Draft Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base, California

Appendices (Volume I)

May 2025

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LIST OF APPENDICES

VOLUME I:

APPENDIX A
State Historic Preservation Office and Native American Tribal Consultations

State of California • Natural Resources Agency Gavin Newsom, *Governor*

DEPARTMENT OF PARKS AND RECREATION
OFFICE OF HISTORIC PRESERVATION
Armando Quintero, *Director*

Julianne Polanco, State Historic Preservation Officer
1725 23rd Street, Suite 100, Sacramento, CA 95816-7100
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February 6, 2025

Reply in Reference to: USAF_2025_0116_002

Ms. Laura L. Miz
Deputy Base Civil Engineer, 30th Civil Engineer Squadron
1172 Iceland Avenue
Vandenberg AFB, CA 93437-6011

VIA ELECTRONIC MAIL

Re: Section 106 Consultation for SpaceX SLC-4 and SLC-6 Increased Launch Cadence and Modifications, Vandenberg Space Force Base, Santa Barbara County

Dear Ms. Miz:

The United States Air Force (USAF) is initiating consultation with the State Historic Preservation Officer (SHPO) regarding its effort to comply with Section 106 of the National Historic Preservation Act of 1966 (54 U.S.C. 306108), as amended, and its implementing regulation found at 36 CFR Part 800.

According to their consultation letter, the USAF are proposing to “modify Space Launch Complex (SLC)-6 and increase launch cadence at both SLC-4 and SLC-6” at Vandenberg Space Force Base. The letter clarifies that no modifications or new construction is proposed at SLC-4. A complete project description may be found in the USAF’s supporting documentation.

In 2020, SLC- 6 was formally determined not eligible for NRHP inclusion. Archeological identification efforts revealed that Native American archaeological sites CA-SBA-1114 and CA-SBA-1941 are within the APE, however these sites were formally determined not eligible in 2021. Subsurface testing efforts at SLC-6’s landing zone were negative and no response from the Santa Ynez Band of Chumash Indians have been received to date

The USAF are requesting concurrence with their APE definition and a finding of no historic properties affected. Upon review of the information provided, the SHPO has the following comments:

1. The SHPO has no objection to the USAF’s area of potential effects definition.

2. The SHPO concurs with the USAF’s finding of no historic properties affected. Be advised that under certain circumstances, such as an unanticipated discovery or

a change in project description, the USAF may have future responsibilities for this undertaking under 36 CFR Part 800.

This letter is being sent in electronic format only. Please confirm receipt of this letter and notify Ed Carroll, Historian II, at Ed.Carroll@parks.ca.gov or 916-503-8466 if there are any questions or to request a hard copy of this letter.

Sincerely,

Julianne Polanco
State Historic Preservation Officer

From: SMALLWOOD, STACY J CIV USSF SSC 30 CES/CEIEA
To: "Wendy Teeter"
Cc: Crystal Mendoza; Nakia Zavalla; CRM Consultation; Edgar Alvarez; Samuel Cohen; NOCERINO, ERIC CIV USAF SSC 30 CES/CEIEA; KAISERSATT, SAMANTHA O CIV USSF SSC 30 CES/CEIEA; Polanco, Julianne@Parks
Subject: RE: [Non-DoD Source] RE: {EXTERNAL} 106 Vandenberg SpaceX SLC-4/SLC-6 Project (813-23-082)
Date: Friday, February 7, 2025 2:06:00 PM

Dear Wendy,

The SHPO responded yesterday with concurrence on our delineation of the APE and finding of *no historic properties affected* for the above-referenced SpaceX Project.

I still need to hear back from the Tribe. As I asked before, can the Tribe identify any effects resulting from the Project which could be considered adverse effects on a tribal cultural resource? What does the Tribe consider to be the cumulative effects?

Your help to clarify the Tribe's concerns is much appreciated.

Thank you,

-Josh

From: Wendy Teeter <wteeter@chumash.gov>
Sent: Wednesday, January 29, 2025 4:03 PM
To: SMALLWOOD, STACY J CIV USSF SSC 30 CES/CEIEA <stacy.smallwood.1@spaceforce.mil>
Cc: Crystal Mendoza <cmendoza@chumash.gov>; Nakia Zavalla <NZavalla@chumash.gov>; CRM Consultation <CRMConsultation@chumash.gov>; Edgar Alvarez <ealvarez@chumash.gov>; Samuel Cohen <scohen@chumash.gov>; NOCERINO, ERIC CIV USAF SSC 30 CES/CEIEA <eric.nocerino@spaceforce.mil>; KAISERSATT, SAMANTHA O CIV USSF SSC 30 CES/CEIEA <samantha.kaisersatt@spaceforce.mil>; Polanco, Julianne@Parks <Julianne.Polanco@parks.ca.gov>
Subject: RE: [Non-DoD Source] RE: {EXTERNAL} 106 Vandenberg SpaceX SLC-4/SLC-6 Project (813-23-082)

Dear Josh,

Thank you for your response to the Tribe's concerns. We will discuss internally and get back to you along with who would like to see the project area as quickly as possible. The SHPO is cc'd here for her records since the project information was sent to the Tribe and SHPO at the same time for consideration.

Sincerely,

Wendy

Wendy Giddens Teeter, PhD, RPA
Cultural Resources Archaeologist | Elders' Council and Culture Department
Santa Ynez Band of Chumash Indians
wteeter@chumash.gov
cell: 805-325-8630

Co-PI, Carrying our Ancestors Home, https://coah-repat.com
Co-Director, Pimu Catalina Island Archaeology Project

From: SMALLWOOD, STACY J CIV USSF SSC 30 CES/CEIEA <stacy.smallwood.1@spaceforce.mil>
Sent: Wednesday, January 29, 2025 12:42 PM
To: Wendy Teeter <wteeter@chumash.gov>
Cc: Crystal Mendoza <cmendoza@chumash.gov>; Nakia Zavalla <NZavalla@chumash.gov>; CRM Consultation <CRMConsultation@chumash.gov>; Edgar Alvarez <ealvarez@chumash.gov>; Samuel Cohen <scohen@chumash.gov>; NOCERINO, ERIC CIV USAF SSC 30 CES/CEIEA <eric.nocerino@spaceforce.mil>; KAISERSATT, SAMANTHA O CIV USSF SSC 30 CES/CEIEA <samantha.kaisersatt@spaceforce.mil>
Subject: RE: [Non-DoD Source] RE: {EXTERNAL} 106 Vandenberg SpaceX SLC-4/SLC-6 Project (813-23-082)

Hi Wendy,
Jenni SciarappaShaw <jesciarappashaw@chumash.gov> reached out to schedule a large group field meeting on either February 26 or 27. I was hoping we could schedule something sooner, but I understand the difficulties of scheduling a large group of people.
To better understand and address the Tribe's concerns, I would like to discuss the concerns you stated below. You had mentioned below that "there are a number of lithic scatters" in the ADI (Area of Direct Impact). There are only two: CA-SBA-1114 and CA-SBA-1941, both of which have no potential to be affected by the project which will do minor improvements along the existing access road through these site polygons, and therefore, these two sites have been eliminated from the APE.
You mentioned a "trail and trade network that should be considered as potentially eligible", yet there is no physical evidence of a trail system or trade network at this location. Of course, the Chumash ancestors traveled all over this region, up and down every part of the coastline, ridges, and canyons to reach villages and resource areas on Vandenberg; hunted, fished, and gathered resources such as chert and other stone materials which are abundant on Base and throughout the region. Obsidian was obtained from as far away as northern California, and shell beads were traded to the Mojave at the Colorado River, but those trade networks are not evident within or adjacent to the Project area. There has been no substantial amount of, if any, trade items found at the lithic scatters in question, and identification of a trail and trade network in the Project vicinity would be speculation, at best.
While a Cultural Landscape Study would be a great opportunity to generate data on the local region, the effort and cost are way beyond the scope of a Project that will have no effect on cultural resources. A Cultural Landscape Study is more appropriate to a Project which will result in an adverse effect which requires mitigation, such as what occurred for the Sentinel Project at Lospe Village which our Cultural Resources Managers worked on together with the Tribe.
In summary, can the Tribe identify any effects resulting from the Project which could be considered adverse effects? What does the Tribe consider to be the cumulative effects?
Your help to clarify the Tribe's concerns is much appreciated.
Thank you.
Respectfully,
-Josh

From: Wendy Teeter <wteeter@chumash.gov>
Sent: Tuesday, January 21, 2025 11:43 AM
To: SMALLWOOD, STACY J CIV USSF SSC 30 CES/CEIEA <stacy.smallwood.1@spaceforce.mil>
Cc: Crystal Mendoza <cmendoza@chumash.gov>; Nakia Zavalla <NZavalla@chumash.gov>; CRM Consultation <CRMConsultation@chumash.gov>; Edgar Alvarez <ealvarez@chumash.gov>; Samuel Cohen <scohen@chumash.gov>
Subject: [Non-DoD Source] RE: {EXTERNAL} 106 Vandenberg SpaceX SLC-4/SLC-6 Project (813-23-082)

