for action initiating an activity or series of activities when coastal effects are reasonably foreseeable. 15 CR 930.31(a). Assuming arguendo that a particular activity did not satisfy the definition of Federal activity in 15 CFR 930.31(a), as long as the DoD is not issuing a federal license or permit to an applicant under subpart D and E or granting federal assistance under subpart F, the federal activity residual category would apply. 15 CFR 930.31(c). The Federal consistency process would still be the appropriate avenue.

We thank you for your partnership with the military in California and look forward to continuing to work with you and your staff on DoD activities through the Federal Consistency process. Our point of contact on this issue is Kathryn Ostapuk, who can be reached at kathryn.g.ostapuk.civ@us.navy.mil or 619-933-2561.

Sincerely,

J. C. GOLUMBFSKIE-JONES
Deputy Regional Environmental Coordinator
By Direction
of the Commander

Copy to: Cassidy Teufel, Federal Consistency Manager, CCC
Kate Hucklebridge, Senior Deputy Director, CCC
Kerry Kehoe, Federal Consistency Specialist, Office for Coastal Management

SLC-5 Department of the Air Force (DAF) Regulations and Advisories

The DAF has adopted numerous regulations, advisories, and standards for Air Force/Space Force Bases that will support space launch programs and the placement and configuration of these launch sites. Vandenberg Space Force Base was identified as a location to launch rockets as the flight paths would work best for human health and safety concerns as they would be over no or low human populations. Further, this location fulfills the need to launch payloads into polar orbit (versus geosynchronous). Federal government payloads are launched by commercial space entities and these actions are federal activities being performed on behalf of a federal agency in exercise of its statutory responsibility (15 CFR 930.31(a)).

DoD/DAF standards exist in the context of the following federal laws and regulations:

Commercial Space Launch Act (CSLA; 1984) permits the use of Government property by launch licensees and states in part that:

> *49 USC app. 2601 Sec 2:*
>
> *(4) the private sector in the United States has the capability of developing and providing private satellite launching and associated services that would complement the launching and associated services now available from the United States Government;*
>
> *(5) the development of commercial launch vehicles and associated services would enable the United States to retain its competitive position internationally, thereby contributing to the national interest and economic well-being of the United States;*
>
> *(6) provision of launch services by the private sector is consistent with the national security interests and foreign policy interests of the United States and would be facilitated by stable, minimal, and appropriate regulatory guidelines that are fairly and expeditiously applied; and,*
>
> *(7): the United States should encourage private sector launches and associated services and, only to the extent necessary, regulate such launches and services in order to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security interests and foreign policy interests of the United States.*
>
> *49 USC 2614, Sec 15:*
>
> *(a) The Secretary shall take such actions as may be necessary to facilitate and encourage the acquisition (by lease, sale, transaction in lieu of sale, or otherwise) by the private sector of launch property of the United States which is excess or is otherwise not needed for public use and of launch services, including utilities, of the United States which are otherwise not needed for public use.*

DoD Directive 3230.3 DoD Support for Commercial Space Launch Activities (1986) states in part that:

> *It is DoD policy to:*
>
> *4.1 Encourage the U.S. private sector development of commercial launch operations.*

Exhibit 4
CD-0003-24

4.1 Endorse fully and facilitate the commercialization of U.S. Expendable Launch Vehicles (ELVs), consistent with U.S. economic, foreign policy, and national security interests.

Title 51 – National and Commercial Space Programs of the United States Code (U.S.C.) states in part that:

§ 20102. SEC 2. Findings:

(8) the strengthening and expansion of the Nation's space transportation infrastructure, including the enhancement of launch sites and launch site support facilities, are essential to support the full range of the Nation's space-related activities'

§ 20102. Sec 102: Policy

It is declared to be national policy that the United States should – (7) sustain a mixed fleet by utilizing commercial expendable launch vehicle services to the fullest extent practicable

10 U.S.C. § 2276 Commercial Space Launch Cooperation (2013) – Congress authorized the Secretary of Defense to encourage commercial space activities by enabling domestic corporation investment in DoD space transportation infrastructure. Congress also authorized the DoD to maximize private entities using DoD space transportation infrastructure capacity.

This document states in part that:

(a) *Authority – The Secretary of Defense may take such actions as the Secretary considers to be in the best interest of the Federal Government to –*
   (1) *Maximize the use of the capacity of the space transportation infrastructure of the Department of Defense by the private sector in the United States;*
   (2) *Maximize the effectiveness and efficiency of the space transportation infrastructure of the Department of Defense;*
   (3) *Reduce the cost of services provided by the Department of Defense related to space transportation infrastructure at launch support facilities and space recovery support facilities;*
   (4) *Encourage commercial space activities by enabling investment by covered entities in the space transportation infrastructure of the Department of Defense; and*
   (5) *Foster cooperation between the Department of Defense and covered entities.*

Determining the location of a Space Launch Complex (SLC) on VSFB. There are several major planning constraints for future development on VSFB, including existing space and missile launch sites and flight hazard zones, Explosive Safety Quantity-Distance Arcs, utility corridors, natural and cultural resources.

SLC-5 is currently the only unused previous launch site on Vandenberg SFB. This location maximizes re-use of previously disturbed land from the Scout operation. Any other locations on VSFB would be previously unused for launch. Potential locations would be green field sites or areas were a portion of the site is previously paved but would not account for the entirety of the program requirement. These sites would also require the appropriate utilities and infrastructure developments, which would further increase impacts to coastal resources. Other locations that were considered for the Phantom Space program include Lompoc Terrace (Consistency Determination for Blue Origin at SLC-9 in progress), Building 330 [Figure 1 (CD for Relativity at SLC-11 in preparation)], the former General Electric Radio Tracking Station (GERTS) site demolished in 2006 (Figures 2 and 3), and Vina Terrace (Figures 4 and 5).

The specific configuration of SLC-5 was developed in coordination with VSFB ground safety inputs for explosive site planning to minimize impact in case of anomaly or mishap; VSFB range safety for overflight paths in case of anomaly or mishap; and, in compliance with the VSFB Wildland Fire Management Plan (WFMP).

The Environmental Planning Function at VSFB provided inputs for avoidance during the initial planning phase, thus there are no graphics showing earlier iterations as these factors were taken into consideration early in the process. The layout was specifically designed to minimize impacts to natural and cultural resources, specifically associated with Honda Creek. The flame bucket configuration was rotated to ensure the exhaust plume was directed away from Honda Creek to reduce potential impacts. The fire breaks and fuel management areas are configured to account for the direction of the exhaust plume and potential for fire ignition sources. The fuel management and firebreaks would have typically been larger but were restricted due to topography in this area.

Further, the lighting plan was developed to reduce impacts to natural resources. The lighting will be pole-mounted, bug-friendly, T24 compliant light-emitting diode (LED) flood lights. Except when necessary for safety or performance of launch operations, or maintenance, artificial lighting at SLC-5 will be minimized during the hours of darkness. The lighting plan would be designed such that lights are directed away from Honda Canyon and would be shielded to reduce scatter into undeveloped areas. Lighting plan design will minimize illumination of Honda Canyon such that that lighting levels of 1-foot candle would not extend beyond the SLC-5 facility.

The location of fire breaks and fuel management zones were developed in compliance with the VSFB Wildland Fire Management Plan (WFMP). The WFMP was prepared in accordance with regulations, standards, and procedures of DoDI 6055.06, DoD Fire and Emergency Services Certification Program, and AFMAN 32-7003 (previously AFI 32-7064).

DoD/DAF Wildland Fire Policy standards exist in the context of the following instruction and guidance:

DoDI 6055.06 states in part that:

> *5.1. The Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) shall:*
>
> *5.1.4. Provide criteria, guidance, and instructions to incorporate fire suppression, fire prevention, and emergency service elements in appropriate DoD program and budget documents.*
>
> *5.5. The Heads of the DoD Components maintaining organized F&ES programs shall:*
>
> *5.5.3. Emphasize prevention as a means to enhance the total F&ES effort and other fire prevention techniques to eliminate the causes of fires and to prevent death, injuries, and property damage if fire occurs.*

Air Force Manual 32-7003 Environmental Conservation [previously Air Force Instruction (AFI) 32-7064]. Section 3P – Wildland Fire Management states in part that:

> *3.80 Wildland Fire Management Plans. All Air Force installations with burnable acreage are required to have a current WFMP.*

3.80.1. Purpose. The purpose of the installation WFMP is to reduce wildfire potential, protect and enhance valuable infrastructure and natural resources, and implement ecosystem resiliency goals and objectives on Air Force-managed properties. The WFMP will directly support the Air Force mission and be consistent with the installation INRMP.

Vandenberg Space Force Base [previously Vandenberg Air Force Base (VAFB)] Wildland Fire Management Plan (WFMP) helps further guide the size, location, and configuration of fuel management zones and firebreaks and states in part that:

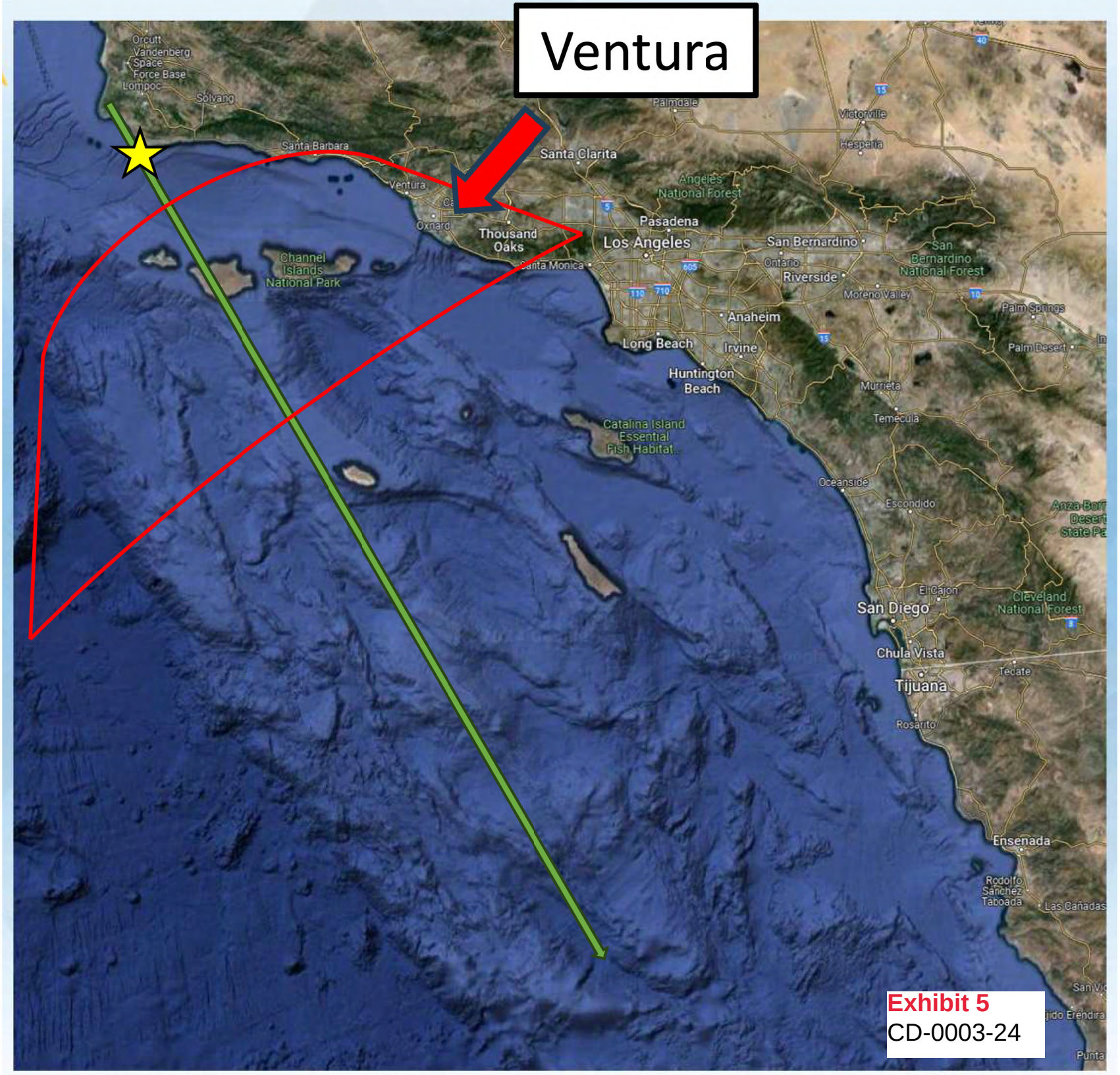
Section 3.9: Missile Launch Facilities and Rocket Launch Complex/Areas

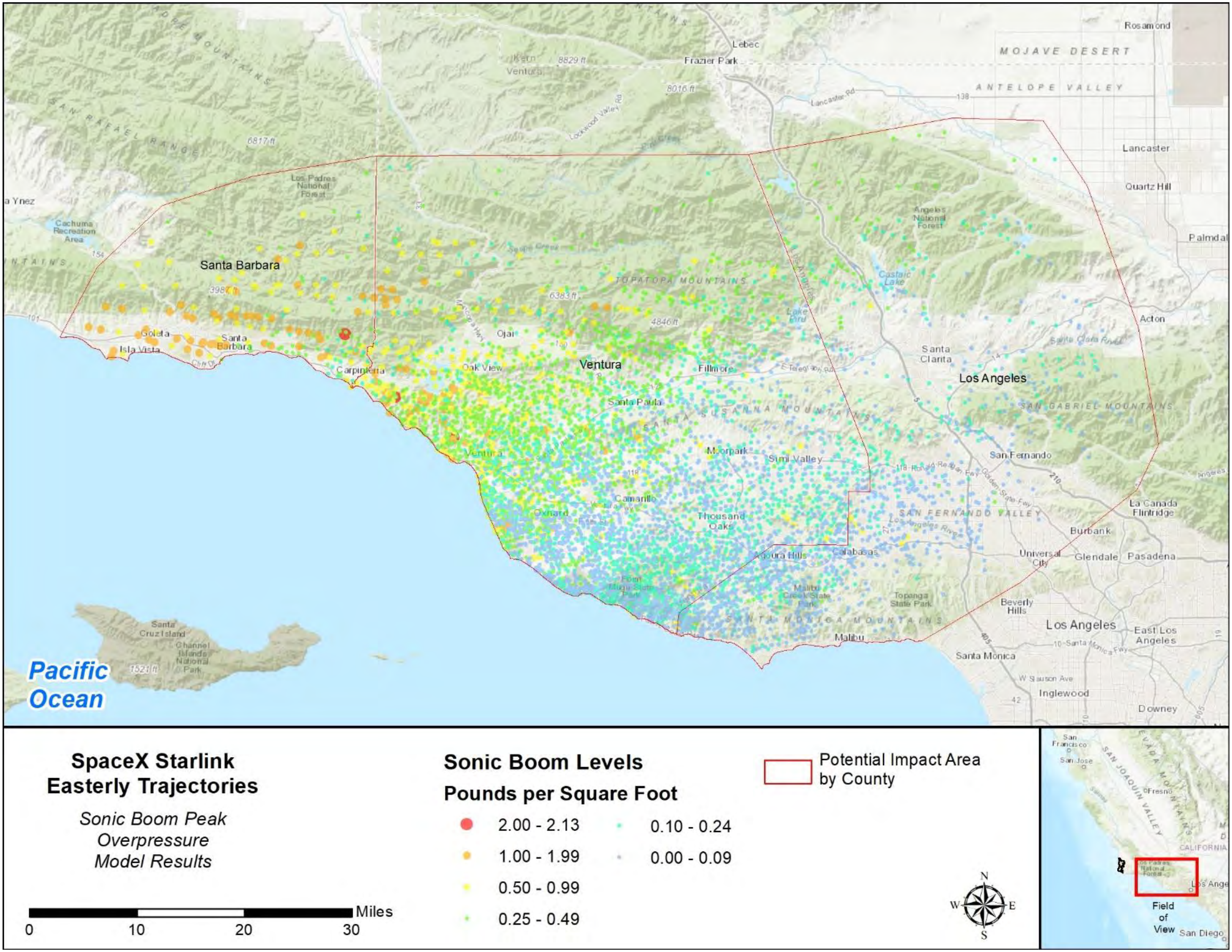
Launch operations are one of the highest sources of ignitions for wildfires on VAFB (Type III Risk Assessment, 2018). Combined with wind activity, year-round low humidity, extremely volatile fuel beds throughout the 99K acres and the hazardous/combustive nature of launch operations, fire/fuel breaks are required for each launch facility and launch complex/area. The using organization must ensure fuel/fire breaks are established prior to mission commencement and maintained. This requirement is to not only protect our launch facilities from wildfires, but also to protect the rest of the installation from fires created by launch operations. Launch operations are inherently dangerous. Nominal launches not only cause spot fires, they also generate hazardous byproducts that prevent firefighters from immediately responding to the launch site until the localized atmosphere is safe. These delays can last up to 30 minutes. During this response delay, fire/fuel breaks are the only thing preventing spot fires from spreading into heavy fuel beds and developing into catastrophic wildfire events. Specifications for fuel/fire breaks are site specific and in general will comply with the VFMP (Appendix 3.7) and best management practices for Access Road and Fire Break Maintenance and Restoration (Appendix 3.8). Development of specifications shall be done in coordination and approval of F&ES Fire Prevention personnel.

Section 3.11 Fire and Fuel Break System Maintenance Plan
Firebreaks provide strategic locations for indirect attack of wildfires on VAFB, which in turn greatly reduces the need for direct attack with heavy ground-disturbing equipment which can result in significant resource damage. Approximately 50 miles of existing firebreaks are currently in place at VAFB, particularly along the installation boundary and adjacent to critical infrastructure. Fire breaks are generally wide, about 16 to 32 feet or 2 to 4 blade widths of a dozer, and contain little to no vegetation. Fire breaks must be constructed and maintained, or rehabilitated, to prevent soil erosion. Fire breaks are maintained through mechanical treatment, such as discing or grading.

Section 3.12 Asset and Infrastructure Protection Plan
F&ES developed a facility risk assessment based on NFPA 1144 guidance. A Wildland Threat Assessment (WTA) is maintained on facilities in the interface zone. Based on the WTA a hazard reduction action plan is in place. The 30th Space Wing Instruction 32-2001 Fire Prevention program includes instructions on establishing and maintaining clearance within the ignition zone around facilities, a minimum of 100 feet. In some instances for mission critical or high hazard facilities the clearance may be increased through assessment by the Fire Prevention Office. This area allows Firefighters a Safety Zone to take defensive actions protecting the facility. Without this zone firefighters will not remain

at the building if conditions get too severe and life safety is in jeopardy. Defensible space is located around the perimeter of each facility identified in the WTA and mapped out (see Appendix 3.9). Buildings and facilities are prioritized where initial clearance work needs to be accomplished. A masticator or other equipment will be used except in areas with NR/CR concerns or the use of equipment is limited, then clearing is done by hand with chainsaws/brush cutters and disposed of by chipping. Annual maintenance of the defensible space will be conducted by mower or other equipment if required.


Ventura
Orcutt
Vandenberg Space Force Base
Lompoc
Solvang
Santa Barbara
Santa Clarita
Palmdale
Victorville
Hesperia
Angeles National Forest
Ventura
Oxnard
Thousand Oaks
Pasadena
Los Angeles
San Bernardino
Ontario
Riverside
San Bernardino National Forest
Moreno Valley
Palm Springs
Palm Desert
Channel Islands National Park
Santa Monica
Anaheim
Long Beach
Irvine
Huntington Beach
Murrieta
Temecula
Catalina Island Essential Fish Habitat
Oceanside
Escondido
El Cajon
San Diego
Cleveland National Forest
Chula Vista
Tijuana
Tecate
Rosarito
Ensenada
Rodolfo Sánchez Taboada
Las Cañadas
Exhibit 5
CD-0003-24


SpaceX Starlink
Easterly Trajectories
Sonic Boom Peak
Overpressure
Model Results
Sonic Boom Levels
Pounds per Square Foot
2.00 - 2.13
1.00 - 1.99
0.50 - 0.99
0.25 - 0.49
0.10 - 0.24
0.00 - 0.09
Potential Impact Area
by County
Miles
0
10
20
30
N
S
E
W
Pacific
Ocean
Santa Barbara
Ventura
Los Angeles
MOJAVE DESERT
ANTELOPE VALLEY
TOPATOPA MOUNTAINS
SANTA SUSANA MOUNTAINS
SAN GABRIEL MOUNTAINS
SAN FERNANDO VALLEY
SANTA MONICA MOUNTAINS
Goleta
Isla Vista
Carpinteria
Ojai
Oak View
Fillmore
Santa Paula
Moorpark
Simi Valley
Camarillo
Oxnard
Thousand Oaks
Agoura Hills
Calabasas
Malibu
Santa Clarita
San Fernando
Burbank
Glendale
Pasadena
Beverly Hills
Santa Monica
Inglewood
Downey
Lancaster
Quartz Hill
Palmdale
Acton
Rosamond
Lebec
Frazier Park
Field
of
View
San Diego

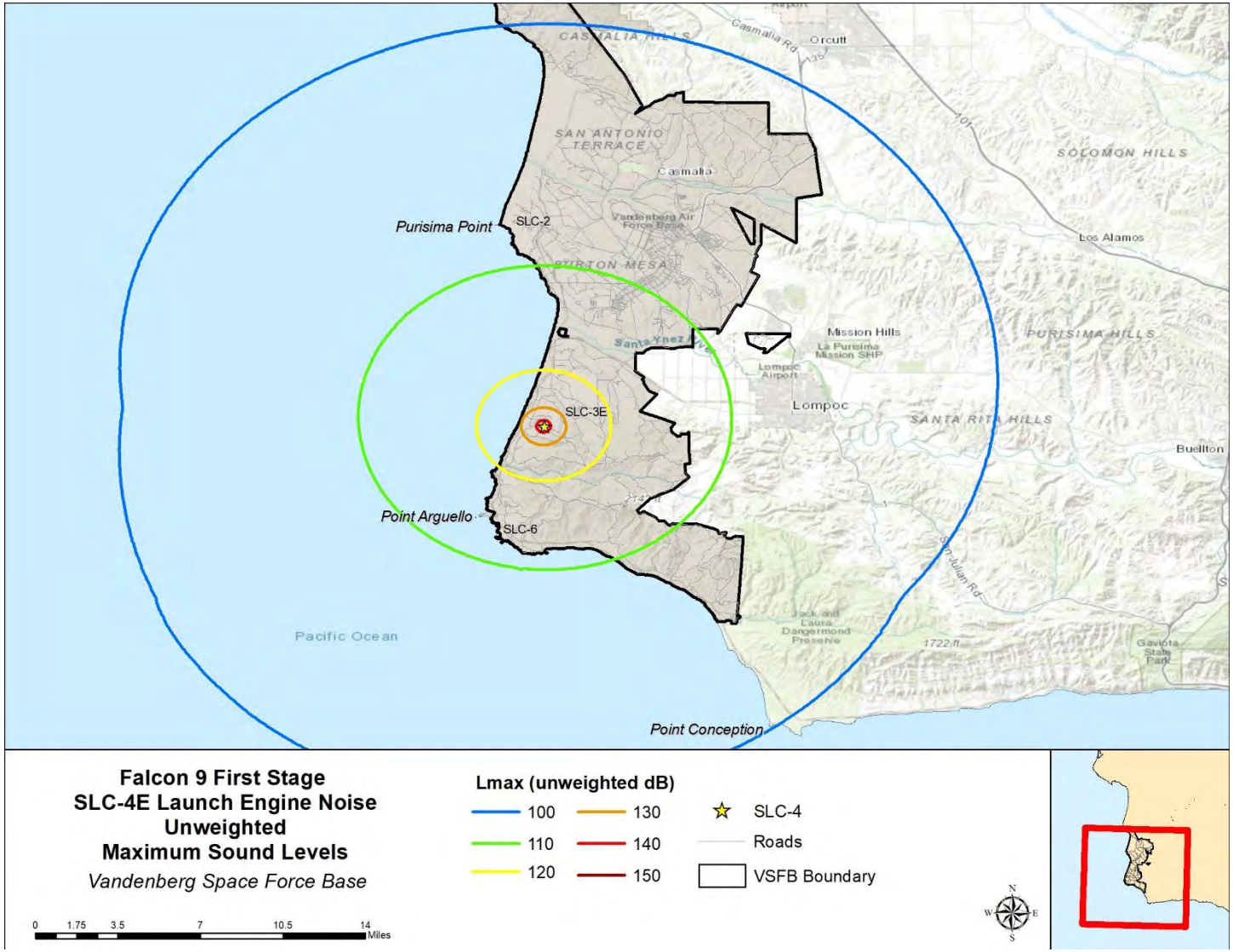


Figure 2.2-2. Maximum Unweighted Engine Noise During Falcon 9 Launch from SLC-4E

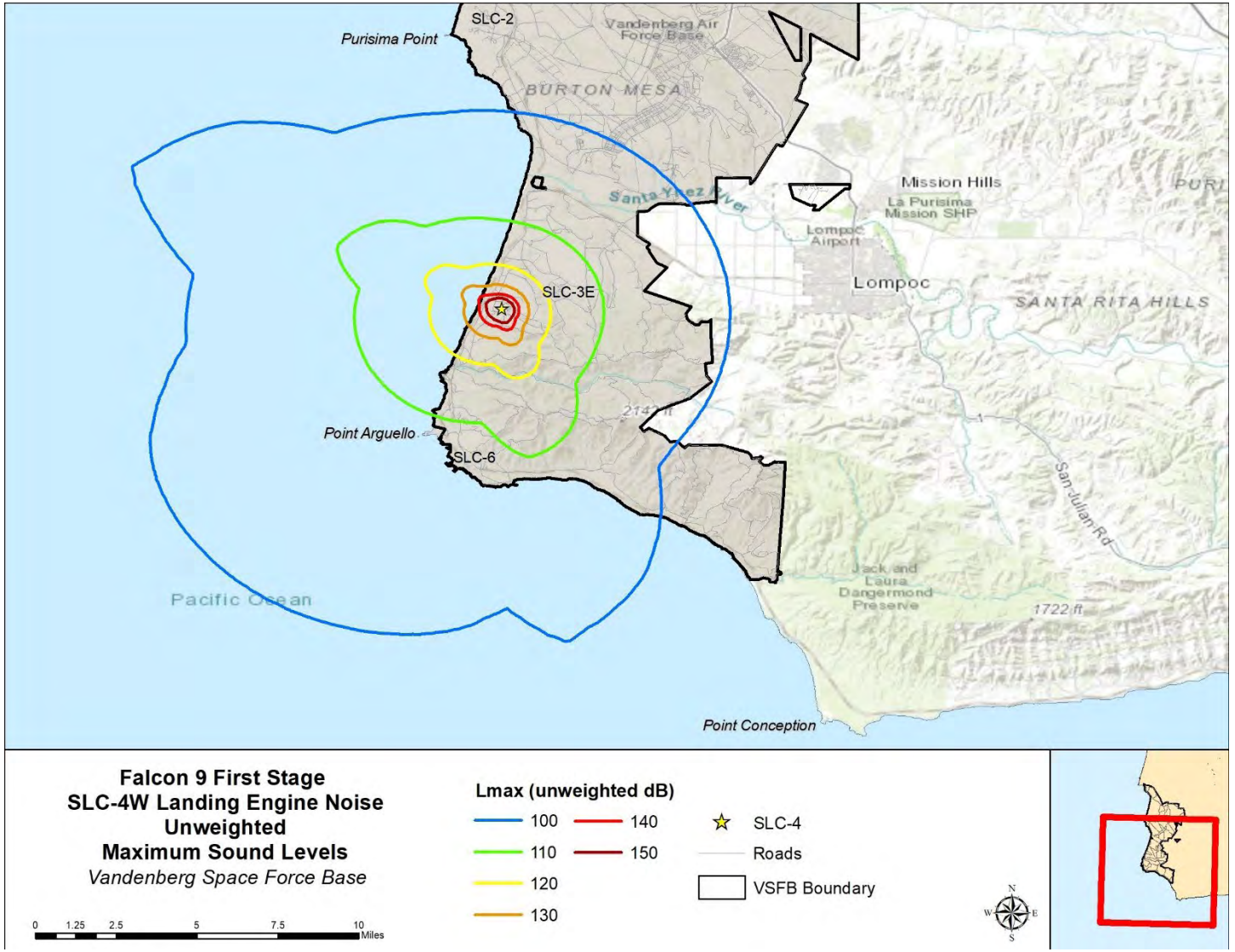


Figure 2.2-3. Maximum Unweighted Engine Noise During Falcon 9 First Stage Landing at SLC-4W

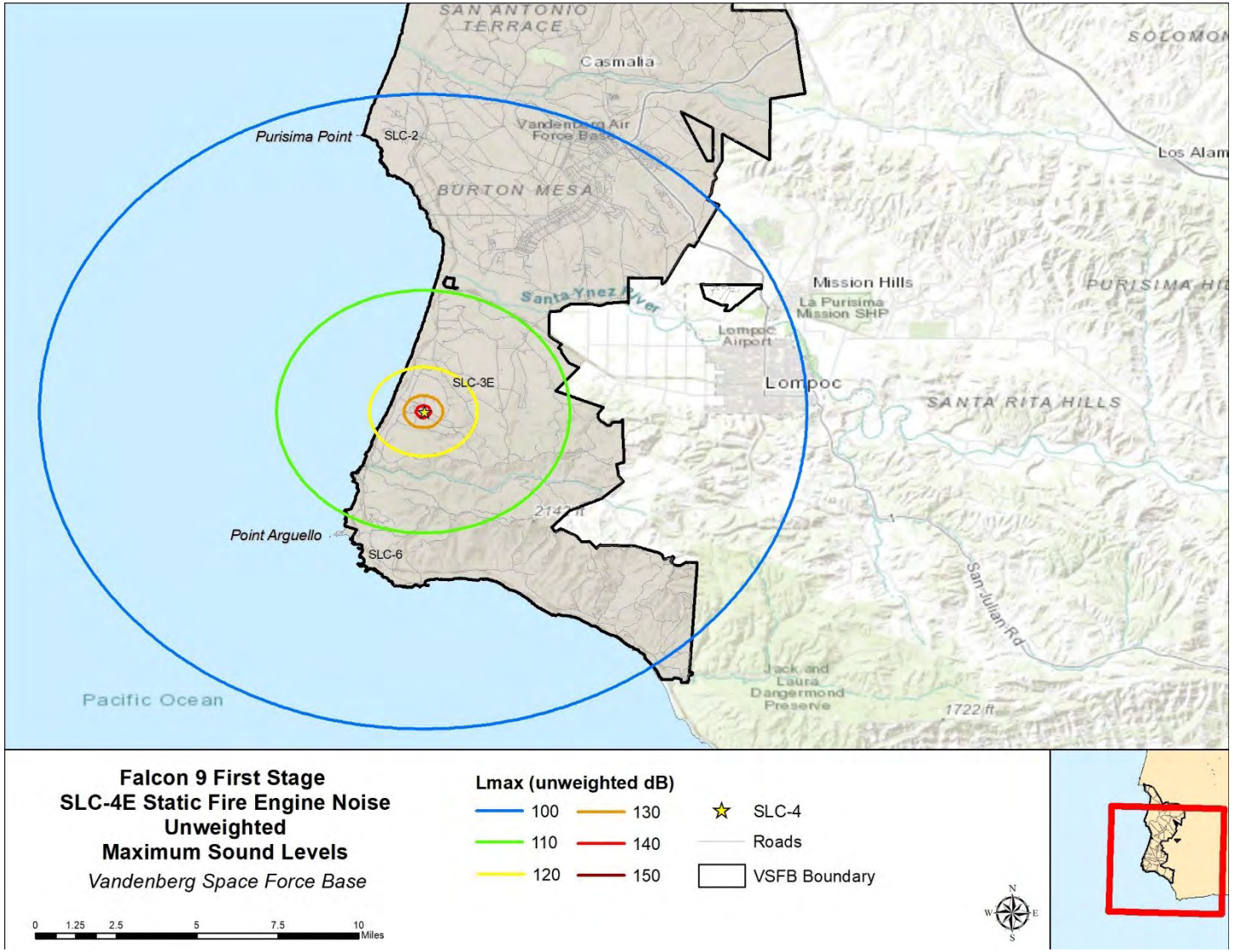


Figure 2.2-4. Maximum Unweighted Engine Noise During Falcon 9 Static Fire at SLC-4W

APPENDIX A

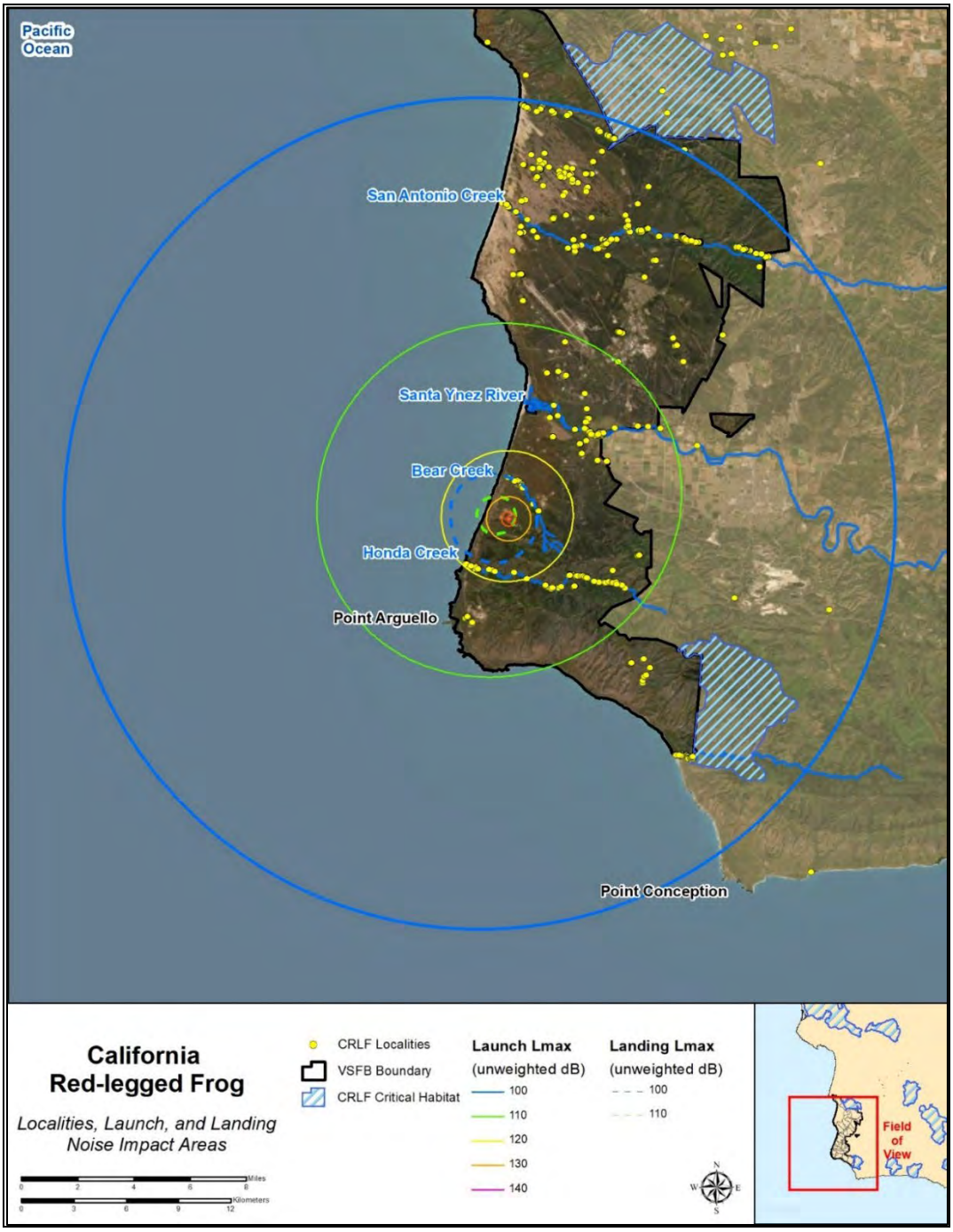


Figure 1a. California red-legged frog occurrences and the projected Launch Noise Effect Area.