Dear Josh,
There is a lot of modifications to SLC-6 that are of concern. We would like to schedule a site visit and discuss the cumulative effects from this work. While we understand there are a number of lithic scatters in the project ADI that by themselves don't seem eligible to the historic register, they are part of a trail and trade network that should be considered as potentially eligible and we would like to propose and partner in this study, evaluation and assessment of the effects to this important traditional cultural landscape before it is damaged by this work.
Thank you,
Wendy

Wendy Giddens Teeter, PhD, RPA
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cell: 805-325-8630

Co-PI, Carrying our Ancestors Home, https://coah-repat.com
Co-Director, Pimu Catalina Island Archaeology Project

From: SMALLWOOD, STACY J CIV USSF SSC 30 CES/CEIEA <stacy.smallwood.1@spaceforce.mil>
Sent: Tuesday, January 21, 2025 8:29 AM
To: Nakia Zavalla <NZavalla@chumash.gov>
Cc: Wendy Teeter <wteeter@chumash.gov>; Crystal Mendoza <cmendoza@chumash.gov>
Subject: {EXTERNAL} 106 Vandenberg SpaceX SLC-4/SLC-6 Project (813-23-082)

Dear Nakia,
This submittal is to initiate Section 106 consultation with the Santa Ynez Band of Chumash Indians regarding the SpaceX SLC-4/SLC-6 Project (813-23-082), Vandenberg Space Force Base, Santa Barbara County, California. The attachments are as follows:
- Signed transmittal letter;
- Section 106 report with appendices.

Please respond with comment within 30 calendar days. Please let me know if you require any additional information or if you require a site visit prior to making comment.
Thank you,

-Josh

Josh Smallwood, M.A., RPA
Installation Tribal Liaison Officer/Cultural Resources Manager
SLD 30 CES/CEIEA
1028 Iceland Avenue, Building 11146
Vandenberg Space Force Base, CA 93437-6010
Mobile: 760-419-0092

DEPARTMENT OF THE AIR FORCE
UNITED STATES SPACE FORCE
SPACE LAUNCH DELTA 30

Josh Smallwood
30 CES/CEIEA
1028 Iceland Avenue
Vandenberg SFB, CA 93437-6010

Ms. Nakia Zavalla
Santa Ynez Band of Chumash Indians
P.O. Box 517
Santa Ynez, CA 93460

Dear Ms. Zavalla

Space Exploration Technologies Corporation (SpaceX) proposes to modify Space Launch Complex (SLC)-6 and increase launch cadence at both SLC-4 and SLC-6 at Vandenberg Space Force Base (VSFB) in Santa Barbara County. The proposed *SpaceX SLC-4/SLC-6 Increased Launch Cadence and Modifications Project* would include increased cadence of Falcon 9 rockets from 50 to 100 launches per year, boost-back return landings at SLC-4 and SLC-6, and modifications to the SLC-6 campus to support Falcon Heavy rockets. No modifications or new construction is proposed at SLC-4.

The Department of the Air Force (DAF) determined the Project is an undertaking subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and will comply with Section 106 using the implementing regulations [36 CFR Part 800]. The DAF has carried out a reasonable and good-faith cultural resources investigation that fulfills federal agency responsibilities pursuant to 36 CFR 800.4(a)-(d) and 36 CFR 800.5(a)-(d). With this letter and the accompanying report, the DAF is initiating consultation with the Tribe.

SpaceX contracted Langan, Inc. to conduct a cultural resources study of the Project area, and to prepare an analysis specifically addressing potential impacts on cultural resources from rocket engine noise and sonic boom vibrations associated with static tests, launches and booster return landings at SLC-4 and SLC-6. Data from the cultural resource noise vibration study has been used to show there is no potential for historic properties in the region to be affected by noise vibrations associated with launch activities at SLC-4 and SLC-6. Additionally, 20 years of site condition assessments on VSFB have indicated that rock art, historic buildings, and archaeological resources on VSFB, in close proximity to SLC-4 and SLC-6, are not affected by short-duration launch noise vibrations and sonic booms from boost-back return landings. Sand cone tests recently conducted by Smallwood within close proximity to SLC-4 confirm that short-duration launch noise of 150 decibels, and sonic booms above 5 pounds per square foot had no visible effect on the integrity of a sand cone with 45-degree slopes. Therefore, it is highly unlikely that any of the historic properties in the Lompoc vicinity or the Northern Channel

Islands has the potential to be affected by noise vibrations and sonic booms which last mere seconds at these thresholds.

It has been concluded that an increased cadence of launches and boost-back at SLC-4 and SLC-6 would not introduce any auditory elements which would have the potential to cause effects to historic properties under 36 CFR 800.3(a)(1). Thus, known historic properties in the region were considered in this study, but have been excluded from the Area of Potential Effects (APE) because there is no potential for them to be affected. No known historic properties have the potential to be affected by an increased cadence of launches and boost-back at SLC-4 and SLC-6, therefore, the noise polygons are not included as part of the APE.

Background research revealed that the boundaries of two Native American archaeological sites (CA-SBA-1114 and CA-SBA-1941) are intersected by the Project Area of Direct Impacts (ADI). CA-SBA-1114 is intersected by the western terminus of Cypress Ridge Road where it joins Coast Road. This site was tested and evaluated for National Register of Historic Places (NRHP) eligibility in 2021 and determined not eligible with SHPO concurrence (SHPO File Reference # USAF_2021_0408_001). The only activity proposed along this segment of Cypress Ridge Road is erosion control by adding a layer of crushed shale within the existing roadbed.

CA-SBA-1941 is intersected by the Project ADI along Cypress Ridge Road. However, CA-SBA-1941 was previously mapped as containing 14 artifacts spread out over a distance of more than 3,500 feet by 700 ft wide and encompassing an area measuring 181,700 square meters. The polygon drawn for the site includes large areas where no artifactual deposit exists. The segment of Cypress Ridge Road which traverses through the site boundaries measures 20 ft wide. Cypress Ridge Road has been previously surveyed with no artifacts being found in the roadway, and 57 shovel test pits (STPs) excavated along the edge of the roadway were completely sterile of cultural material. Furthermore, the only activity proposed along this segment of Cypress Ridge Road is erosion control by adding a layer of crushed shale within the existing roadbed. Based on previous investigation, the cultural materials recorded as CA-SBA-1941 are not situated within the ADI, and no buried deposits have been identified within the ADI, therefore, CA-SBA-1941 does not exist within the ADI and the proposed erosion control activity has no potential to affect the site. Therefore, CA-SBA-1941 is not included in the APE.

Due to the sensitive nature of the area south of SLC-6 for buried deposits, as evidenced by construction monitoring which occurred in the 1980s, a total of 52 STPs were excavated across the 23-acre proposed Landing Zone Improvement Area to establish the presence/absence of buried archaeological deposits. None of the 52 STPs excavated in the landing zone area encountered any cultural material. The balance of the Project area has been surveyed at an intensive level and while several archaeological sites have been recorded in the vicinity, no additional archaeological resources exist within or immediately adjacent to the ADI.

Finally, the entirety of the existing SLC-6 campus has been previously recorded as a Cold War era cultural resource (P-42-041202), evaluated for NRHP eligibility, and determined not eligible with SHPO concurrence (SHPO File Reference # USAF_2020_1109_001). Therefore, SLC-6 is not a historic property, and the demolition, modification, and new construction activities proposed within the existing, developed portions of the SLC-6 campus will have no potential to affect a historic property.

Details of the investigation are provided in the attachment. Details of the investigation are provided in the attachment; however, briefly stated, the DAF has determined the following:

a. The APE for the SLC-4/SLC-6 Increased Launch Cadence and Modifications Project is adequately delineated; and

b. The undertaking will have *no effect* on any known historic properties.

In summary, the DAF has reached a Section 106 finding of *no historic properties affected* for this undertaking. The DAF recognizes that the Santa Ynez Band of Chumash Indians may have concerns beyond the purview of the National Historic Preservation Act. Therefore, I am seeking any additional comments or concerns you may have about cultural resources. I would appreciate receiving any feedback as part of this consultation within the next 30 calendar days. Please feel free to let me know if you require additional time. I can be reached at (760) 419-0092 or via email at stacy.smallwood.1@spaceforce.mil. Thank you for your assistance with this undertaking.