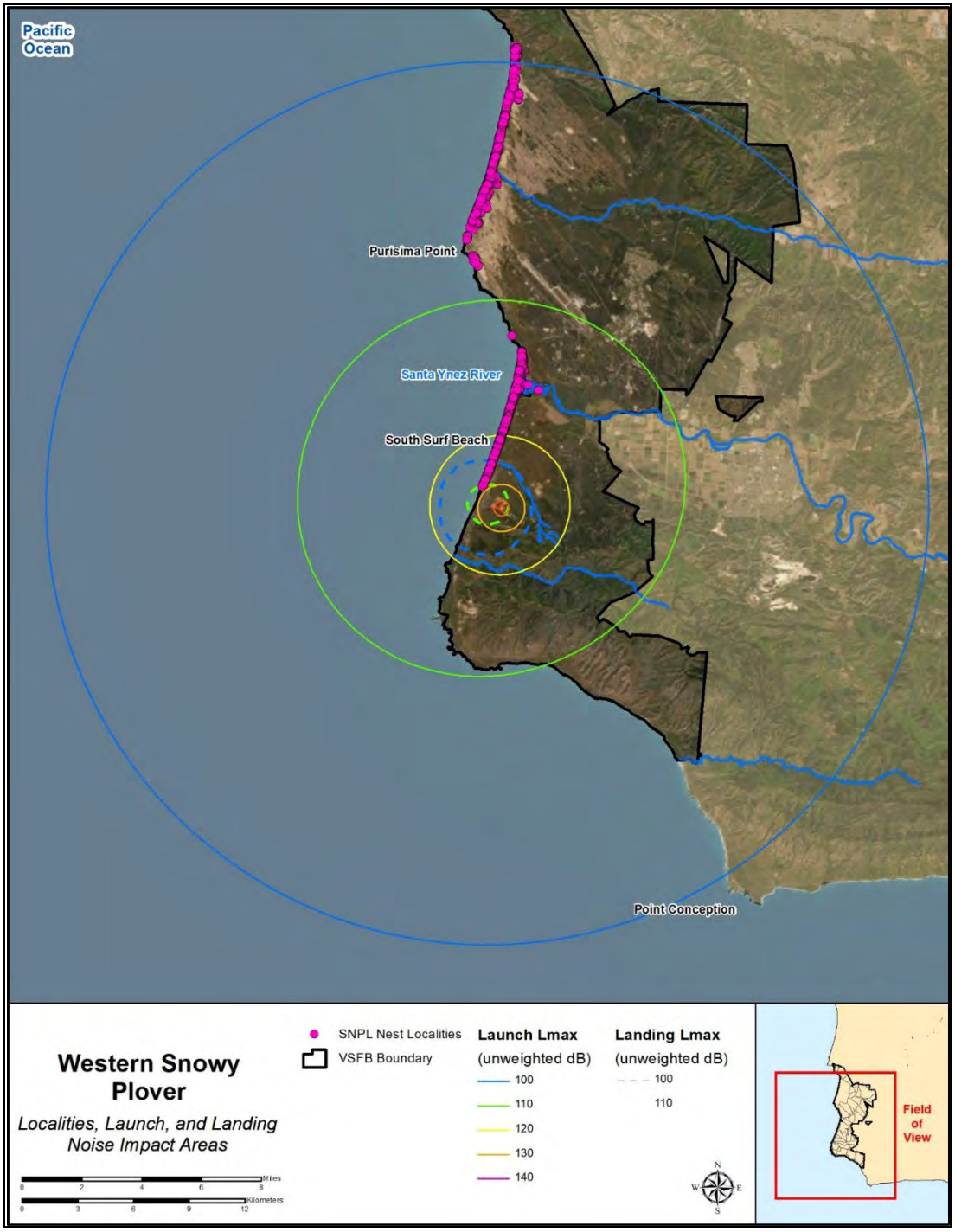


Figure 1b. Western snowy plover nesting occurrences and the projected Launch Noise Effect Area.

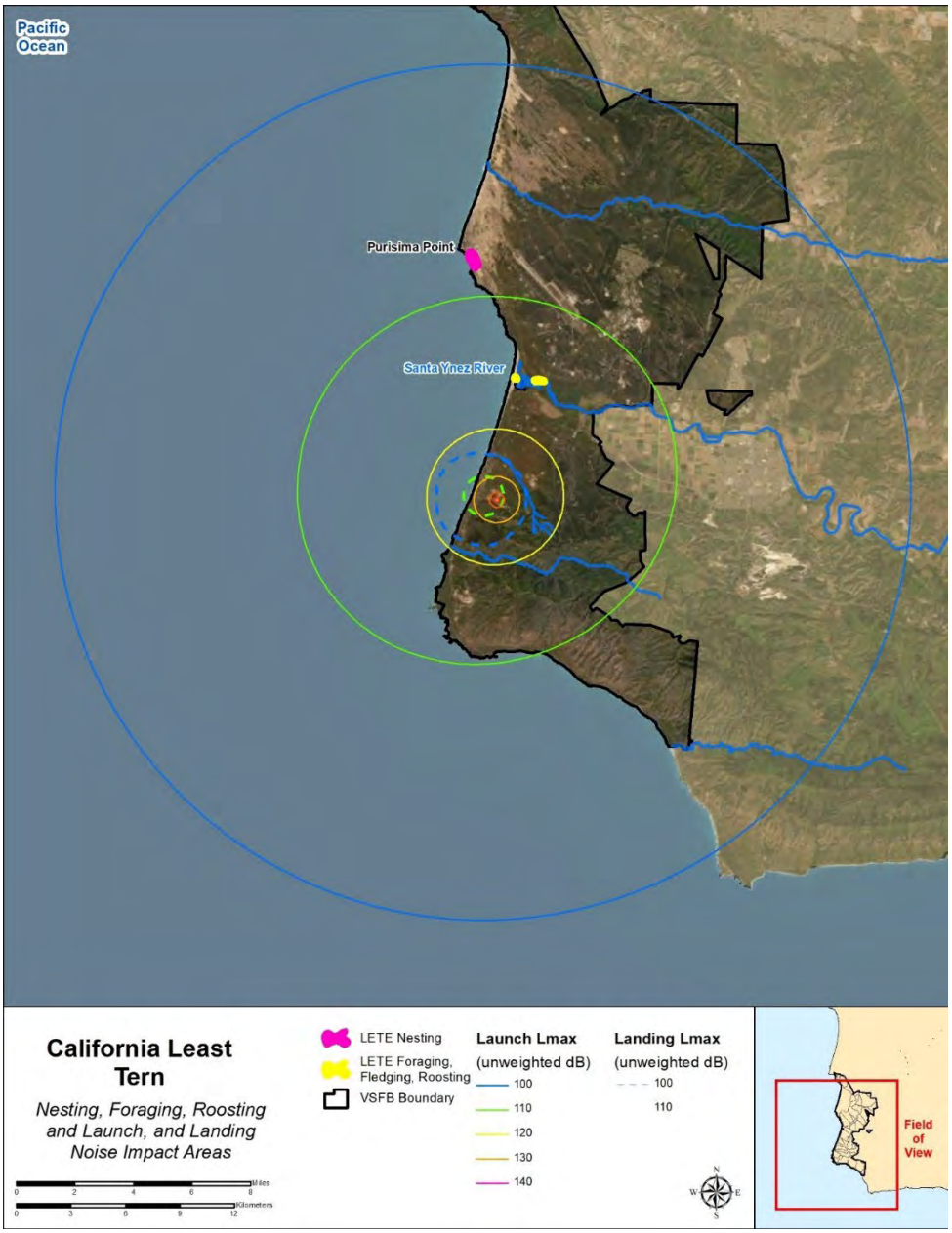


Figure 1c. California least tern nesting occurrences and the projected Launch Noise Effect Area.

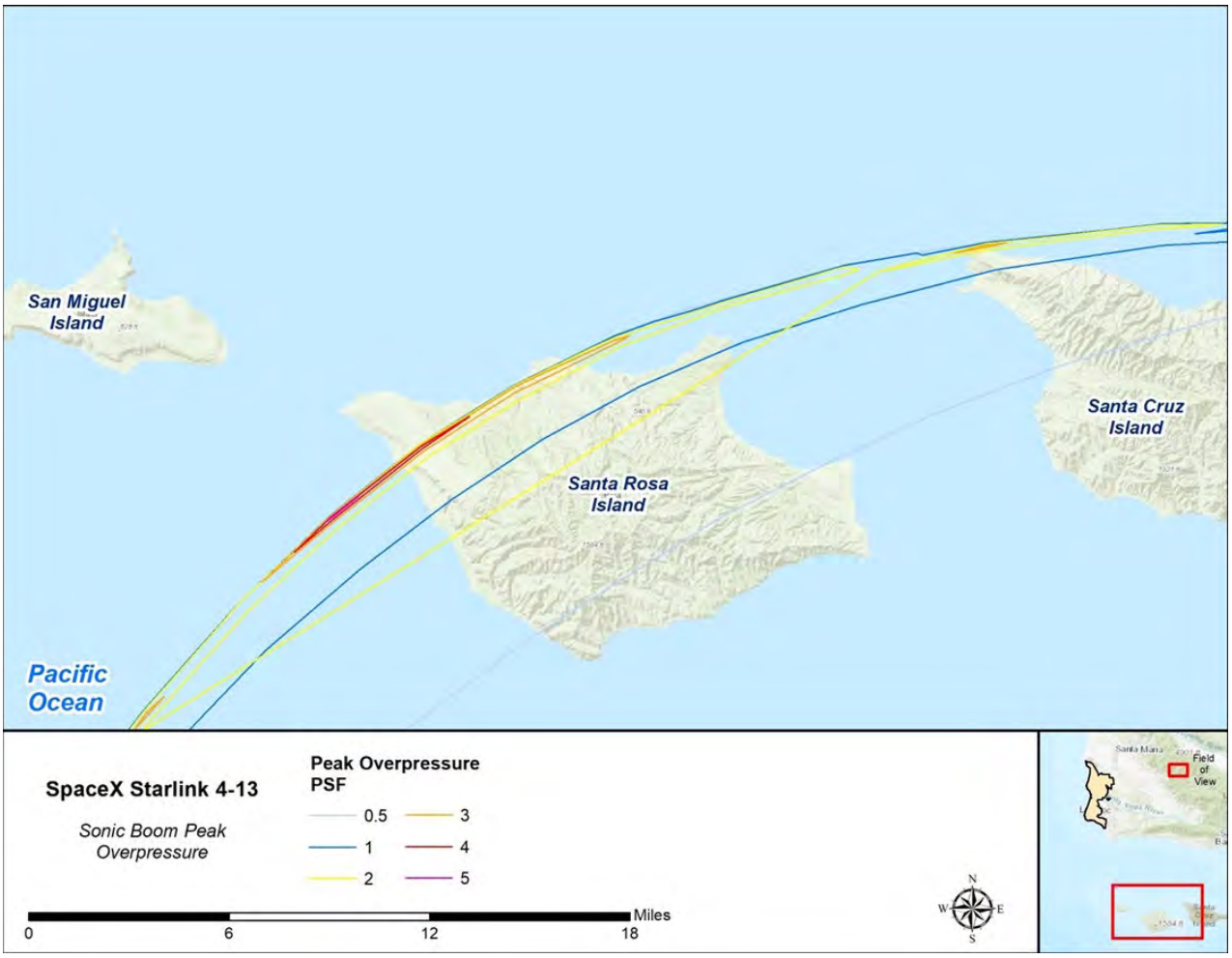


Figure 2a. Portion of the Sonic Boom Overpressure Effect Area impacting the Northern Channel Islands during launch ascent.

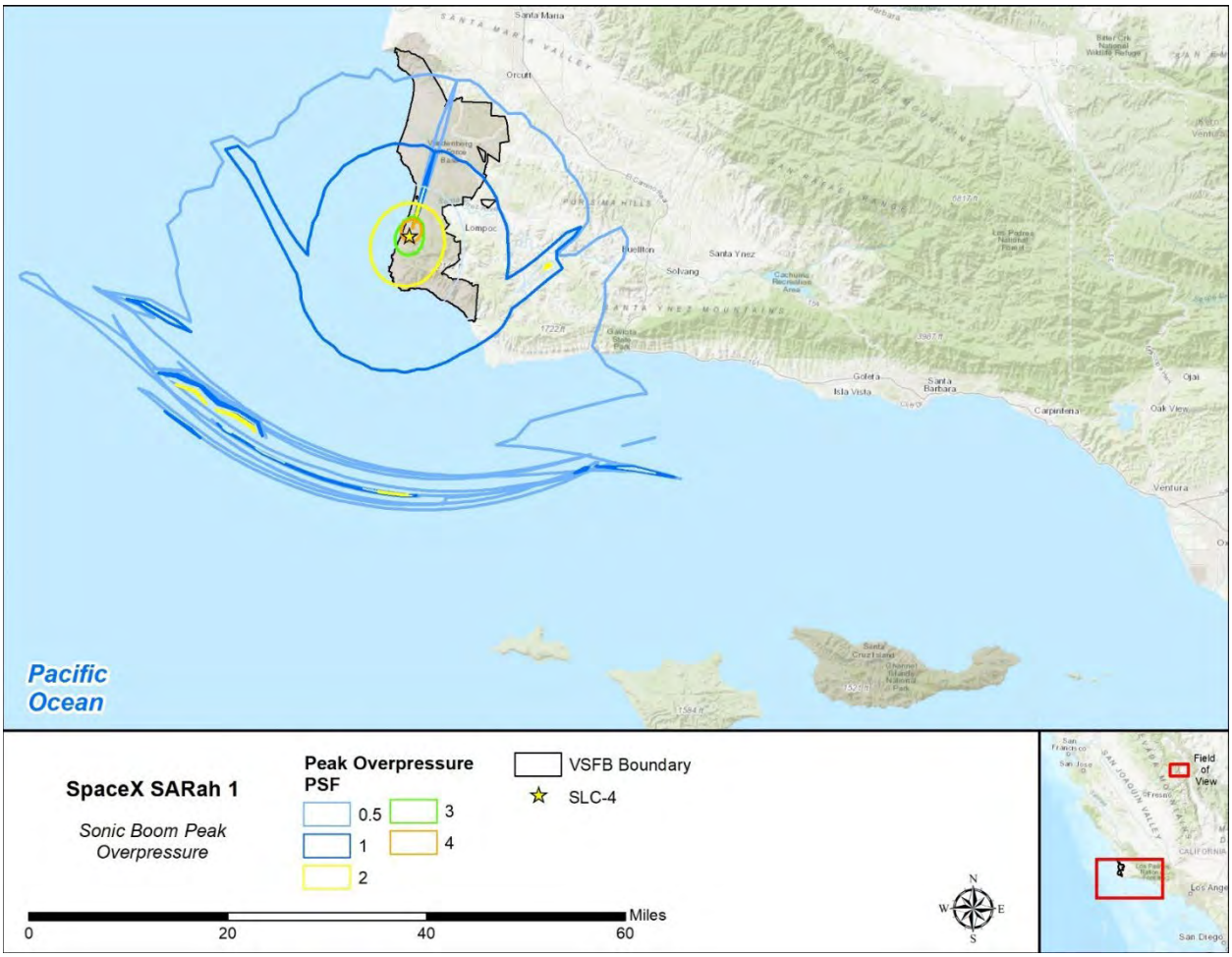


Figure 2b. The Sonic Boom Overpressure Effect Area impacting VSFB during launch descent to SLC-4.