Sincerely

JOSH SMALLWOOD, M.A., RPA
Base Archaeologist
Asset Management Flight

Attachment:
Identification of Historic Properties and Finding of No Effect, SpaceX SLC-4 and SLC-6 Increased Launch Cadence and Modifications Project (813-23-082)

LANGAN

Memorandum

324 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001

To: Brian Pownall - SpaceX

From: Heather McDaniel McDevitt, MA, RPA - Langan

Subject: Cultural Resources Assessment - Annual Falcon Launch Cadence Increase at SLC-4 and SLC-6 and Modification of SLC 6, Vandenberg Space Force Base, California (Langan Project No.: 781017001)

Date: January 13, 2025

Attachments: Appendix A – Figures

Space Exploration Technologies Corp. (SpaceX) retained Langan to conduct a cultural resources inventory, pedestrian survey and subsurface testing to support compliance with Section 106 of the National Historic Preservation Act (NHPA) for the proposed action of the Annual Falcon Launch Cadence Increase at SLC-4 and SLC-6 and Modification of SLC 6, Vandenberg Space Force Base (VSFB), California (Proposed Action). The intent of these assessments is to determine if resources exist within the study area that have potential to be adversely affected by the Proposed Action (Figure 1 Cultural Resources Study Area [CRSA]). In addition to a California Historical Information System (CHRIS) records search, a separate cultural resources records search for the on-Base portion of the Archaeological Study Area (ASA) for the Proposed Action was conducted by the 30th Civil Engineer Squadron, Installation Management Flight, Cultural Resources Office (30 CES/CEIEA) employing the VSFB database of cultural resources. This memo includes the following components: a brief project description for the Proposed Action; explanation of the CRSA and ASA; methods; summary of the VSFB and CHRIS database records search results for the CRSA; results of the pedestrian survey and the subsurface testing; and conclusions regarding whether the Proposed Action would result in an adverse effect to cultural resources located within the total ASA.

This investigation was performed by Langan's Cultural Resources Practice staff under the direction of Principal Investigator, Heather McDaniel McDevitt, RPA, who exceeds Secretary of Interior standards for prehistoric and historic archaeology. Each aspect of the study was conducted in consultation with the 30 CES/CEIEA and could not have been accomplished without their support as well as that of the SpaceX environmental team and the Santa Ynez Band of Chumash Indians (SYBCI).

Proposed Undertaking

SpaceX is proposing an increase in the annual Falcon launch cadence at VSFB through launch and landing operations at Space Launch Complex (SLC)-4 and SLC-6 and the modification of the SLC-6 facility for Falcon 9 and Falcon Heavy launch vehicles to support future U.S. Government and commercial launch service needs. The purpose of the Proposed Action is to provide greater mission capability to the United States (US) government and commercial customers by increasing Falcon 9 and Falcon Heavy launch cadence capacity at both SLC-4 and SLC-6 from 50 to 100 launches per year. SpaceX developed the Falcon 9 and Falcon Heavy vertical orbital launch vehicles with the intent to launch commercial and government payloads from VSFB with reusable launch technology employing an in-air boost-back maneuver, return flight, and landing of the Falcon 9 first stage either downrange on a droneship in the Pacific Ocean or at the SLC-4 and the newly proposed SLC-6 pads at VSFB. The Proposed Action is needed to meet current and near-term U.S. Government space launch requirements from and return heavy-lift launch capability to the Western Range. Additionally, the Proposed Action would assist in fulfilling (in part) 10 USC Section 2276(a), "Commercial space launch cooperation" authorizing the Secretary of Defense to, with respect to its space transportation infrastructure: 1) maximize effectiveness and efficiency; 2) maximize use capacity by the private sector in the U.S.; 3) reduce its cost of services; and 4) encourage space activities by fostering cooperation with and enabling investment by covered entities.

This proposed action would include the annual landing of up to 12 boosters at SLC-4 for years 2024-2028 and up to 17 first stage boosters at SLC-6 for years 2025-2028. Therefore, the proposed launch increase includes an associated increase in boost-back landings of the first stage up to 100 times with no more than 12 of the first stage landings occurring at SLC-4 and no more than 17 of the first stage landings occurring at SLC-6 annually and the remainder occurring on the droneship located in the Pacific Ocean as described in the 2023 Supplemental Environmental Assessment (SEA). Additionally, there is potential for a static fire test of the engines, lasting a few seconds, to precede each launch by one to two days. Trajectories from SLC-4 would remain within the previously analyzed launch azimuth of between 140 and 325 degrees and trajectories from SLC-6 would fall within the same range. Fairing recovery and jettisoning of the Merlin Vacuum Engine skirt ring would occur as described in the 2023 SEA. SpaceX is proposing to expand its downrange recovery area by approximately 900 miles west and approximately 1,000 miles south to support Falcon Heavy missions. The droneship would then transport the booster to the Port of Long Beach as described in the 2023 SEA.

In order to support launches of the Falcon 9 and Falcon Heavy and landings of the first stage boosters at SLC-6, modifications of the SLC-6 facility would be required. A complete description of the Proposed Action can be provided upon request. SpaceX would modify SLC-6 to support Falcon 9 and Falcon Heavy launches. SpaceX would construct commodity storage tanks, a water tower, ground supporting equipment, and a rail system from the hangar to the launch pad. Where possible, existing infrastructure would be modified. This could include the liquid oxygen storage, launch pad apron and access road, and fence line. The existing flame trench would be retained and converted to a unidirectional water-cooled flame diverter, and a deluge/acoustic suppression system would be installed. Construction would generally occur in previously disturbed areas and on existing impervious surfaces, but some earthwork is anticipated. A new hangar or modification of an existing structure would be required for vehicle processing.

Approximately 143,000 square feet of commodity storage would be required. This includes storage tanks for liquid oxygen, rocket propellant-1, water, nitrogen, helium, and other launch commodities. A 200-foot water tower would be constructed on the east side of the launch complex. Firebreaks would be incorporated as appropriate into the site design and final site layout is subject to Space Launch Delta (SLD) 30 review and approval.

SpaceX would construct two landing zones south of SLC-6 to support landing of first stage Falcon boosters launching from SLC-6. Each landing zone would be made up of a 280-foot diameter concrete pad surrounded by a 60-foot gravel apron, for a total diameter of 400 feet. SpaceX would construct a new nitrogen gas line from SLC-6 to a fluids bay at the landing zones. The fluids bay is used to send nitrogen to different systems of the booster after landing. A 30-foot by 30-foot pedestal, which sits flush with the ground, would be constructed at each landing pad to support post-landing operations. Crane storage, a cleared area to lay down cranes when not in operation, is proposed on the western site boundary. Each landing zone would have a connection to the existing road to support booster transport. Approximately 16 acres would be cleared to construct the landing zones and approximately 7 acres would be impervious.

A new approximately 50-foot wide firebreak is proposed south of the landing zones and would connect to the existing firebreak for SLC-8. Additionally, Cypress Ridge Road would be improved within its existing footprint to protect against potential erosion. An offset plan for any native Coastal Scrub shrubland alliance impacts would be developed in accordance with the VSFB Integrated Natural Resources Management Plan and approved prior to construction.

For ease of identification, the areas of ground disturbance are categorized as separate areas and are illustrated in Figure 12 – Areas of Potential Ground Disturbance. Following are the proposed Project components, listed north to south that will or have the potential to result in ground-disturbance or landscape-alterations:

Far Northern Improvement Area *- Encompassing between approximately 3 to 9 acres (depending on whether modification of hanger is completed) and approximately 415 linear feet at an approximate width of 100 feet for rail system installation.*

Construction:
- Installation of rail system from the hangar to the launch pad (approximately 415 linear feet within Far North Improvement Area at a width of approximately 100 feet); and

Modifications/improvements:
- Modification of existing hanger for vehicle processing (potential) (approximately 9 acres).

Near Northern Improvement Area *(encompassing approximately 6 acres and 590 linear feet at an approximate width of 100 feet for rail system installation)*

Construction:
- Installation of rail system from the potential new hangar to the launch pad (approximately 590 linear feet within Near North Improvement Area at a width of approximately 100 feet); and
- Construction of new hanger for vehicle processing (potential) (approximately 6 acres).

Modifications/improvements:

Relocation of fence line

Central SLC-6 Improvement Area - *Encompassing approximately 34 acres including 680 linear feet at an approximate width of 100 feet for rail system installation.*

Construction:

- Construction of commodity storage tanks (approximately 2 acres);
- Construction of aerospace ground supporting equipment (approximately 0.2 acre);
- Installation of rail system from the hangar to the launch pad (approximately 680 linear feet within Central SLC-6 Improvement Area at a width of approximately 100 feet);
- Construction of a 143,000 square feet space for commodity storage (approximately 3 acres)
    - storage tanks for liquid oxygen, rocket propellant-1, water, nitrogen, helium, and other launch commodities; and
- Installation of a 200-foot water tower (replacing former water tower previously demolished) (approximately 0.1 acre).

Modifications/improvements:

- Installation of liquid oxygen storage (approximately 1 acre); and
- Conversion of existing flame trench to a unidirectional water-cooled flame diverter (approximately 0.4 acre).

Landing Zone Improvement Area - *Encompassing* approximately *23 acres (landing zone area = 16 acres and potential additional grubbing/grading preparation = 7 acres) and 1,420 linear feet for nitrogen gas line installation. Depth of disturbance is estimated to not extend deeper than 5 feet below current ground surface (bcgs) within the 16 acres to establish the subgrade and no deeper than 3 feet bcgs for installation of the nitrogen gas line. All other disturbances are expected to occur within graded soils.*

Construction:

- Construction of two landing zones including (approximately 16 acres):
    - Two 280-ft-diameter concrete pads;
    - 60-foot gravel apron surrounding each pad;
    - 50-foot access road from Road N to each landing pad (approximately 2 acres).
    - Two 30 x 30-foot pedestals to support post-landing operations (placed east of each landing pad);
    - The above areas total approximately 7 acres of impervious pavement;
- Installation of approximately 1,420 linear feet of new nitrogen gas line from SLC-6 to a 30 x 60-foot fluids bay; and

Cleared/Graded Areas:

- To construct the landing zones, preparation (grubbing, grading, etc.) within the area surrounding the landing zones, totaling approximately 7 additional acres, may be required; and
- Crane storage located west of the landing pads (approximately 1 acre).

Fire Breaks Improvement Area - *Encompassing approximately 2,035 linear feet* at an approximate width of 20 feet; *2,410 linear feet at an approximate width of 50 feet; and 6,340 linear feet at an approximate width of 17 feet. Depth of disturbance is estimated to not exceed one-foot bcgs for initial mechanical clearing of vegetation employing a bulldozer followed by periodic tilling at an approximate depth of six inches for firebreak maintenance.*

Cleared Areas:

- 50-foot-wide firebreak east and south of the landing zones connecting to the existing firebreak for SLC-8 (approximately 2,410 linear feet along North Road at an approximate width of 50 feet and 2,035 linear feet from North Road to the SLC-8 firebreak at an approximate width of 20 feet); and
- Improvement of Cypress Ridge Road within its existing footprint to protect against potential erosion (approximately 6,340 linear feet at an approximate width of 17 feet).

Cultural Resources and Archaeological Study Areas

The area of potential effect (APE) of an undertaking is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist" (36 CFR 800-16(d)). The APE considers any physical, visual, or auditory effects that the project may have on historic properties. The APE for the current project will be developed in consideration of ground-disturbing or landscape-altering actions and auditory effects predicated on vibratory impacts. In order to define the APE, an assessment of the CRSA (see Figure 1) and more specifically, the ASA (see Figure 12) has been conducted the results of which are provided in this report. The CRSA was determined based on data and thresholds relative to auditory effects provided in the noise study (KBR 2024) conducted to specifically address the Proposed Action and relevant literature. The ASA, located within the CRSA, was determined based on the extent of proposed ground disturbances relative to known resources.

AUDITORY EFFECTS PREDICATED ON VIBRATORY IMPACTS

KBR, Inc. (2024) conducted a noise study to support environmental studies for Federal Aviation Administration (FAA) launch licensing and the United States Space Force (USSF) 2024 environmental review under the National Environmental Policy Act (NEPA) of Falcon 9 and Falcon Heavy cadence increase and SLC-6 campus modifications at VSFB (KBR 2024). This noise modeling study was conducted to estimate the single event and cumulative noise levels within the vicinity of VSFB from future Flacon 9 and Heavy launches, landings and static fire tests proposed to occur as SLC-4 and SLC-6.

Based on previous studies that have determined at which levels structures and archaeological resources could potentially be affected by rocket noise and sonic booms; the focus of this study's analysis was determined by the auditory effects threshold of noise exceeding 120 dB and sonic booms exceeding 2 psf. In 1972, Guest et al. conducted analysis to assess claims that rocket engine thrusts were potentially impacting areas adjacent to a test site located at Marshall Space Flight Center's Mississippi Test Facility. The results of the study established that the potential to damage the most sensitive structural components such as windows and plaster on historic buildings occurred as a result of prolonged noise thresholds greater than 120 dB. Furthermore, the FAA uses the 120 dB noise contour for engine noise to define areas that may experience structural damage resulting from space launch vehicle noise. A 2016 study by Richard Fenton and Rick Methold considered the long-tern continuous measurement of airborne sound pressure levels, air over pressure and ground-born vibration caused by a series of activities undertaken on Military of Defense (MOD) facilities. Their study was conducted at the request of the MOD to analyze possible causal links between the studied activities and measured magnitudes to determine the likely risk of potential building damage. Fenton and Methold considered the influence of various factors that can affect acoustic impacts to structures and determined a 'safe' maximum threshold of 134 dB to be used for blast regime planning by the MOD but also recognized the scholarly consensus, including the authors, that damage becomes improbable below approximately 140 dB. The study by KBR, Inc. considers the range between 120 and 140 dB as well as the 'safe' maximum threshold of 134 dB.

Rocket Noise

The noise study identified where unweighted maximum noise levels (Lmax) were expected to occur employing the RNOISE model, that computes the far field noise levels, to estimate the impacts of rocket noise. Based on criteria described in their report, KBR Inc.'s (2024) study found that estimated contours from 130 dB and 140 dB resulting from all Falcon 9 flight and test operations are well within VSFB property. Since SLC-6 is located about 3.5 miles southwest of SLC-4 the noise exposure reach from rocket noise produced by Falcon launch and landing events occurring at SLC-6 is further southwest than the exposure reach of the same events occurring at SLC-4. Accordingly, noise exposure in Lompoc is estimated to be less from Falcon 9 launch and landing events at SLC-6 compared to Falcon 9 launch and landing events at SLC-4.

Falcon 9 orbital launch events are estimated to generate Lmax of 134 dB approximately 0.5 miles from the launch pad. Falcon Heavy launch events are estimated to generate Lmax of 134 dB approximately 1 mile from the launch pad with the 120 dB contour extending only slightly outside and east of the VSFB in an uninhabited area. The Lmax dB thresholds of 120, 140 and 145 dB contours estimated for Falcon 9 and Falcon Heavy orbital launch events at SLC-4 and SLC-6 are shown in Figures 2 and 3. Falcon 9 and Falcon Heavy orbital landing events occurring at SLC-4 and SLC-6 are estimated to generate Lmax of between the 120 and 140 dB contours entirely within VSFB property (see Figures 4 and 5).

Finally, Falcon 9 static fires tests occurring at both SLC-4 and SLC-6 and Falcon Heavy static fires tests occurring at SLC-6 are estimated to result in Lmax of between the 120 and 140 dB entirely within VSFB property (see Figures 6 and 7). Only levels less than an Lmax of 60 dB, which is well outside the threshold range of Lmax 120 and 140 dB, are anticipated to extend into the community outside VSFB when test events occur at night and/or when onshore wind conditions favor sound propagation to the east.

In consultation with the 30 CES/CEIEA concerning the Proposed Action and its potential for direct and indirect effects to cultural resources resulting from any related construction, static fire, launches, and boost-back landings, an area of direct impacts (ADI) and subsequent APE will be determined. The ADI for the Proposed Action relative to auditory effects predicted on vibratory impacts will include the area within which noise vibrations reach levels above 120 dB, as well as sonic booms in excess of 2 psf.

SONIC BOOMS LEVELS

A study conducted to assess the effects of aircraft noise and sonic booms on structures (Haber et al. 1989) determined that potential damage resulting from sonic booms measuring at 2-4 pounds per square foot (psf) were nominal and categorized as failures that occurred due to the poor condition of the structures or elements of the structure. Additionally, in a study commissioned by NASA it was reported that only rare and minor damage may occur with overpressures between 2 and 5 psf and that experimental testing of sonic boom effects has shown structures in good condition remain undamaged by overpressures up to 11 psf (Gibbs 2017). The Proposed Action will not result in overpressures any greater than 5 psf. Accordingly, the threshold for potential damage resulting from sonic booms (overpressure) for this Proposed Action is established at 2 psf or greater.

KBR Inc. computed the sonic boom footprint for each launch and landing event associated with the Proposed Action employing PCBoom modeling. These efforts determined the launch azimuths that have the potential to produce a sonic boom that could impact land during all launch and landing events included in the Proposed Action and identify where overpressures of 2 psf or greater are expected to occur. Figures 8 through 11 show the sonic boom footprint, in the form of overpressure contours, for Falcon 9 launch and landing events at SLC-4 and SLC-6 and the Falcon Heavy launch and landing events at SLC-6.

According to KBR Inc.'s (2024) study findings, peak overpressures levels from Falcon 9 launch events occurring at SLC-4 are estimated at between 0.1 and 1.0 psf with the crescent-shaped contour located entirely over water (see Figure 8). Peak overpressure levels from Falcon 9 launch events occurring at SLC-6 are between 0.1 and 5.0 psf with the crescent-shaped contour located entirely over water (see Figure 9). Peak overpressure levels from Falcon Heavy launch events occurring at SLC-6 are estimated between 0.1 and 7.0 psf with the crescent-shaped contour located mostly over water (see Figure 9), except for the exposed land areas of the Northern Channel Islands as well as Oxnard, CA and areas just north of Los Angeles, CA. Only a limited area of the Northern Channel Islands is estimated to be exposed to overpressure levels between 5.0 and 7.0 psf.

KBR Inc.'s (2024) study found sonic boom levels resulting from landing events at SLC-4 range from 5.0 to 7.5 psf near the landing pad and 0.1 to 5.0 psf on VSFB in areas away from the SLC-4 landing pad (see Figure 10). The greatest psf of 7.5 is limited to a narrow 100-yard-wide area off shore and the boom levels within the NCI area are estimated to range between 0.1 to 2.0 psf. The sonic boom footprint and overpressure levels for the Falcon Heavy landing events at SLC-6 have a similar shape to the Falcon 9 (see Figure 11). The exception is that the Falcon Heavy landings are expected to have higher overpressure levels near the landing pad.