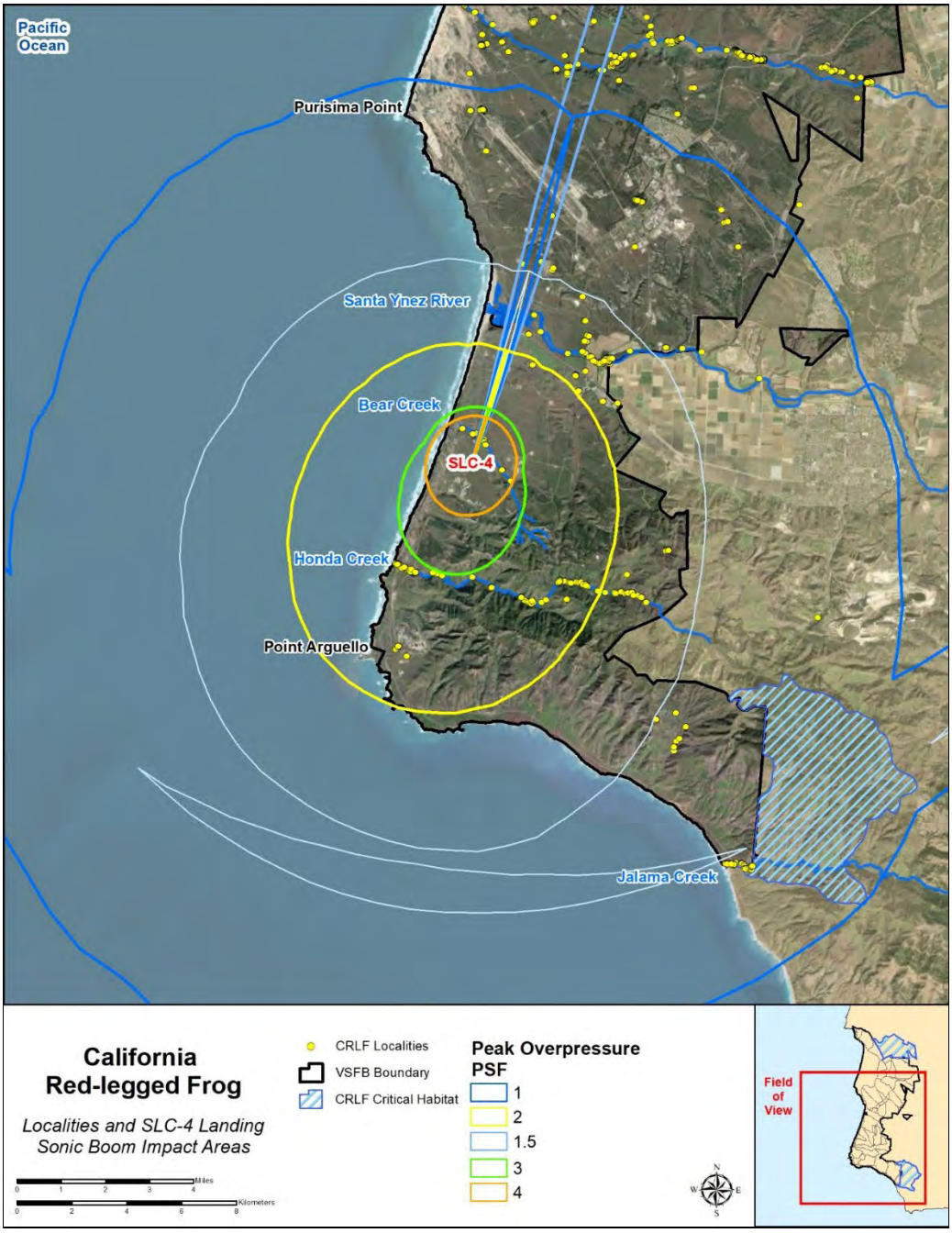


Figure 2c. California red-legged frog occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

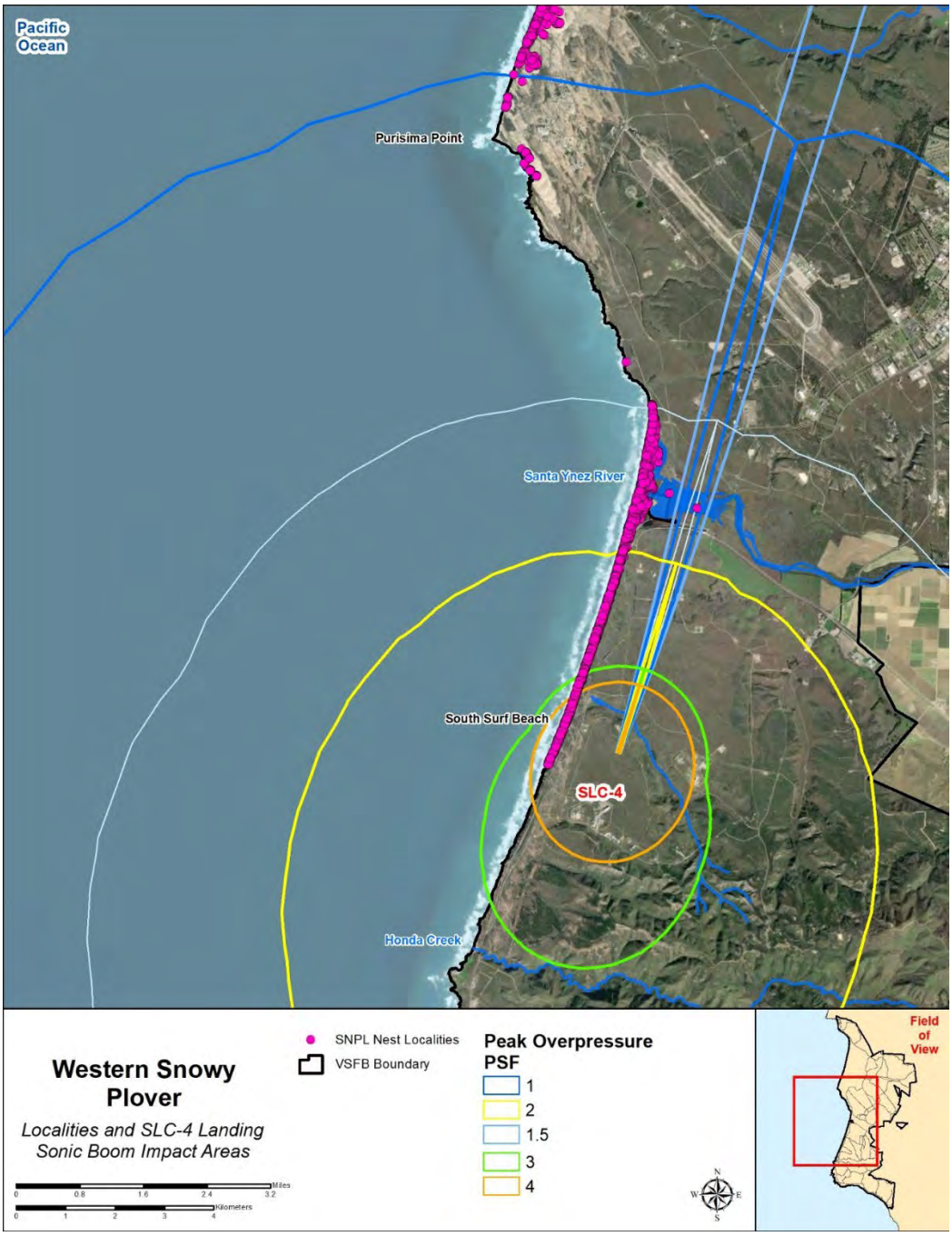


Figure 2d. Western snowy plover occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

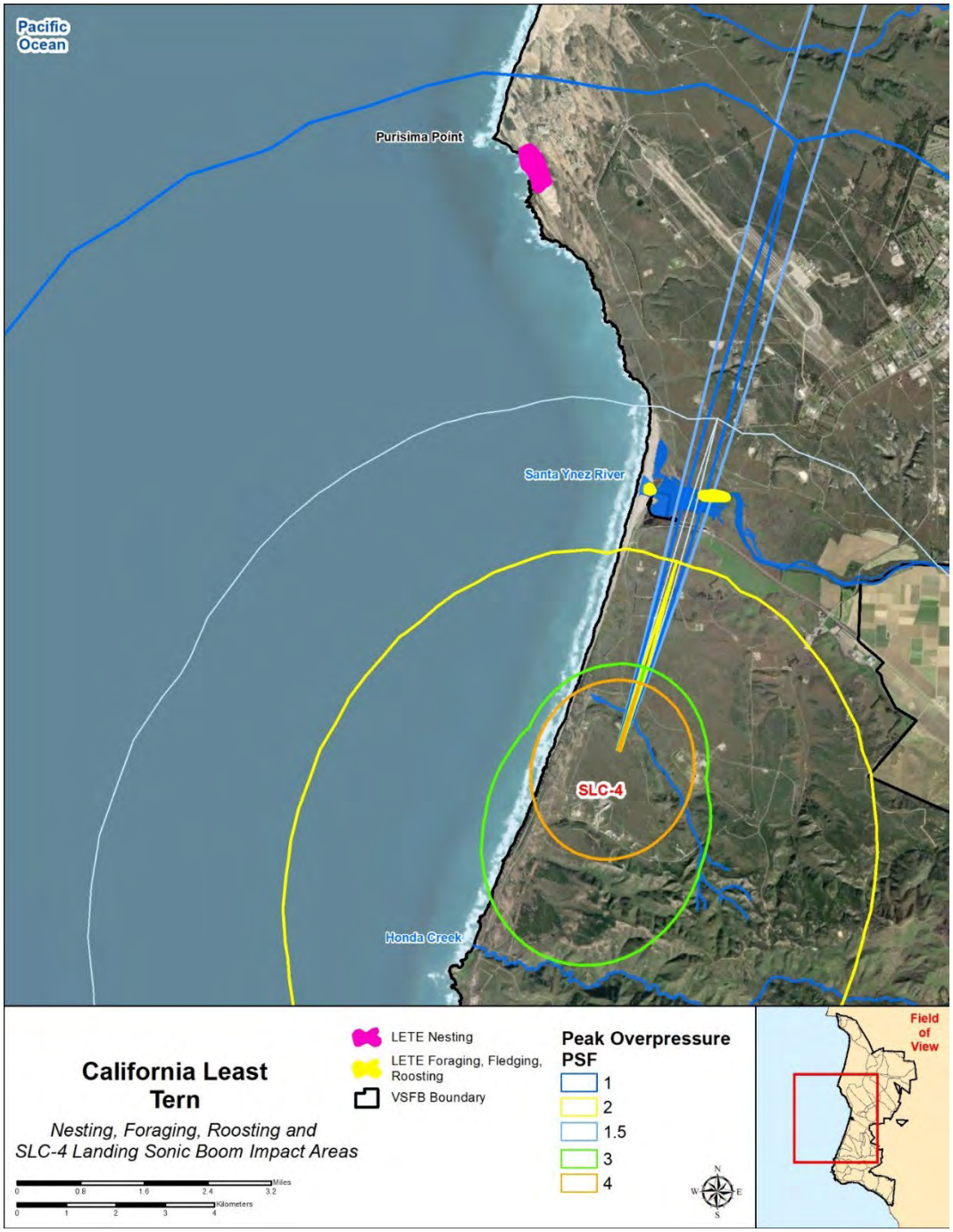


Figure 2e. California least tern occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Ecological Services
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
2022-0013990-S7-001

March 21, 2023

Beatrice L. Kephart
30 CES/CEI
1028 Iceland Avenue
Vandenberg Space Force Base, California 93437

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.

<u>California Condor</u>

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.

California Least Tern

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 4,1961 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

Foraging Behavior

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

California Red-legged Frog

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

Launch Operations

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

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

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.

Western Snowy Plover

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

LITERATURE CITED

[30 CES] 30th Civil Engineer Squadron. 2021. Programmatic Biological Assessment: Effects of Activities Conducted at Vandenberg Space Force Base, California, on 15 Federally Listed Threatened and Endangered Species. July 1, 2021. Vandenberg Space Force Base,

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APPENDIX A

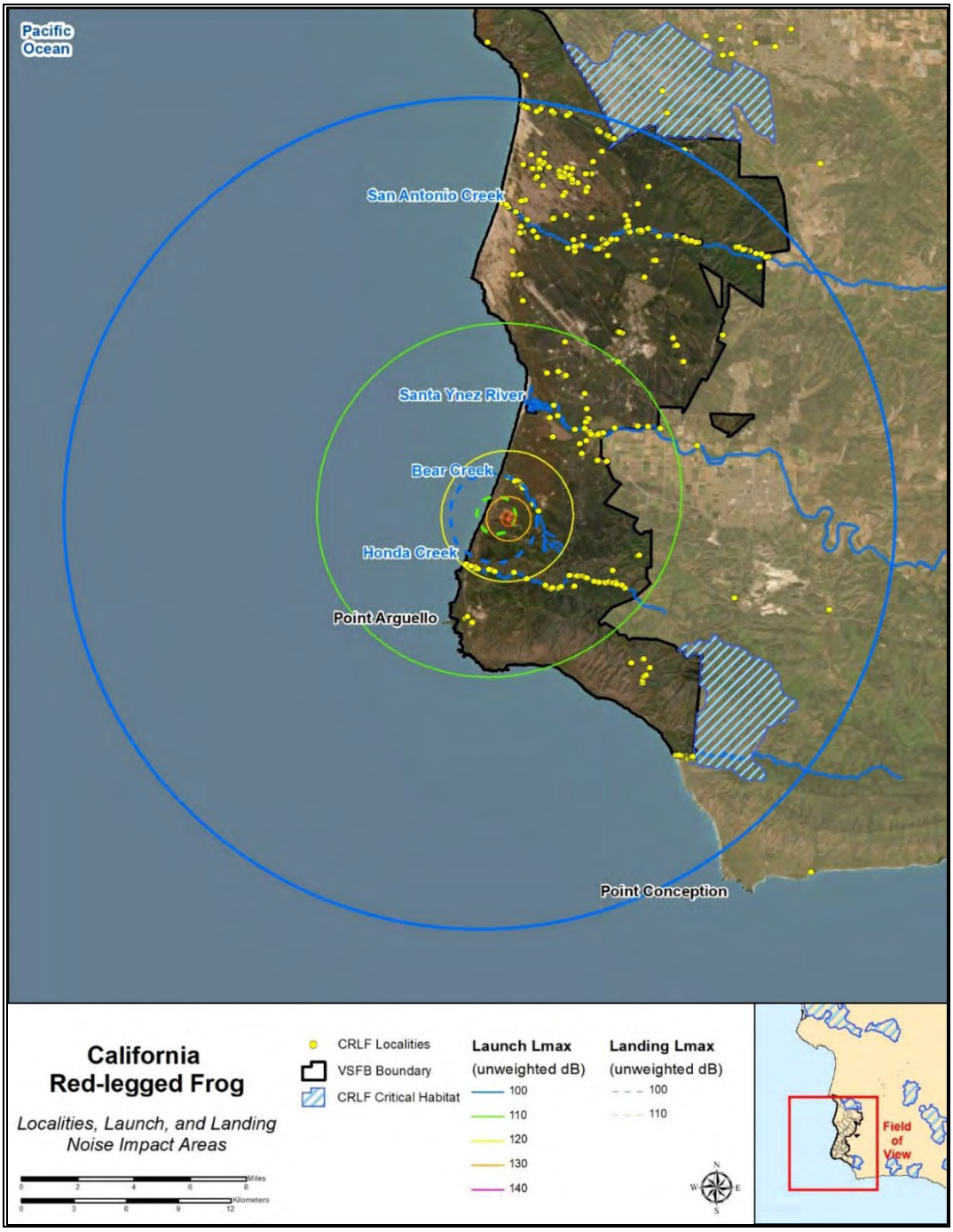


Figure 1a. California red-legged frog occurrences and the projected Launch Noise Effect Area.

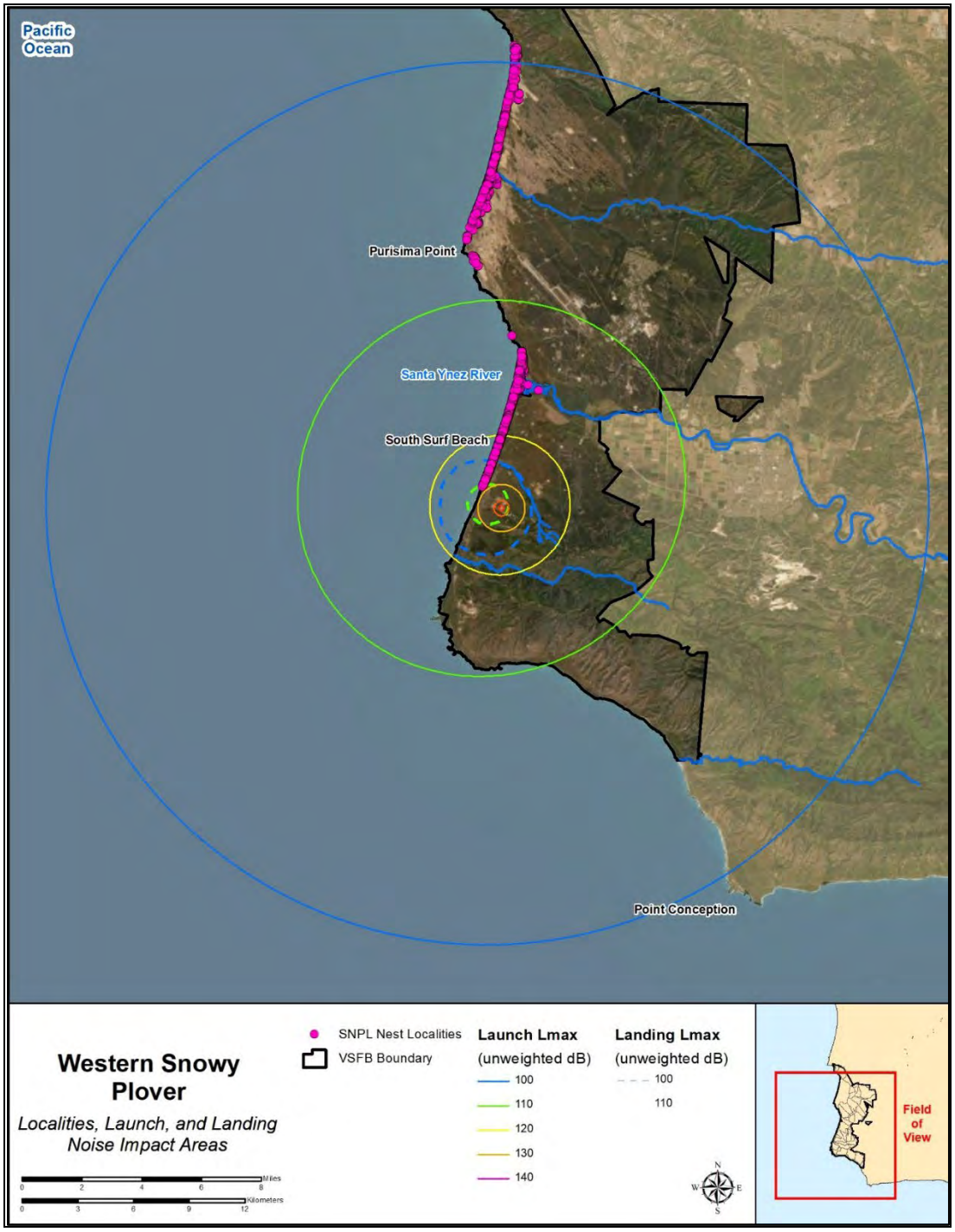


Figure 1b. Western snowy plover nesting occurrences and the projected Launch Noise Effect Area.