In short, sonic boom overpressure measurements of 2 psf or greater resulting from the Proposed Action are predicted to occur within portions of the Lompoc Valley and surrounding areas, including VSFB, and the three most northerly Channel Islands (NCI) of San Miguel Island, Santa

Rosa Island, and Santa Cruz Island with sonic booms reaching 5 psf primarily occurring on VSFB and over open ocean.

GROUND-DISTURBING OR LANDSCAPE-ALTERING ACTIONS

In consultation with the 30 CES/CEIEA and based on the description of the proposed action provided by SpaceX, boundaries of known cultural resources and findings of previously conducted studies, Langan investigated ASA for the SLC-6 Landing Zone Area, the Firebreak Area, and the Cypress Ridge and North Fire Access Roads as illustrated in Figure 12. The ASAs encompass the predicted development footprint for the ground disturbing or landscape altering activities including potential grading, launch pad construction and related infrastructure, improvement and maintenance of access roads and firebreaks. Langan conducted a cultural resource inventory, pedestrian survey and subsurface testing. No cultural material was identified within the ASA as a result of any of the investigative approaches.

Methods

RECORDS SEARCH

A cultural resource records search of the California Historical Resources Information System (CHRIS) for the cultural resource study area outside of the VSFB was conducted at the Central Coastal Information Center (CCIC) on February 10 and 24, 2023 in support of the 2023 SEA environmental review efforts. The results from the 2023 records search were reviewed and only one applicable, as defined below, additional resource was identified during a supplemental records search conducted in December 2023 in support of this study. The records search included a review of all recorded archaeological sites and built environment resources. Additionally, a review of the National Register of Historic Places (NRHP), the California Register of Historical Resources (CRHR), the California Historic Property Data File, and the lists of California State Historical Landmarks, California Points of Historical Interest, and Archaeological Determinations of Eligibility was conducted.

In consultation with the 30 CES/CEIEA, Ms. McDaniel McDevitt reviewed available literature to determine what types of resources located within the cultural resource study area have the potential to be impacted by the auditory effects of the Proposed Action predicated on vibratory impacts. Analysis specifically addressing potential impacts on built environment historic properties from rocket engine noise and sonic boom vibrations associated with static tests, launches and boost-back landings at SLC-4 and SLC-6 considered previously conducted studies. These studies include those by Fenton and Methold (2016), Guest and Sloane (1972) and Gibbs (2017) that establish the thresholds at which prolonged noise thresholds (static fires) and sonic booms have the potential to impact historic properties. Additionally, Ms. McDaniel McDevitt reviewed a previous study that considered potential impacts to archaeological sites (Norcerino et al. 2021) and consulted with Mr. Josh Smallwood of the 30 CES/CEIEA regarding the results of experimental analysis conducted by the 30 CES/CEIEA at VSFB (Smallwood personal communication 2023). The experimental analysis included the placement and observation of a 12-inch-tall, 45-degree slopes and cone and a 12x12x12-inch midden chunk on a concrete pad located 3,180 feet to the southwest of the SLC-4 SpaceX boost-back pad to determine if noise vibration resulting from two SpaceX launches/boost-back landings would result in any visual change to the materials. No visual impacts were observed in either the midden chunk or sand cone after the launch/boost-back with the exception of a few fine grains of sand shifting down the cone likely resulting from the samples drying in the wind. Importantly, there was no cracking or crumbling observed, on the midden chunk or sand cones from launch vibrations/sonic boom overpressures (Smallwood personal communication 2023). Smallwood asserted that based on experimental analysis and observations of archaeological sites located on base, VSFB cultural resources staff have established that archaeological sites consisting of only surface artifacts and/or buried archaeological material do not have the potential to be affected by rocket engine noise. A sheer cliff-face midden deposit present within CA-SBA-530 located in the southern portion of the VSFB between SLC-4 and SLC-6 has been monitored for impacts resulting from noise vibrations. Despite the observation of significant impacts resulting from natural erosion due to rainfall, wind, and wave compression, no visible effect resulting from noise vibrations due to launch and boost-back events has been observed (Smallwood personal communication 2023).

A condition assessment program has occurred at the NRHP-eligible Honda Ridge Rock Art Site (CA-SBA-550), located 7,000 feet east of SLC-6, since the early 2000s (Nocerino et al. 2021; Smallwood personal communication 2023). The program has found no evidence of effects to the rock art surfaces from heavy- and medium-payload rocket launches and boost backs or sonic boom overpressure (Smallwood personal communication 2023). Therefore, all archaeological resources, including those with rock art, cairns, and rock shelters were excluded from further consideration because they are highly unlikely to be affected by short-duration launch noise from an increased cadence of SpaceX launches, static fires, and boost-back landings.

Finally, all but one building located on VSFB and within the cultural resource study area are associated with launch complexes and supporting infrastructure and are built to withstand concussive forces. The only historic building located on VSFB that is not associated with launch complexes or supporting infrastructure is the former U.S. Coast Guard Lifeboat Rescue Station (P-42-040495). The Colonial Revival architectural style, wood-frame structures were built in 1936 as administrative barracks with ancillary structures. The buildings have been subjected to many years of medium and heavy launches and boost-back landings at SLC-4 as well as launches conducted at nearby SLC-6 with no reported and observed effect.

Based on these considerations, the off-Base cultural resources records search focused on resources identified by the CHRIS as NRHP listed or eligible for listing in accordance with the Office of Historic Preservation (OHP) attribute codes (OHP 1995). Those categories identified for consideration of the potential for effects resulting from the Proposed Action included built environment resources and archaeological features located above ground such as rock art, cairns and rock shelters.

HISTORIC AERIAL AND TOPOGRAPHIC MAP REVIEW

Historical topographic maps and aerial photographs were reviewed to better understand the nature of landscape change to the improvement areas proposed for potential ground-disturbing or landscape-altering activities and surrounding area over time. A review of all available historical aerial photographs was conducted and includes the following years: 1981, 1994, 2005, 2008, 2009, 2010, and 2012 (NETR 2024a). Through careful comparative review of historical aerials, changes to the landscape of a study area may be revealed. Historic aerials were also used to obtain approximate dates of construction and dates of alterations for buildings and structures within and surrounding the subject property. A review of available topographic maps was conducted and includes the following years: 1948, 1956, 1957, 1958, 1960, 1966, 1967, 1968, 1986, 1987, 2012, 2015, 2018, and 2021 (NETR 2024b). Topographic maps depict elevation of the study area as well as the areas surrounding it and illustrate the location of roads, structural features, community services and some buildings. Although topographic maps are not comprehensive and do vary from year to year in their inclusion of information, they are another tool in determining the presence of structures and the nature of land use.

The historic topographic maps were limited in illustrative data; however, they do demonstrate that the general area within which Central SLC-6, Near North and Far North improvement areas are located has been developed with roads, trails and structures since at least 1948 with no development illustrated in the proposed landing zones and firebreaks improvement areas. The historic photographic aerials demonstrate that the Central SLC-6, Near North and Far North improvement areas have been substantially disturbed by grading and construction and demolition of structures roads and utility installation since at least 1981 (the earliest aerial photograph available) and the landing zones and firebreaks have only been slightly disturbed by limited grading. These disturbances coincide with the recording of the Cold-War historical built-environment resources documented by the first recordation of the site by Dames and Moore in 1994 and the West Coast Space Shuttle Orbiter and launch complex recordation by U.S. Army Construction Engineering Research Laboratory in 1996 and the most recent recordation by Smallwood in 2018. Based on these results and that a large portion of the areas are currently covered in pavement and structures, it was determined that the Central SLC-6, Near North and Far North improvement areas were highly disturbed to a degree greater than that which is being proposed for this undertaking and that a pedestrian survey of these areas would not provide any relevant information. Since the proposed landing zones and new firebreak have been only minimally disturbed, a pedestrian survey of the landings zones and both firebreaks were determined necessary as well as subsurface testing in a portion of the proposed Landing Zones improvement area.

PEDESTRIAN SURVEY

The intensive-level survey methods consisted of a pedestrian survey conducted in parallel transects, spaced no more than 3 meters apart (approximately 10 feet), where feasible. The ground surface was inspected for prehistoric artifacts (e.g., flaked stone tools, tool-making debris, groundstone tools, ceramics, fire-affected rock), soil discoloration that might indicate the presence of a cultural midden, soil depressions, features indicative of structures and/or buildings (e.g., standing exterior walls, post holes, foundations), and historical artifacts (e.g., metal, glass, ceramics, building materials). To overcome visibility issues, small shovel scrapes were conducted in 10-meter intervals, or subjectively as needed. Ground disturbances such as rodent burrows, ephemeral trails and areas of barren ground were given specific attention to provide the best opportunity to observe soils and any potential exposed subsurface materials. No artifacts were collected during the survey.