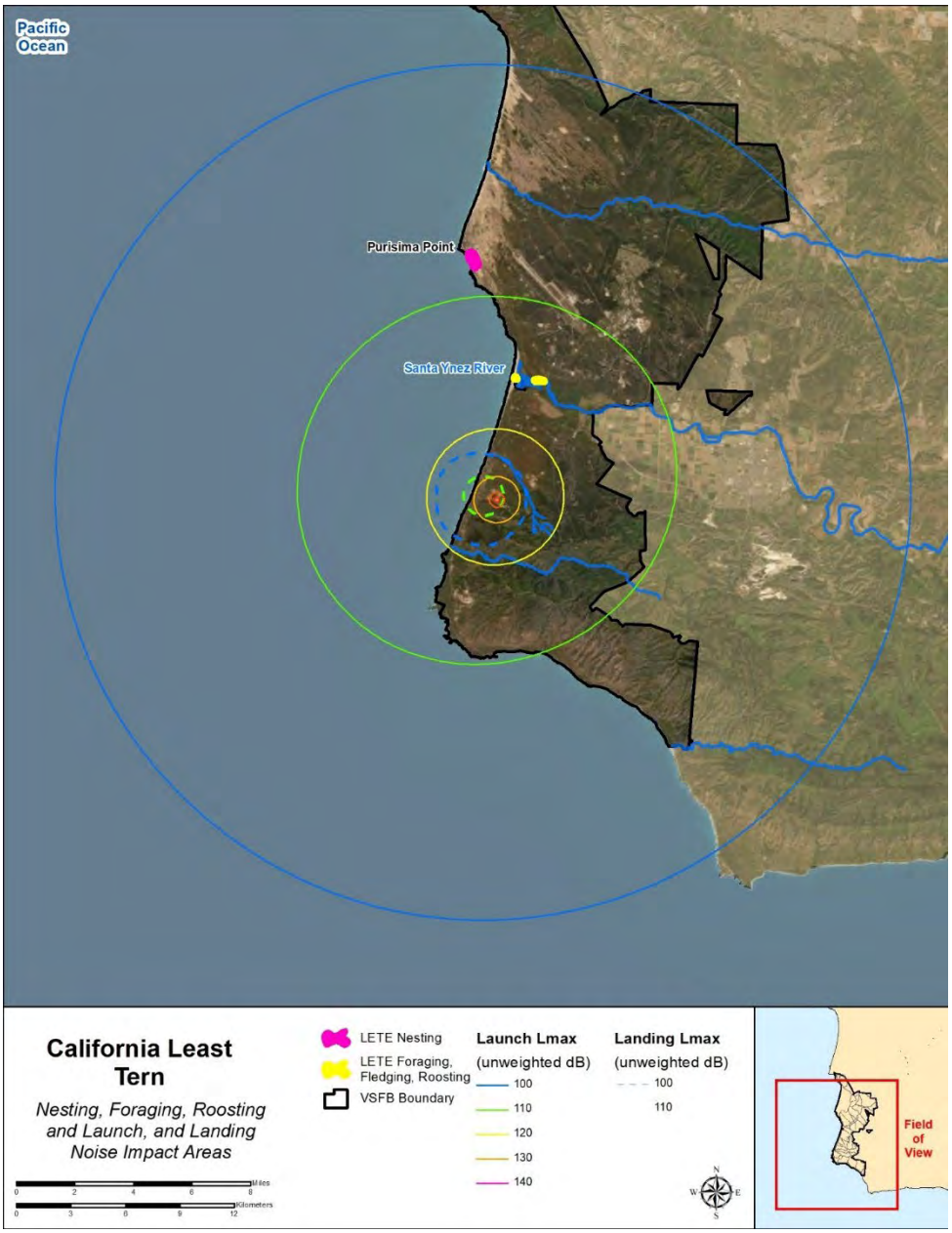


Figure 1c. California least tern nesting occurrences and the projected Launch Noise Effect Area.

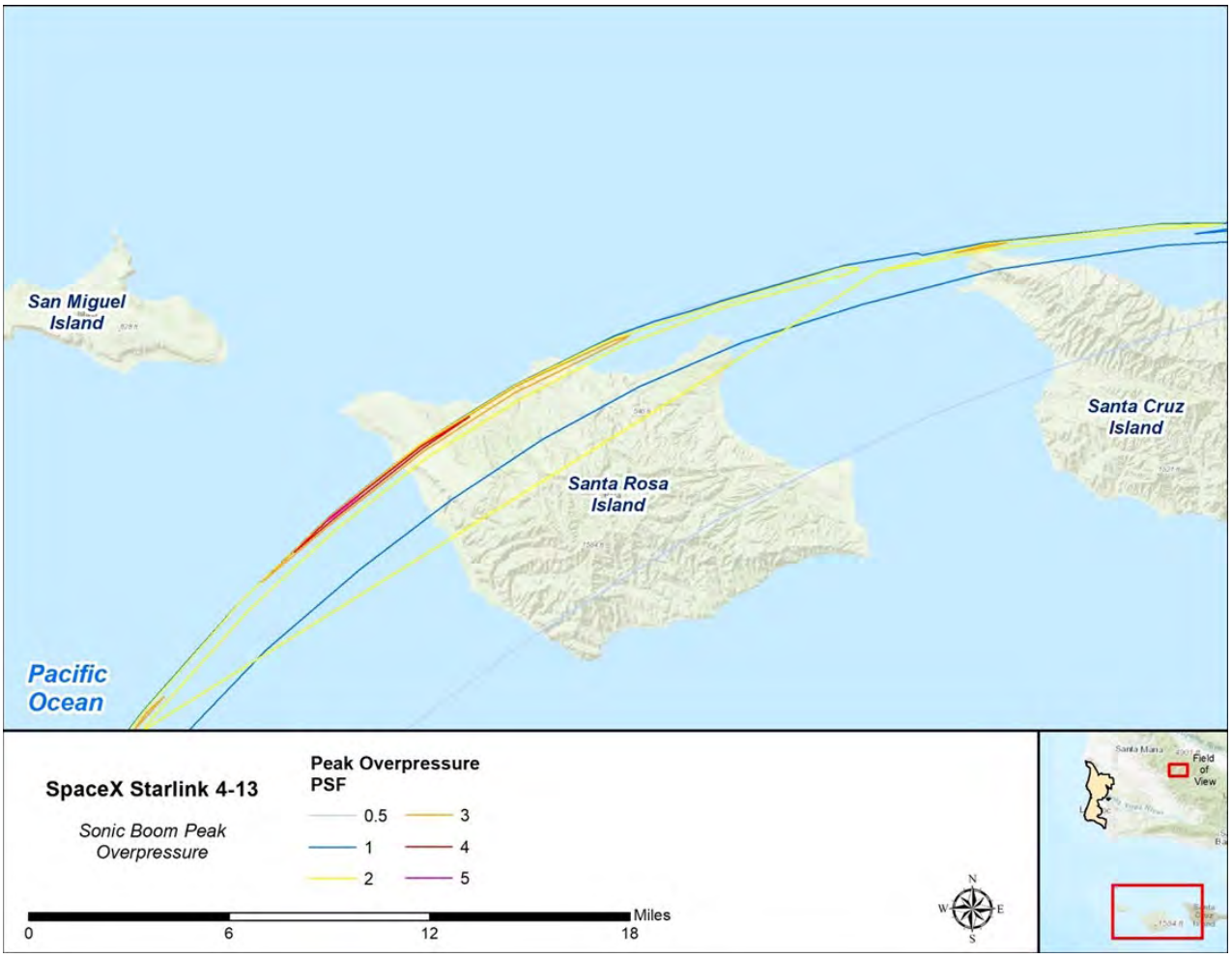


Figure 2a. Portion of the Sonic Boom Overpressure Effect Area impacting the Northern Channel Islands during launch ascent.

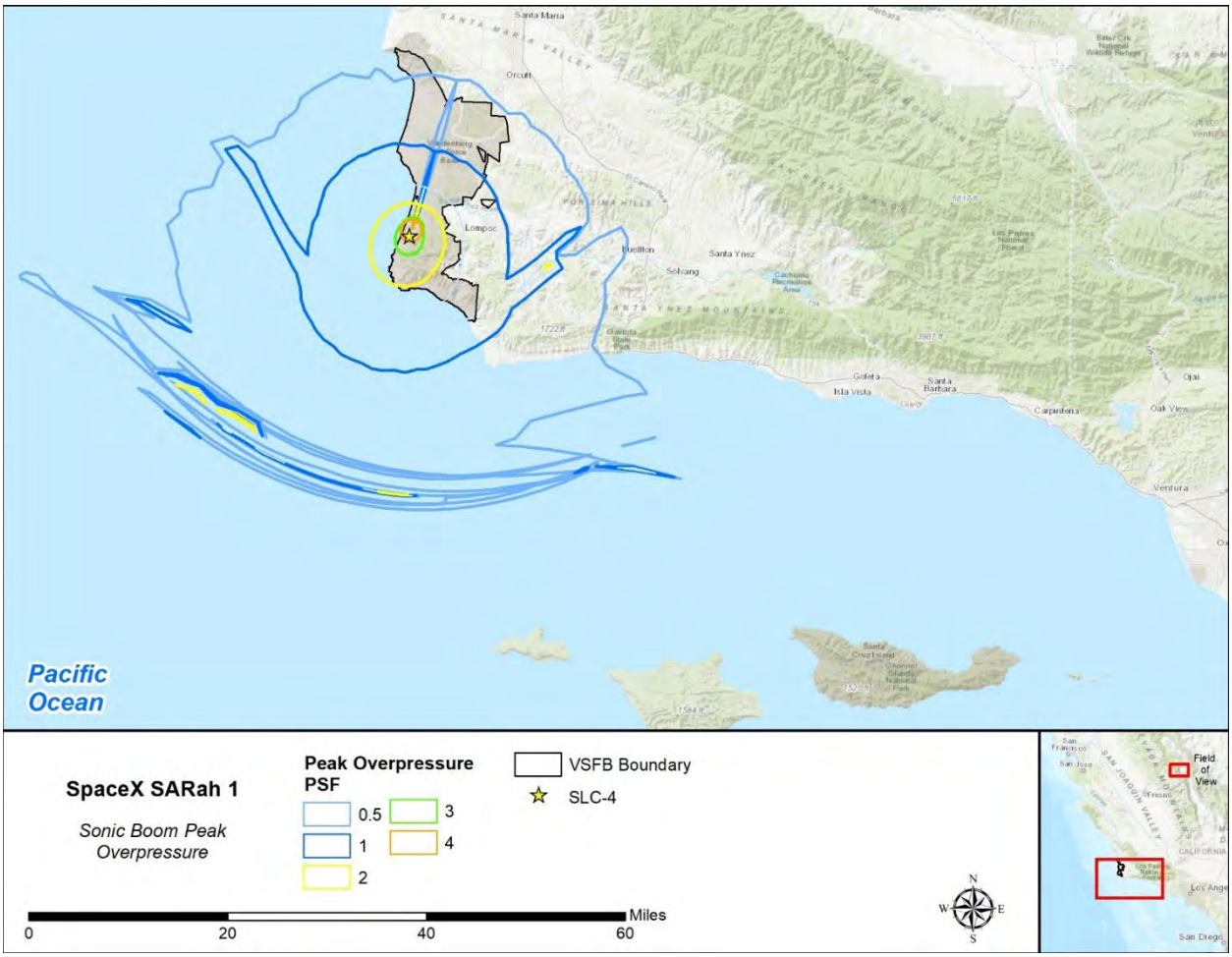


Figure 2b. The Sonic Boom Overpressure Effect Area impacting VSFB during launch descent to SLC-4.

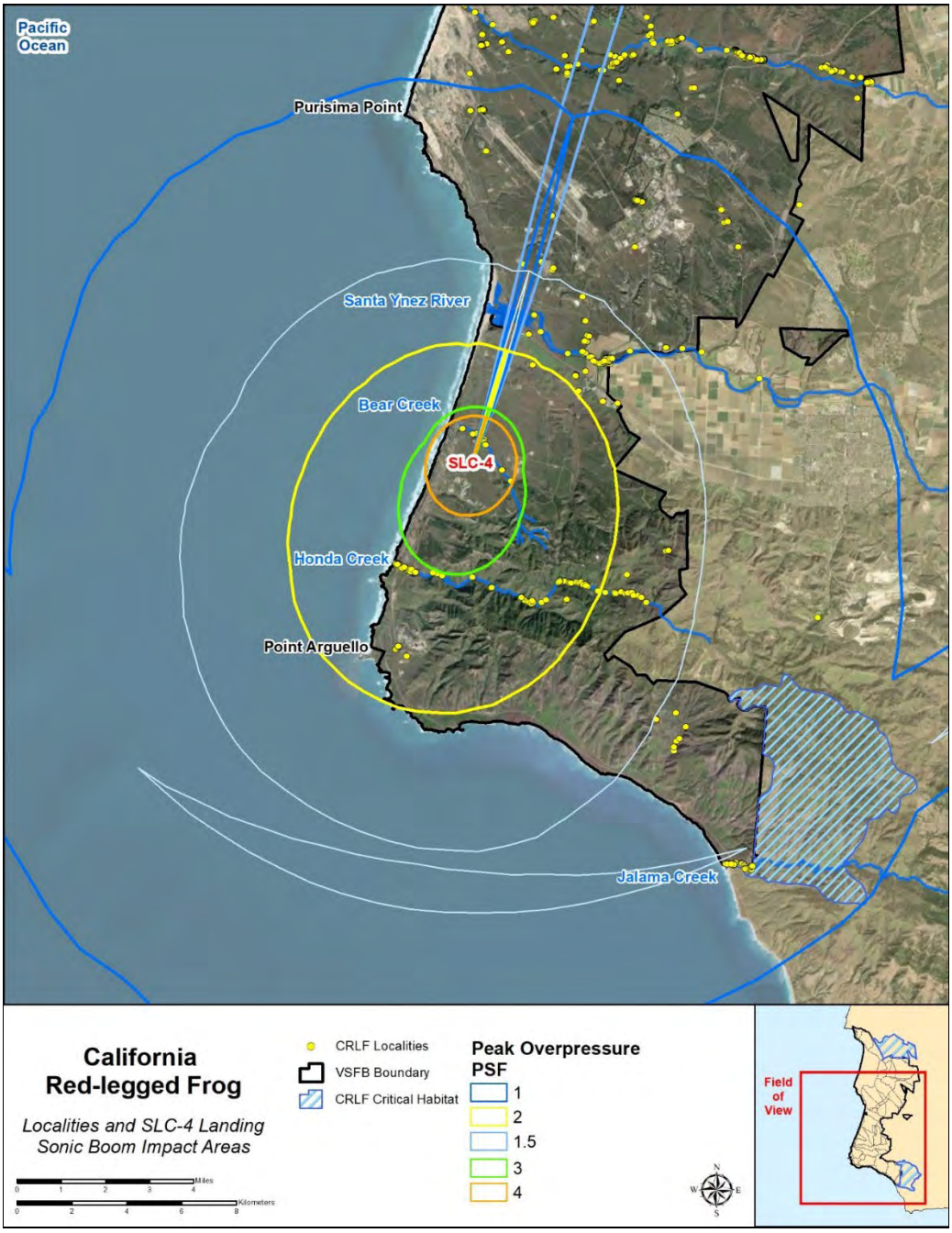


Figure 2c. California red-legged frog occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

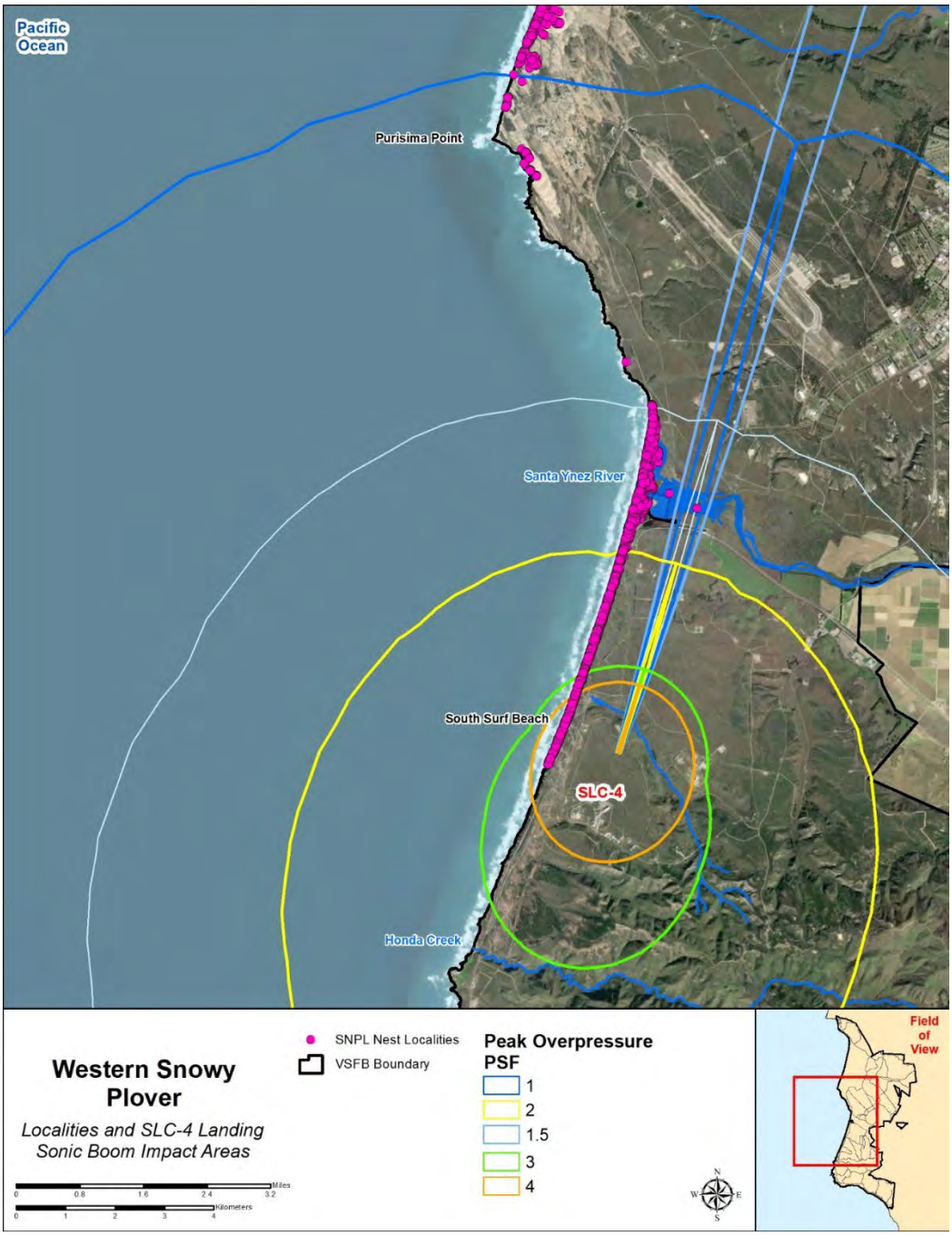


Figure 2d. Western snowy plover occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

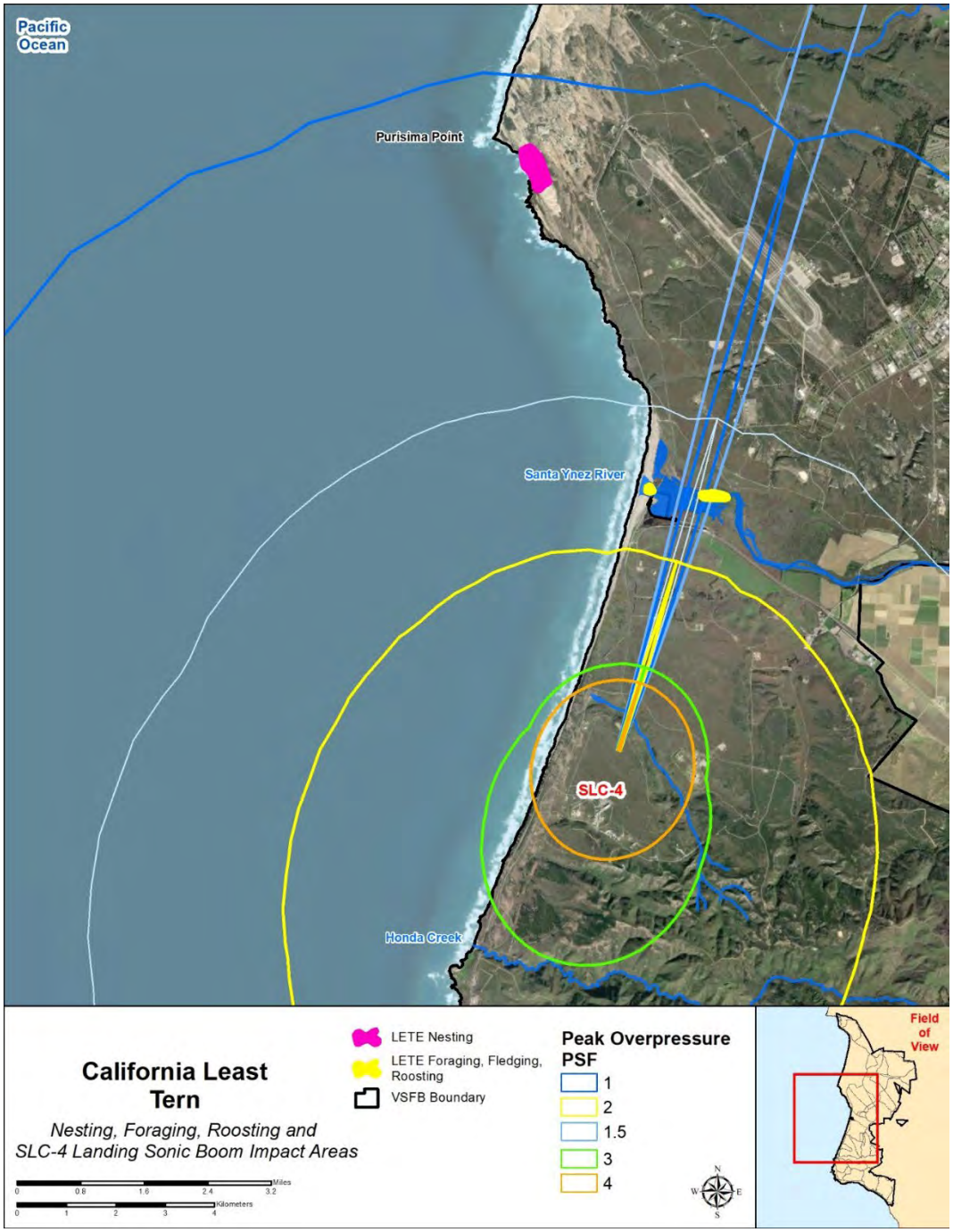


Figure 2e. California least tern occurrences and the projected Sonic Boom Overpressure Effect Area produced during vehicle landing at SLC-4.

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

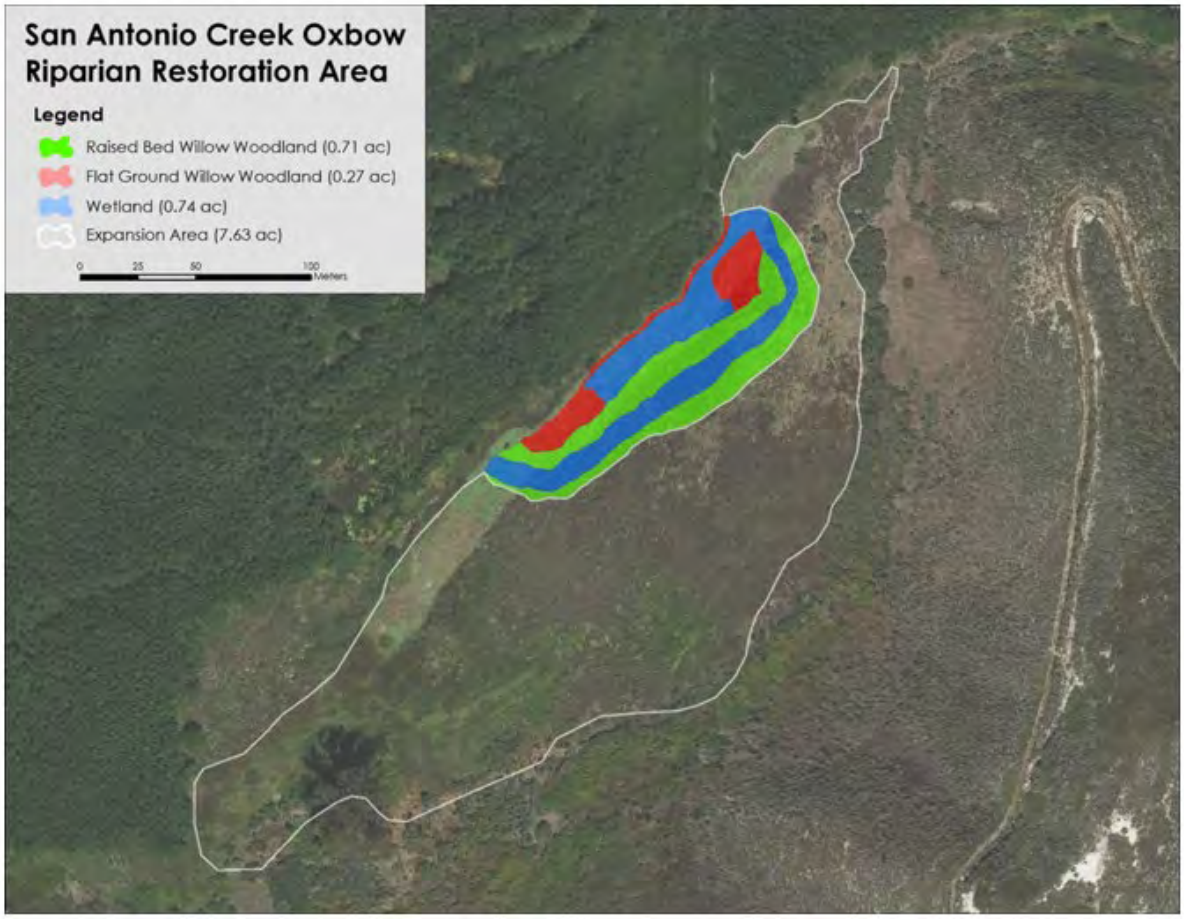


Figure 4a. Potential mitigation area (San Antonio Creek Oxbow Restoration Area) for California red-legged frog. Current restoration efforts depicted in green, red, and blue.

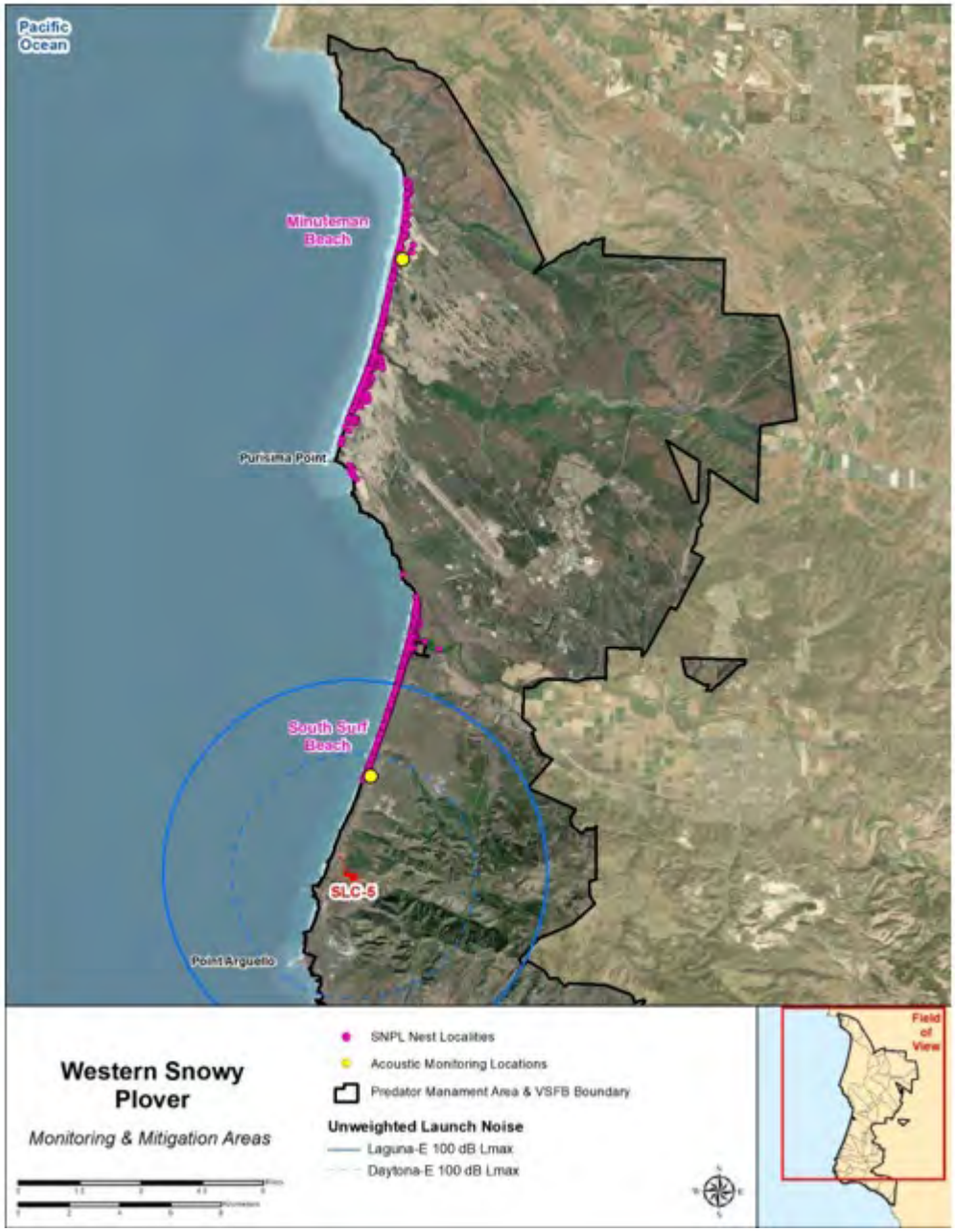
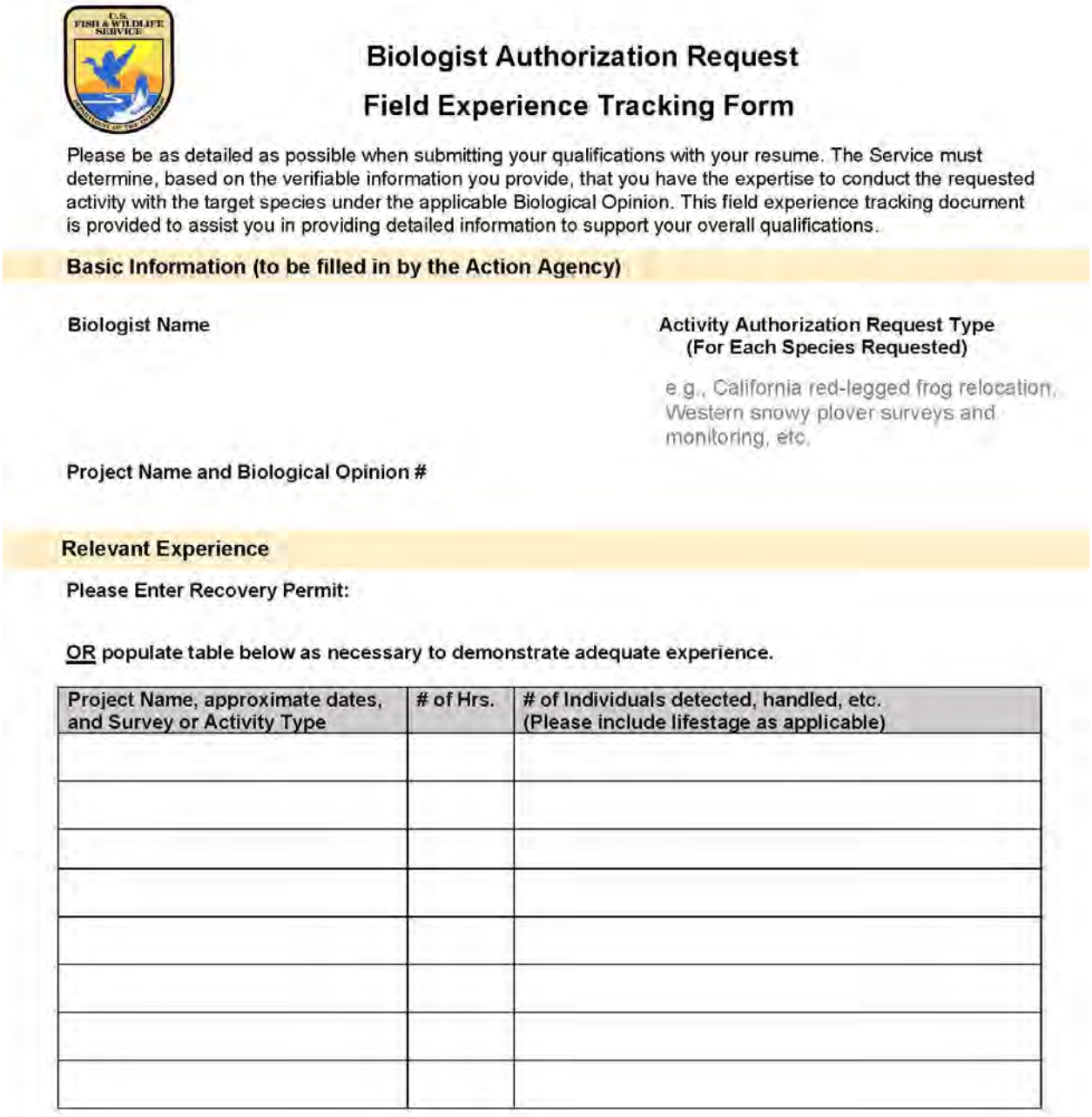


Figure 4b. Potential mitigation area (Predator Management Area) for western snowy plover and California least tern. Note that the figure references a separate project's (Phantom) launch noise effect area to be disregarded (Kaisersatt, pers. comm, 2023c; MSRS 2022d).