SUBSURFACE TESTING

The necessity for subsurface testing within the ASAs was determined in consultation with the 30 CES/CEIEA and was limited to the areas within the Landing Zone improvement area that had not already been subjected to subsurface testing. Subsurface testing was conducted employing shovel test pits (STPs) placed in a 50-meter (164-ft) staggered grid. All efforts were made to adhere to the prescribed grid placement; however, the chaparral within a majority of the ASA was very dense requiring minimal shifting of the locations (< one meter) in order to avoid mechanical vegetation clearing. The STPs measured 50 cm diameter and were excavated in 20-centimeter levels to a prescribed depth of 150 cm unless refusal was reached. Refusal was determined by encountering either groundwater or impenetrable rock. A sampling of no more than 0.3 liter (1 cup) of soils was removed from each level and dried to ensure a more accurate reading of soil color, texture and composition. All excavated soils were dry-screened through 1/8-inch mesh and placed back in the ground (backfilled) once the STP was completed and fully documented.

All fieldwork (pedestrian survey and subsurface testing) was documented using field notes and an Apple Generation 7 iPad (iPad) equipped with ESRI Field Maps software with close-scale georeferenced field maps of the proposed Project site, and aerial photographs. Location-specific photographs were taken using the iPad's 12-mega-pixel resolution camera. If any cultural resources had been identified during the fieldwork, they would have been recorded on standard field forms, consistent with the *Instructions for Recording Historical Resources* (Office of Historic Preservation 1995). All field practices met the Secretary of Interior's standards and guidelines for a cultural resources inventory and subsurface testing.

Fieldwork was conducted in the presence of a Tribal monitor provided by the Santa Ynez Band of Chumash Indians (SYBCI). Field notes, photographs, and records related to the current study are on file at Langan's Santa Barbara, California office. STP logs and a spreadsheet of soil descriptions and testing results can be found in appendices B and C.

Results

RECORDS SEARCH

Tables 1 and 2 provide both built environment and archaeological cultural resources that are listed on or determined eligible for listing on the NRHP and are, as previously mentioned, identified as including elements that may have the potential for effects resulting from the Proposed Action. Table 3 provides a list of cultural resources within 0.5-mile of the ASA (Far North, Near North, Central SLC-6, Landing Zones, Firebreaks improvement areas) none of which are listed on or determined eligible for listing on the NRHP but are important to understanding the general archaeological sensitivity of the areas proposed for ground-disturbing or landscape-altering actions. For the purpose of this assessment and since the San Miguel, Santa Rosa, and Santa Cruz Archaeological Districts encompass the entirety of their respective islands, all contributing resources within the districts are assumed eligible for the NRHP for the purposes of this Proposed Action. As such, individual archaeological resources on the NCI are captured in the respective island's archaeological district.

On-Base Resources Related to Auditory Effects. The records search of the VSFB cultural resources database conducted by the 30 CES/CEIEA revealed that large portions of the CRSA within the VSFB has been previously surveyed for cultural resources resulting in the identification of 350 previously recorded cultural resources within this portion of the CRSA. Of these resources, four archaeological sites and 103 historic-age buildings fit the criteria previously outlined as those with above-ground buildings, structures, or objects that are NRHP-listed or eligible and could potentially be affected by launch noise vibrations. The four archaeological resources are rock art sites, and the 103 historic-age buildings are associated with launch complexes and supporting infrastructure that have been built to withstand concussive forces. A total of 123 other archaeological sites on VSFB have been identified within the CRSA but do not include elements that could potentially be affected by launch noise vibrations and sonic boom overpressure. As previously explained, the only historic NRHP-listed structures located on VSFB that are not associated with launch complexes or supporting infrastructure is the former U.S. Coast Guard Lifeboat Rescue Station (P-42-040495). The Colonial Revival architectural style, wood-frame structures were built in 1936 as administrative barracks with ancillary structures. The buildings have been subjected to many years of medium and heavy launches and boost-back landings at SLC-4 as well as launches conducted at nearby SLC-6 with no reported and observed effect.

Far North, Near North, Central SLC-6, Landing Zones, and Firebreaks Improvement Areas. Areas where ground-disturbing or landscape-altering actions, ASA, are proposed were scrutinized specifically for the potential of unknown cultural resources to exist. The records search of the VSFB cultural resources database conducted by the 30 CES/CEIEA revealed that the areas proposed for ground-disturbing or landscape-altering actions have been partially addressed by previous studies resulting in the identification of 16 previously recorded cultural resources within this portion of the ASA. Of these resources one (1) is a multicomponent (consisting of both prehistoric and historic components); thirteen (13) are prehistoric-era archaeological sites; one (1) is a historic-era archaeological site; and one is a built environment historic district. Except for CA-SBA-1941, each of the sites have either been found ineligible or have unknown eligibility due to a lack of testing/evaluation. As explained further below, CA-SBA-1941 is assumed eligible for NRHP listing but the portion overlapping the ASA (Cypress Ridge Rd firebreak) has been found not contributing to the assumed eligibility of the site. The most recent studies addressing the ASA include *Archaeological Investigations in 2014–2015 for Firebreaks and Fire Access Roads, Vandenberg Air Force Base, Santa Barbara County, California* by Clayton G. Lebow, Rebecca L. McKim, Douglas R. Harro, and Michelle Newcomb; *Identification of Historic Properties and Assessment of Effects Vandenberg Operational Lightning Tracking System (VOLTS) Project, Vandenberg Air Force Base, Santa Barbara County, California (813-17-060)* by Josh Smallwood and Christopher Ryan; and *Cultural Resource Investigations at SLC-3W, SLC-5, SLC-8, Lompoc Terrace, and the Boat Dock Vandenberg Space Force Base, California (813-19-033CRV)* by Joyce Gerber, Eric S. Nocerino and Karin Pitts-Olemedo with contributions by Clayton G. Lebow.

Table 1. Cultural Resources Located within One-Half Mile of the ASA

Designation	Resource Description	Recorded By	NRHP Eligibility	Proximity to Proposed Project Site
CA-SBA-639	Prehistoric site consisting of a heavy density shell midden on sea cliff with moderate vertebrate faunal density and light density of chipped stone; radiocarbon testing dates site to Middle-Late Transitional Period; likely associated with CA-SBA-1783	Spanne 1970; Carbon and Mason 1994; McDowell 1994; Enright 2011; Cruz 2020; Coleman and Mirro 2004;	unknown	290 m (950 ft) west of Cypress Ridge Fire Access Road
CA-SBA-1114	Prehistoric site consisting of chipped stone flakes; potential chipping/production site. (summary provided following)	Sawyer 1974; Pitts-Olmedo et al. 2020;	Not eligible pursuant to 36 CFR 60.6 (a–d)	Immediately adjacent and east of Cypress Ridge Fire Access Road
CA-SBA-1148H	Historic archaeological site associated with Sudden Ranch, Red Roof Canyon,. Headquarters for the northern portion of Sudden Ranch in the late nineteenth and early twentieth century; site of Station B-30 during WWII. Site has been totally destroyed by construction of SLC-6. (summary provided following)	Spanne 1976; Enright et al. 2016	Not eligible pursuant to 36 CFR 60.6 (a–d)	505 m (1650 ft) north of Landing Zone
CA-SBA-1149	Multicomponent archaeological site. Large prehistoric with sparse lithic and shell scatter with discrete areas of higher density; Historic ranch house site.	Spanne 1974 and 1982; Gibson 1988; Marmor 1988; Gibson Hawley et al. 1998	unknown; not yet evaluated	250 m (825 ft) south of Cypress Ridge Fire Access Road
CA-SBA-1686	Prehistoric site consisting of groundstone and chipped stone artifacts; cultural deposit confirmed to over 140 cm in depth. (summary provided following)	Serena 1981;	unknown; appears ineligible due to destruction	19 m (64 ft) northeast of Cypress Ridge Fire Access Road
CA-SBA-1783	see CA-SBA-639			170 m (550 ft) southwest of Cypress Ridge Fire Access Road
CA-SBA-1941	Prehistoric site consisting of a low density of groundstone and chipped stone artifacts; cultural	Spanne 1985; Gibson 1988;	Assumed eligible; portion	Overlaps Cypress Ridge

Designation	Resource Description	Recorded By	NRHP Eligibility	Proximity to Proposed Project Site
	deposit confirmed to over 140 cm in depth. (summary provided following)	Lebow et al. 2016	overlapping Cypress Ridge Rd found not contributing to assumed eligibility	Fire Access Road
CA-SBA-2032	Prehistoric site consisting of a low density of groundstone and chipped stone artifacts; three loci within consisting of more abundant artifacts; typology of artifacts potentially dates site to Early Period. (summary provided following)	Spanne 1985; Gibson 1986; Harrow at al. 1998; Lebow et al. 2016	Unknown	730 m (2400 ft) north of Landing Zone
CA-SBA-2212	Prehistoric site consisting of a low density scatter of lithic flakes and one groundstone artifact; typology of artifacts potentially dates site to Early Period; possible association with CA-SBA-1941. (summary provided following)	Gibson 1988; Garza and James 2009;	unknown; not yet evaluated	290 m (950 ft) southeast of Cypress Ridge Fire Access Road
CA-SBA-2213	Prehistoric site consisting of three manos and one metate fragment on edge of small terrace overlooking unnamed drainage; typology of artifacts potentially dates site to Early Period. (summary provided following)	Gibson 1988; Garza and James 2009;	unknown; not yet evaluated	205 m (675 ft) southeast of Cypress Ridge Fire Access Road
CA-SBA-2214	Prehistoric site consisting of trace density of lithic flakes and one *Olivella biplicata* shell with chipped spire (likely bead); potentially Early Period site. (summary provided following)	Gibson 1988; Garza and James 2009;	unknown; not yet evaluated	215 m (700 ft) east of Cypress Ridge Fire Access Road
CA-SBA-2217	Prehistoric site consisting of groundstone artifacts; one of 3 loci previously recorded as one archaeological site. (summary provided following)	Gibson 1986 and 1996	Not eligible pursuant to 36 CFR 60.6 (a–d)	60 m (200 ft) northeast of Landing Zone
CA-SBA-2218	Prehistoric site consisting of groundstone artifacts; one of 3 loci previously recorded as one archaeological site. (summary provided following)	Gibson 1986 and 1996	Not eligible pursuant to 36 CFR 60.6 (a–d)	35 m (110 ft) west of Landing Zone