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.

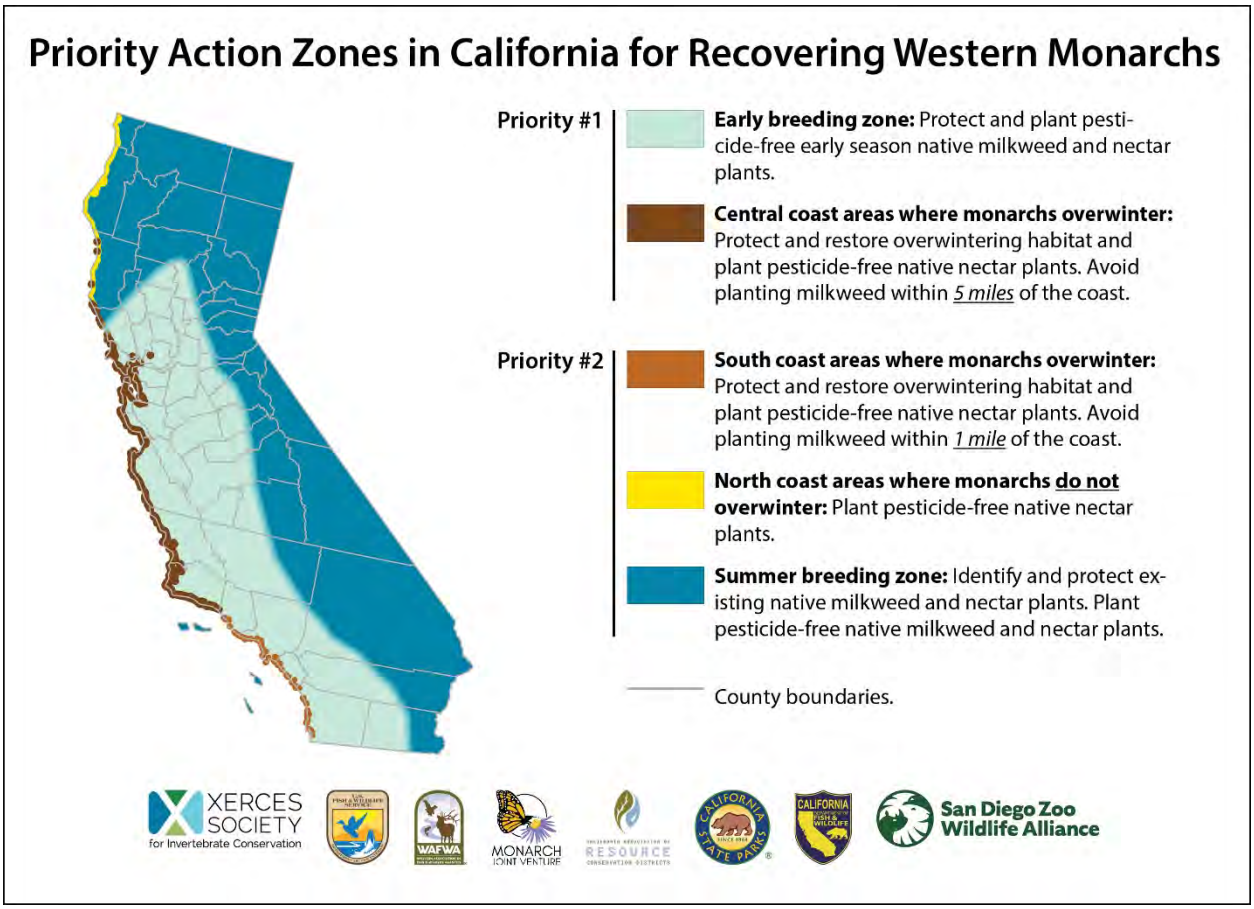


Figure 1. Priority Monarch Habitat Restoration Areas in California.

Coastal California Overwintering Habitat: 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.

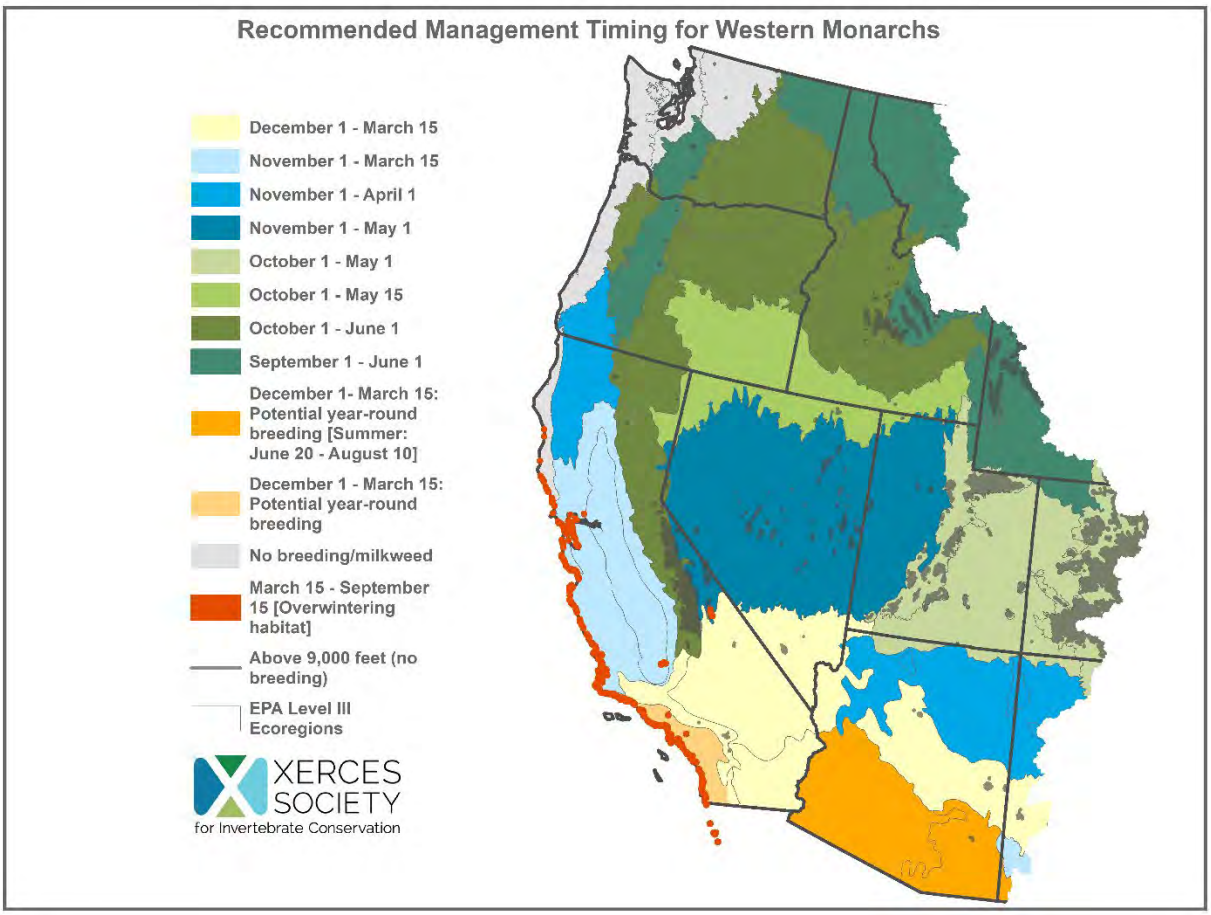


Figure 2. Recommended Management (i.e., mowing, burning, grazing, pesticide applications) Timing Windows in the western U.S. by Zone.

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.

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;

Exhibit 8
CD-0003-24

(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.

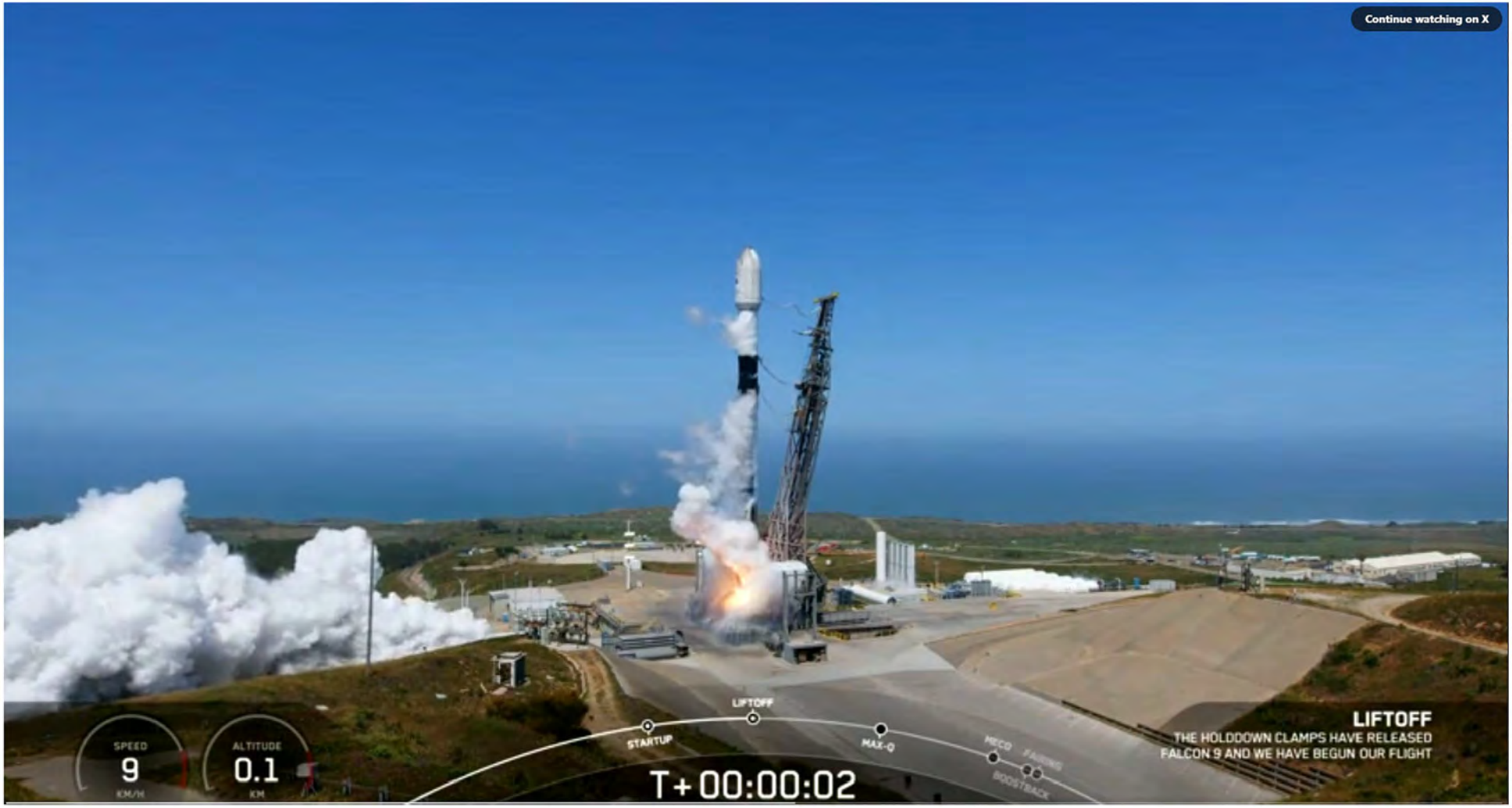
Sincerely,

Dan Lawson
Long Beach Branch Chief
Protected Resource Division

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

Administrative Record Number: 151422WCR2023PR00013

Exhibit 9
CD-0003-24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LIFTOFF
THE HOLDDOWN CLAMPS HAVE RELEASED
FALCON 9 AND WE HAVE BEGUN OUR FLIGHT


Continue watching on X
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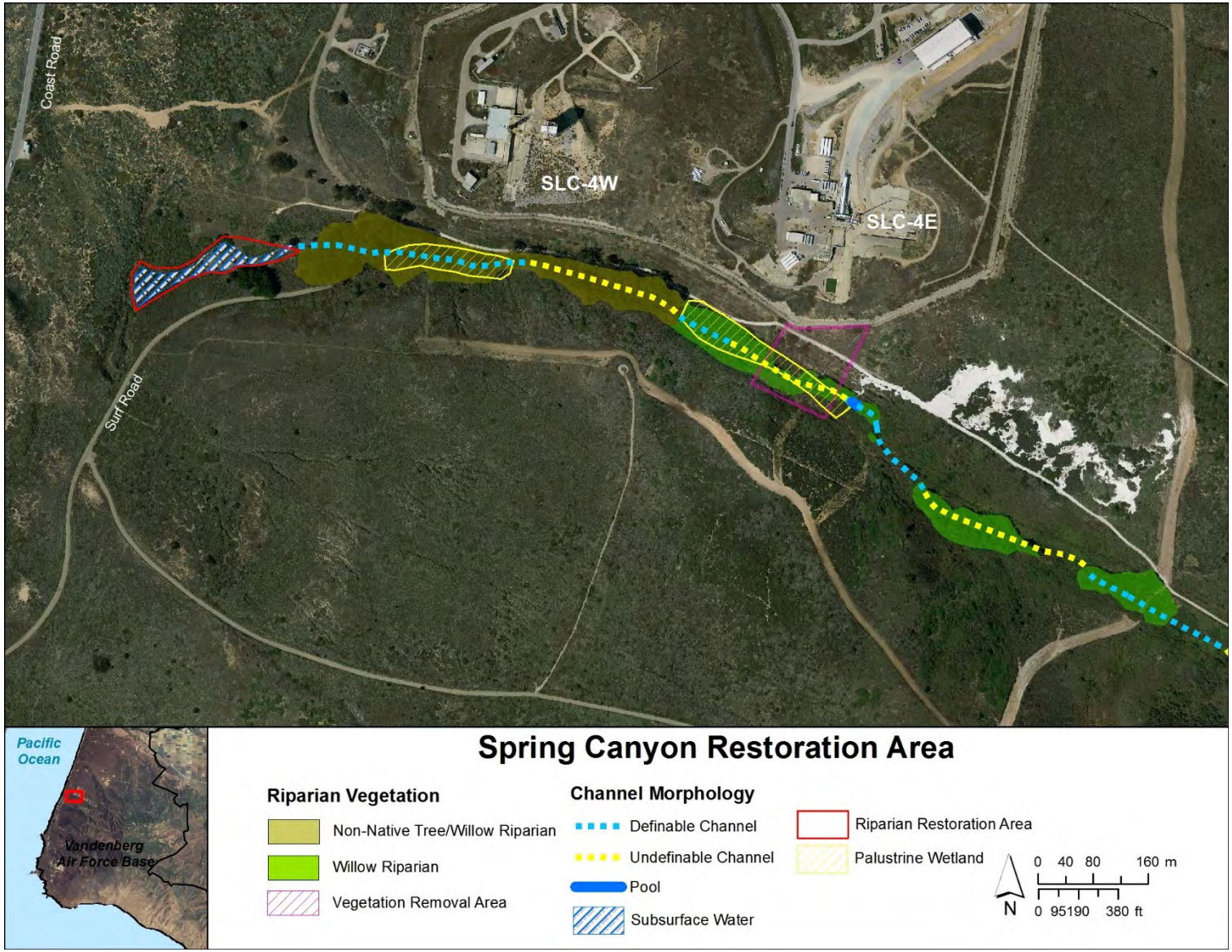


Figure 1-3. Spring Canyon Restoration Area. Note: "Definable" versus "Undefinable" channel were primarily estimated during an assessment performed in 2013 (ManTech SRS Technologies, Inc. 2013).

Exhibit 10
CD-0003-24

Contingency Evacuation Email: Updated Protocols

From: Santa Barbara County Parks Reservations
To: Santa Barbara County Parks Reservations
Subject: IMPORTANT INFORMATION REGARDING YOUR JALAMA BEACH RESERVATION (November 16)

Dear Valued Jalama Beach County Park Visitor,

Vandenberg Space Force Base and SpaceX has scheduled a launch for Thursday, November 16, 2023. The launch window is from 11:38 pm to 3:30 am the early morning of the 17th.

At this time **Jalama Beach is not subject to an evacuation** order due to the estimated number of overnight visitors being below the population threshold set by Space Force Launch Control, Safety Office, and the Federal Aviation Administration (FAA). **However, as the launch date/time approaches, if the estimated population threshold is exceeded, there will be a need to evacuate the campground from 3-hrs prior am/pm on November 16th until an all-clear status is issued by Space Force**.