Designation	Resource Description	Recorded By	NRHP Eligibility	Proximity to Proposed Project Site
CA-SBA-2219	Prehistoric site consisting of groundstone and chipped-stone artifacts; one of 3 loci previously recorded as one archaeological site. (summary provided following)	Gibson 1986 and 1996	Not eligible pursuant to 36 CFR 60.6 (a–d)	275 m (900 ft) west of Landing Zone
CA-SBA-2797	Prehistoric site consisting of a low-density bone and lithic scatter.	Davis and Carrillo 1994	unknown; not yet evaluated	320 m (1050 ft) south of Cypress Ridge Fire Access Road
P-42-041209 included within is P-42-041202	Built Environment Historic District: Space Shuttle Orbiter Program District. District encompasses numerous buildings and structures on North and South Base including include SLC-6, Building 3000, the Shuttle airstrip, Building 398, Building 330, the South Base Harbor, and various segments of tow roads which interconnect these facilities. (summary provided following)	Smallwood 2018 (P-42-041209); Dames and Moore 1994, Nowlan et al. 1996, Smallwood 2018 (P-42-041202)	Not eligible pursuant to 36 CFR 60.6 (a–d)	Within the Central SLC-6 Improvement Area; partially within the Near Northern Improvement Area; north adjacent to the Far North Improvement area; and south adjacent to the Landing Zones
VAFB-ISO-318	Prehistoric isolate – well-shaped basalt hammerstone. (summary provided following)	Unknown	Not eligible	9 m (30 ft) east of Cypress Ridge Road firebreak
VAFB-ISO-319	Unknown origin isolate – six to ten shell fragments. (summary provided following)	Unknown	Not eligible	201 m (660 ft) southeast of Cypress Ridge Road firebreak
VAFB-ISO-320	Prehistoric isolate – light brown Monterey chert primary flake. (summary provided following)	Unknown	Not eligible	34 m (110 ft) east of Cypress Ridge Road firebreak

Central SLC-6, Near North, and Far North Improvement Areas. These Central SLC-6 improvement area has been previously subjected to a reconnaissance survey (Smallwood 2018) and portions of the Near North and the entirety of the Far North improvement areas have not been addressed by a pedestrian survey or subsurface testing. However, as demonstrated in the results of the historic topographic maps and aerial photographs and review of site records, all three improvement areas have been subject to significant ground disturbance and landscape altering activities since at least the 1800s and are currently largely developed with structures and pavement. The 2018 reconnaissance survey recorded and evaluated numerous structures and associated facilities within the SLC-6 portion of the Space Shuttle Orbiter Program District. Although the SLC-6 complex and the Space Shuttle Orbiter Program District it is located within were associated with planned launch facilities developed in support of the Space Shuttle program, they were never used for that purpose. As such they do not meet the threshold of significance and therefore are considered ineligible for listing on the NRHP (see P-42-041202 summary below). Summaries for the resources within and nearest these improvement areas are included below to demonstrate the type of unknown resources that could potentially exist within this portion of the ASA.

CA-SBA-1148H

CA-SBA-1148H is a historic site, measuring approximately 295 meters (968 ft.) north to south by 213 meters (699 ft.) east to west, at an elevation of approximately 400 ft. amsl, and is located immediately adjacent and south of proposed Far North Improvement Area and approximately 39 meters (133 feet) west of proposed Near North Improvement Area the of the ASA. CA-SBA-1148H was originally documented as part of the 1800s Long Ranch; however, further research revealed that the area also served as the headquarter for the northern outpost of Sudden Ranch in the late nineteenth and early twentieth centuries. Additionally, the site was occupied by the WWII radar reporting station center (Station B-30); the associated structures were dismantled at the close of WWII. CA-SBA-1148H was originally formally recorded in 1974 by Larry Spanne, who described the site as “a historic ranch site with foundations and historic artifacts on the surface” and owned by George Long in 1800s. CA-SBA-1148H was revisited in 2012 by Vincent Parsick III who updated the site record to reflect the Sudden Ranch and Station B-30 components and to document remaining artifacts and features. Parsick also documented the condition of the early historic Long/Sudden Ranch site as completely destroyed by heavy earthworks resulting from the historic installation of Station B-30 and subsequently by the USAF SLC-6. CA-SBA-1148H has been documented as not eligible for NRHP listing pursuant to 36 CFR 60.6 (a–d).

CA-SBA-2032

CA-SBA-2032 is a prehistoric site, measuring approximately 284 meters (932 ft.) north to south by 62 meters (203 ft.) east to west, at an elevation of approximately 400 ft. amsl, and is located approximately 42 meters (136 feet) west of the proposed Far North Improvement Area of the ASA. CA-SBA-2032 was originally documented as consisting of a scatter of manos, chert biface fragments, thinning flakes and debitage, an anvil, cobble hammer and several modified cobbles. CA-SBA-2032 was originally formally recorded in 1986 by R.O. Gibson, who described the site as “a low-density artifact scatter largely buried on the flat to gently sloping terrace on the north side of Red Roof Canyon” and dated the site to be older than 3,000 years based on artifact typology. Gibson conducted sub surface testing employing shovel test pits and concluded that the site was 50-75 percent destroyed but since he did not conduct boundary testing, that portions of the site may remain intact. CA-SBA-2032 was revisited in 1998 by D.R. Harro during construction monitoring who updated the site record to document artifacts identified during construction and the level of disturbance. Harro states that construction of the lower “V-23” parking lot and North Access Road, trenching for the liquid nitrogen pipeline and installation of utility poles resulted in major impacts to the site. Therefore, Harro recommended CA-SBA-2032 as not eligible for listing on the NRHP. The documented have impacts significantly disturbed the area between CA-SBA-2032 and the proposed Far North Improvement Area.

P-42-041202

P-42-041202 is a built environment resource identified as a military property (HP 34) containing numerous structures and ancillary facilities. Known as Space Launch Complex (SLC)-6, the resource was originally constructed in 1966 on the former Long Ranch of the 1800s and the Sudden Ranch of the late 19th and early 20th centuries. SLC-6 was originally built to support the Manned Orbiting Laboratory (MOL) Program initiated in 1963 that was cancelled in 1969. After a decade, the complex underwent a major reconstruction by the United States Air Force (USAF) in support of the Space Shuttle Orbiter Program. The complex was used to fit test the Program's prototype, Enterprise, but due to the Space Shuttle Challenger explosion at Cape Canaveral in 1986, no shuttle mission was ever conducted at the complex. P-42-041202 was first evaluated by Dames and Moore in 1994 as a Cold War historical built-environment resource and again in 1996 by Nowlan et al. SLC-6 currently contains a single concrete launch pad with launch mount and two exhaust ducts; a mobile service tower; an assembly building; a payload change-out building; a payload preparation room; a LO_2 tank; a LH_2 tank; a sound suppression water deluge system; ancillary buildings and structures; and a 1.5-mile-long railroad spur travels from the Union Pacific mainline to the Solid Rocket Motor Processing Facility immediately west of Lunar Road. As mentioned previously, although the SLC-6 complex and the Space Shuttle Orbiter Program District it is located within were associated with planned launch facilities developed in support of the Space Shuttle program, they were never officially used for that purpose. As such they do not meet the threshold of significance and therefore are considered ineligible for listing on the NRHP.

Landing Zones. The proposed landing zone area has been previously subjected to a pedestrian survey and partially addressed by subsurface testing (Gerber et al. 2023). As previously mentioned, no cultural resources have been identified within the Landing Zone portion of the ASA. The Gerber et al. 2023 study conducted a pedestrian survey of the entire Landing Zone portion of the ASA and nineteen shovel test pits within the southern and central portions of the Landing Zone portion of the ASA. Both the pedestrian survey and subsurface testing efforts did not result in the identification of cultural resources or materials. Following are summaries of resources identified nearest the Landing Zone portion of the ASA. Although all three sites have been determined ineligible for NRHP, summaries for the resources nearest this improvement area are included to demonstrate the type of unknown resources that could potentially exist within this portion of the ASA.