While we **do not** anticipate the need to evacuate the campground at this time, please note the following:

- If an evacuation order is issued you will be notified in a subsequent email and all campers will be evacuated to the end of Jalama Road on to Highway 1. If you will be in mid-stay, you do not have to break down your campsite, and large camping gear may be left behind; however, we do recommend you take your valuables with you.
- While the campground is not currently subject to evacuation, if you do stay overnight in the park, please be advised while highly unlikely, there is a small risk of launch vehicle failure which could cause debris to fall on the campground.
- If you would like to move your check-in date or shorten your stay, depending on availability, please submit a reservation change form by visiting www.sbparks.org/support or contact our Call Center at (805) 568-2460. All changes will be made at no additional charge, and any shortened stays will be partially refunded.
- You may move your stay the evening of the launch to Cachuma Lake Recreation Area, depending on availability, which is approximately 50 miles from Jalama Beach. Please submit a reservation change form by visiting www.sbparks.org/support or contact our Call Center at (805) 568-2460 for availability at Cachuma Lake.
- If you would like to completely cancel the reservation, please submit a reservation change form by visiting www.sbparks.org/support or contact our Call Center (805) 568-2460. You must contact the Call Center by web form or phone to receive a full refund for your cancellation. Remember to disclose the "Jalama Safety Relocation" as the reason for your cancellation. Alternatively, please be advised that cancellations and refund requests initiated through the website will only include the site fee.

Please note that there is always a possibility that the launch may be cancelled or postponed to a later time. Backup dates are November 17th, 18th, and 19th.

We sincerely apologize for any inconvenience this may have caused, and hope this notification will

Exhibit 11
CD-0003-24

help you make any necessary adjustments to your plans. Please let us know if you have any questions or concerns regarding this launch, and thank you for camping at Jalama Beach Park.

Evacuation Email: Sent by SBC for all launches with early 2023 Protocols. Now only used if SLD 30 issues a full evacuation notice.

From: Santa Barbara County Parks Reservations
To: Santa Barbara County Parks Reservations
Subject: IMPORTANT INFORMATION REGARDING YOUR JALAMA BEACH RESERVATION (Jan 28)

Dear Valued Jalama Beach County Park Visitor,

Santa Barbara County Parks has just been notified by Vandenberg Space Force Base of a launch scheduled for **Sunday, January 29. from 5:30 AM to approximately 1:06 PM**, or until Park Staff receives an approval from the base to re-enter. All campers at Jalama Beach will be mandatorily evacuated during this window for safety reasons**.** All business should return to normal outside the relocation window and campers may return to Jalama Beach as soon as an all-clear status is received.

You are being contacted because you currently have a camping reservation that may conflict with this mandatory safety evacuation window, and we wanted to take the time to notify you of this occurrence so that you may make any changes to your travel plans accordingly. Please review the following options:

- If you are scheduled to camp on **Saturday, January 28th**, you may do so, but please be advised that you will be forced to evacuate the site **5:30 AM**. All campers will be evacuated to the end of Jalama Road on to Highway 1. If you will be in mid-stay, you do not have to break down your campsite, and large camping gear may be left behind; however, we do recommend you take your valuables with you.
- If you would like to move your check-in date or shorten your stay, depending on availability, please submit a reservation change form by visiting www.sbparks.org/support or contact our Call Center at (805) 568-2460. All changes will be made at no additional charge, and any shortened stays will be partially refunded.
- You may move your stay the evening before the launch to Cachuma Lake Recreation Area, depending on availability, which is approximately 50 miles from Jalama Beach. Please submit a reservation change form by visiting www.sbparks.org/support or contact our Call Center at (805) 568-2460 for availability at Cachuma Lake.
- If you would like to completely cancel the reservation, please submit a reservation change form by visiting www.sbparks.org/support or contact our Call Center (805) 568-2460. You must contact the Call Center by web form or phone to receive a full refund for your cancellation. Remember to disclose the "Jalama Safety Relocation" as the reason for your cancellation. Alternatively, please be advised that cancellations and refund requests initiated through the website will only include the site fee.

Please note that there is always a possibility that the event may be cancelled or postponed to a later time. The backup date is Monday, January 30th.

We sincerely apologize for any inconvenience this may have caused, and hope this notification will help you make any necessary adjustments to your plans. Please let us know if you have any questions or concerns regarding the mandatory safety relocation, and thank you for camping at Jalama Beach Park.

Santa Barbara County Parks
123 E Anapamu Street, 2nd Floor
Santa Barbara, CA 93101
Phone: (805) 568-2460
Email: Reservations@sbparks.org

Parks-County-0

CALIFORNIA COASTAL COMMISSION
ENERGY, OCEAN RESOURCES AND FEDERAL CONSISTENCY
455 MARKET STREET, SUITE 300
SAN FRANCISCO, CA 94105-2421
VOICE (415) 904-5200
FAX (415) 904-5400

February 16, 2024

Beatrice L. Kephart
United States Space Force
30 CES/CEI
1028 Iceland Avenue
Vandenberg SFB, CA 93437-6010

Re: **Remedial Action Proposal – SpaceX Falcon 9 Space Launch Activities**

Dear Chief Kephart,

The purpose of this letter is to provide notification and supporting information regarding the determination by the California Coastal Commission (Commission) that the project to expand the Space Exploration Technologies (SpaceX) Falcon 9 space launch and landing program at Vandenberg Space Force Base (VSFB), for which the U.S. Space Force submitted to the Commission a negative determination (no. ND-0009-23), is being conducted and is having effects on coastal uses and resources substantially different than originally described and as a result, is affecting coastal uses and resources and is not consistent to the maximum extent practicable with the enforceable policies of the California Coastal Management Program (CCMP). This letter further proposes several remedial actions for the U.S. Space Force to take to address the situation.

Commission staff appreciates the close communications with your staff over the past several months to better understand the history, need, and process for Falcon 9 space launch and landing operations at VSFB. We also appreciate your efforts to work with us to identify a pathway to address the inconsistency of those operations with the CCMP. We look forward to continuing this coordination.

Subject Negative Determination
On May 5, 2023, the Commission's Executive Director concurred with negative determination no. ND-0009-23 by the U.S. Space Force for an expansion of the SpaceX Falcon 9 program at VSFB from six to 36 annual launches from the existing SLC-4E launch complex as well as the addition of offshore landing locations in the Pacific Ocean and associated activities such as payload processing. The launches serve the primary purpose of placing into Earth orbit small satellites for SpaceX's "Starlink" commercial satellite internet business.

As detailed further in the November 30, 2023, staff report[1] prepared for the Commission's consideration, the U.S. Space Force described in its negative determination that for public safety, SpaceX launches may require short-duration (between four and eight hours)

[1] Available at https://documents.coastal.ca.gov/reports/2023/12/F8c/F8c-12-2023-report.pdf

closures and evacuations of Jalama Beach and Jalama Beach County Park and Campground (Jalama) outside of VSFB but that the number of such closures would not exceed 12 per year. With the addition and implementation of a variety of measures to minimize adverse impacts to public coastal access and recreation, both of which are coastal uses and resources protected by enforceable policies of the CCMP, the Commission previously found in 1998 its concurrence with the U.S. Air Force's Consistency Determination No. CD-049-98 for an earlier space program that this level of temporary beach closures would not be inconsistent with the relevant enforceable policies of the CCMP.

Shortly after the Executive Director's concurrence with negative determination no. ND-0009-23, however, Commission staff learned through discussions with staff from Santa Barbara County's Parks and Recreation Department that the number of temporary closures and evacuations of the beach and campground at Jalama due to SpaceX launches within the first seven months of 2023 had already surpassed the annual maximum of 12 that the U.S. Space Force committed not to exceed in its negative determination. Further, Commission staff learned that public coastal access and recreation at Jalama was being affected by SpaceX launch activities in more ways than just the temporary closure and evacuation of the beach and campground. Specifically, public coastal access and recreation is also adversely affected through (1) closures of the 14 mile long road between Highway 1 and Jalama Beach to incoming traffic in advance of scheduled SpaceX launches, even when a full closure and evacuation does not occur; (2) email notices of possible closure and evacuation to those holding campground reservations during the time of a scheduled SpaceX launch; and (3) website notices of possible closure and evacuation to those seeking to secure a campsite reservation during the time of a scheduled SpaceX launch. These launch activities limit and prevent coastal access and recreation, result in cancellations of campsite reservations and limit the number of reservations secured.

None of these adverse impacts to public coastal access and recreation were acknowledged or discussed by Space Force in its negative determination. Accordingly, they were also not considered by the Executive Director before issuing her concurrence. Following Commission staff's identification of this issue, U.S. Space Force staff confirmed that its understanding of coordination and communication between SpaceX and Santa Barbara County staff was incomplete and that a wider range of adverse impacts were occurring as a result of launch activities than it had described in its negative determination. Commission staff also visited the SpaceX launch facility on VSFB in September 2023 and met with SpaceX staff who acknowledged the public access and recreation impacts associated with its launch activities.
In addition, as noted by Space Force in its negative determination and confirmed through review of publicly available SpaceX launch records by Commission staff, SpaceX carried out at least 13 launches from VSFB in 2022, more than double the six previously considered and concurred with by the Executive Director in August of 2015 through review of negative determination no. ND-0027-15 from the U.S. Air Force.

As a result of the Commission's enhanced understanding of SpaceX's space launch activities carried out under ND-0009-23, it determined on December 12, 2023, that the activities are being conducted and are having effects on coastal uses and resources substantially different than originally described by the U.S. Space Force in its negative

determination. In addition, because these effects exceed those which the Commission has previously determined to be consistent with the public coastal access and recreation policies of the CCMP, the Commission also determined that the substantially different effects from the SpaceX launch activities are not consistent to the maximum extent practicable with the enforceable policies of the CCMP. Feasible alternatives are available which would avoid or significantly reduce the adverse impacts of SpaceX's launch activities and mitigation measures may also be available to offset them. Further supporting information regarding the Commission's determinations is available in the previously referenced November 30, 2023, staff report considered and adopted by the Commission.

Remedial Action

On December 15, 2023, the Commission approved a resolution[2] authorizing its Executive Director to prepare and send a letter to the U.S. Space Force proposing the following remedial actions to resolve this situation and ensure space launch and landing activities by SpaceX are carried out consistent with the enforceable policies of the CCMP:

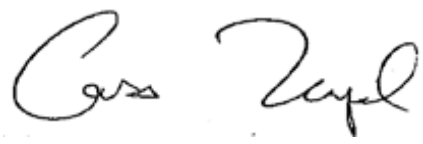
1. U.S. Space Force should prepare and submit a consistency determination (CD) for the expansion of SpaceX Falcon 9 space launch and landing activities at VSFB from six per year to 36, with a complete evaluation of conformance with the enforceable policies of the CCMP. This should include analysis of effects to public coastal access and recreation that integrates currently available information regarding the various manners in which these coastal resources and uses are affected and a proposal to provide compensatory mitigation for those impacts that have already occurred, and will continue to occur, due to continuing Falcon 9 space launch and landing activities.

2. Until that CD has been submitted and considered by the Commission, U.S. Space Force should limit SpaceX launch azimuths and scheduling in order to avoid further adverse impacts to public coastal access and recreation at Jalama.

Conclusion

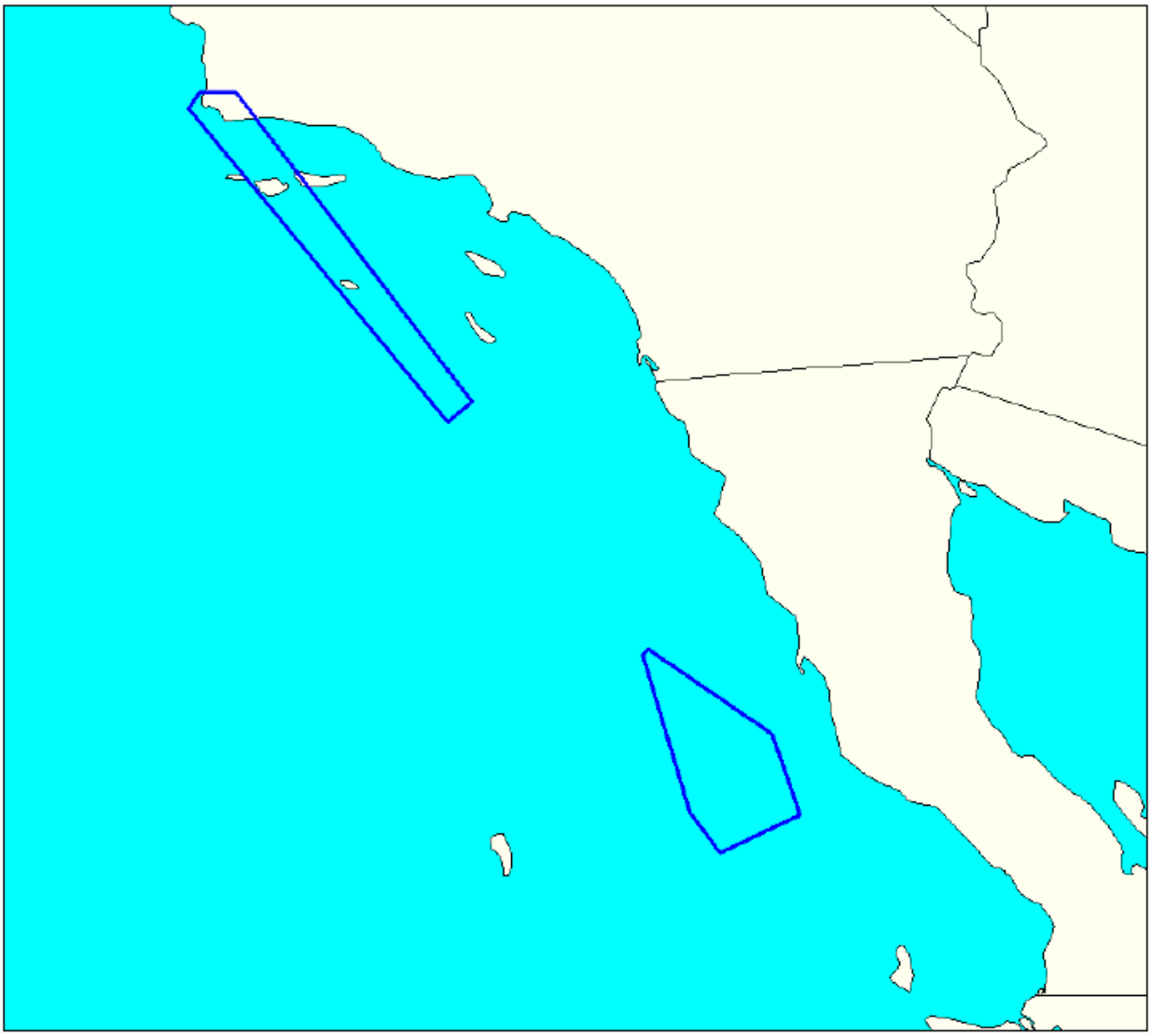
We look forward to U.S. Space Force's timely consideration of the information in this letter and implementation of the identified remedial actions. If you have any questions or would like to discuss implementation of the remedial actions please contact Cassidy Teufel at Cassidy.Teufel@coastal.ca.gov.

Sincerely,



Cassidy Teufel
Director
Energy, Ocean Resources and Federal Consistency Division.

[2] https://documents.coastal.ca.gov/reports/2023/12/F8c/F8c-12-2023-report.pdf



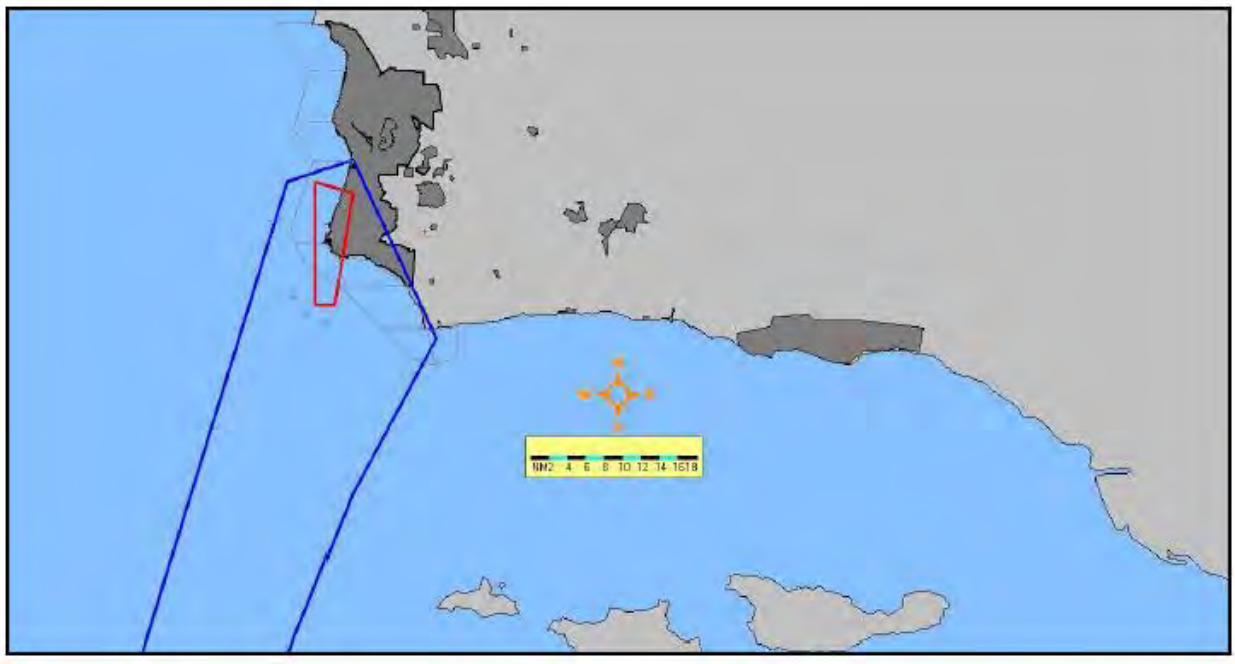


Exhibit 13
CD-0003-24