CA-SBA-2217

CA-SBA-2217 is a prehistoric site, measuring approximately 91 meters (300 ft.) north to south by 107 meters (350 ft.) east to west, at an elevation of approximately 475 ft. amsl, and is located approximately 30 meters (100 feet) northeast of the proposed landing zone portion of the ASA. CA-SBA-2217 was originally documented as part of a larger site consisting of three loci (A, B and C) with similar content including uniface, biface and triface manos, cobble chopper and hammer and potential anvil. Based on typology of artifacts, the site was interpreted as dating to pre 3,000 B.P. CA-SBA-2217 was originally formally recorded in 1986 by R.O. Gibson, who described the site as "contains at least 3 subsurface concentrations of ground stone artifacts occurring from 1 to 5 feet below the modern surface and unearthed during construction activity along the gently sloping terrace." CA-SBA-2217 was revisited in 1996 by R.O. Gibson who updated the site record to reflect the separation of the three loci into three separate archaeological sites: Locus A as CA-SBA-2217, Locus B as CA-SBA-2218, and Locus C as CA-SBA-2219. All three sites were discovered and further observed as a result of pedestrian survey, limited subsurface testing and monitoring and all three were considered ineligible for NRHP.

CA-SBA-2218

CA-SBA-2218 is a prehistoric site, measuring approximately 350 meters (1,150 ft.) north to south by 107 meters (350 ft.) west, at an elevation of approximately 415 ft. amsl, and is located approximately 61 meters (200 feet) west of the proposed landing zone portion of the ASA. Please see summary of CA-SBA-2217 for additional information.

CA-SBA-2219

CA-SBA-2219 is a prehistoric site, measuring approximately 350 meters (1,125 ft.) north to south by 107 meters (675 ft.) east to west, at an elevation of approximately 380 ft. amsl, and is located approximately 274 meters (900 feet) west of the proposed landing zone portion of the ASA. Please see summary of CA-SBA-2217 for additional information. CA-SBA-2217 was originally documented as part of a larger site consisting of three loci (A, B and C) with similar content. Cultural material observed at this site during separate studies includes multiface and uniface manos, as well as utilized flake tools and a single crescent. Based on typology of artifacts, the site was interpreted as an Early Period dating to pre 3,000 B.P. CA-SBA-2217 was originally formally recorded in 1986 by R.O. Gibson with additional observations made in 1981 during construction of Coast Road; in 1990 by Environmental Solutions that reviewed Gibson's data and concluded the site has retained little to no integrity and suggested large scale excavations to properly delineate the site boundary; Applied Earthworks conducted testing in 2011 to determine potential effects to the site resulting from a proposed undertaking. All three testing locations within and outside the northern portion of CA-SBA-2219 were negative for cultural resources (no resources found). Like CA-SBA-2217 and -2218, CA-SBA-2219 is considered ineligible for NRHP.

Firebreaks Improvement Area. The proposed north firebreak road improvement and maintenance area has been previously subjected to a pedestrian survey and partially addressed by subsurface testing (Gerber et al. 2023). As previously mentioned, no cultural resources have been identified within the north firebreak road improvement and maintenance area of the ASA. The Gerber et al. 2023 study conducted a pedestrian survey of the entire north firebreak road improvement and maintenance area of the ASA and six shovel test pits within the western portion of the north firebreak road improvement and maintenance area of the ASA. Both the pedestrian survey and subsurface testing efforts did not result in the identification of cultural resources or materials.

The proposed Cypress Ridge and North fire access roads improvement and maintenance area have been previously subjected to a pedestrian survey and partially addressed by subsurface testing (Lebow et al. 2016). Cypress Ridge Road overlaps CA-SBA-1941 for approximately 1.150 meters and the entirety of the site encompasses 181,700 square meters. Pedestrian survey efforts resulted in the identification of only fourteen artifacts including seven manos and seven pieces of flaked stone. Applied Earthworks conducted 57 shovel test pits (STPs) placed outside but adjacent to the road at regular intervals along the entirety of the linear expanse where the road overlaps CA-SBA-1941. No cultural resources were observed within any of the STPs. Based on the findings, Applied Earthworks deduced integrity of CA-SBA-1941 had been lost within the firebreak road and as a result "this portion of the site does not contribute to the site's assumed National Register eligibility: (Lebow et al. 2016). Following are summaries of resources identified nearest the Firebreak improvement areas to demonstrate the type of unknown resources that could potentially exist within this portion of the ASA.

CA-SBA-1114

CA-SBA-1114 is a prehistoric site, measuring approximately 30 meters (98 ft.) north to south by 43 meters (141 ft.) east to west, at an elevation of approximately 110 m (360 ft.) amsl, and is located immediately adjacent and east of the western terminus of Cypress Ridge Fire Access Road firebreak portion of the ASA. CA-SBA-1114 is documented as containing lithic debitage and one utilized flake tool. CA-SBA-1114 was originally formally recorded in 1974 by W.B. Sawyer, who described the site as "no midden;/chert flakes; no shell" and "aboriginal; shipping site; occasional use". Sawyer noted that the site had been disturbed by previous road and railroad realignment activities. CA-SBA-1114 was revisited in 2020 by Pitts-Olmeda et al. who updated the site record to document excavations they had conducted to establish the site boundary and evaluate the site's eligibility for listing on the NRHP. Twenty-one shovel test pits and two 0.5 by 1 meter test units were conducted. Based on the results of the excavations, Pitts-Olmeda et al. determined that CA-SBA-1114 does not meet the criteria for listing eligibility on the NRHP.

CA-SBA-1686

CA-SBA-1686 is a prehistoric site, measuring approximately 100 meters (328 ft.) north to south by 70 meters (230 ft.) east to west, at an elevation of approximately 212 m (696 ft.) amsl, and is located approximately 19 m (64 ft) northeast of the western terminus of Cypress Ridge Fire Access Road firebreak portion of the ASA. CA-SBA-1686 is documented as containing Monterey chert and obsidian debitage, chert bifacial tools, hammerstones, manos, chert cores and andesite and shale flakes. CA-SBA-1686 was formally recorded in 1981 by J. Serena, who described the site as "deep deposit of chert debitage and tools, sandstone manos and hammerstones, obsidian and andesite and shale debitage". Serena conducted a "block" and four unit excavations; results and interpretation are not provided in site record. However, Serena does state that "all but the southeast corner of the site had been destroyed by construction", likely of the V-33 external tank processing and storage facility depicted on the site map. Although the site has been subjected to exploratory excavations, the results and interpretation are not available and therefore a formal evaluation results of the site's eligibility for NRHP listing is unknown. However, based on the information available in the site record and the level of disturbance, the site appears ineligible for listing eligibility on the NRHP.

CA-SBA-2212

CA-SBA-2212 is a prehistoric site, measuring approximately 80 meters (262 ft.) north to south by 63 meters (207 ft.) east to west, at an elevation of approximately 212 m (696 ft.) amsl, and is located approximately 290 m (950 ft) southeast of the Cypress Ridge Fire Access Road firebreak portion of the ASA. CA-SBA-2212 is documented as containing Monterey chert flakes, one sandstone mano with pecking and polish and located along a long narrow ridge/terrace with a possible rock outcrop just below that may provide water. Based on typology of artifacts, the site was interpreted as dating to the Early Period potentially connected to CA-SBA-1941. CA-SBA-2212 was originally formally recorded in 1989 by R.O. Gibson, who described the site as "a trace to light density pf Monterey chert flakes and one mano…"; Gibson noted that the site was in excellent condition. CA-SBA-2212 was revisited in 2009 by S. Garza and S. James who updated the site record describing no change in the constituents of the site, but that the condition was disturbed by burrowing animals and game trails. CA-SBA-2212 has not been subjected to subsurface investigations to fully delineate the site boundary nor has it been evaluated for listing on the NRHP.

CA-SBA-2213

CA-SBA-2213 is a prehistoric site, measuring approximately 57 meters (187 ft.) north to south by 18 meters (59 ft.) east to west, at an elevation of approximately 216 m. (709 ft) amsl, and is located approximately 205 m (675 ft) southeast of Cypress Ridge Fire Access Road firebreak portion of the ASA. CA-SBA-2213 is documented as containing "3 tan sandstone manos, all completed with well used and polished surfaces, one is a biface with slight edge grinding, two are trifacial with canting on the edge," and one thin fragment of a basin metate. Based on typology of artifacts, the site was interpreted as dating to the Early Period. CA-SBA-2213 was originally formally recorded in 1988 by R.O. Gibson, who described the site as "a concentration of three mons and one metate fragment located at the southern edge of a small terrace bounded by very steep side overlooking an unnamed drainage"; Gibson noted that the site was in excellent condition with the exception of four small "blowouts" in the center of the site where the sandstone artifacts were identified suggesting that yet unidentified cultural deposits exist subsurface. CA-SBA-2213 was revisited in 2009 by S. Garza and S. James who updated the site record describing no change in the constituents or condition of the site. CA-SBA-2213 has not been subjected to subsurface investigations to fully delineate the site boundary nor has it been evaluated for listing on the NRHP.

CA-SBA-2214

CA-SBA-2214 is a prehistoric site, measuring approximately 155 meters (509 ft.) north to south by 101 meters (331 ft.) east to west, at an elevation of approximately 204 m (669 ft). amsl, and is located approximately 215 m (700 ft) east of Cypress Ridge Fire Access Road firebreak portion of the ASA. CA-SBA-2214 is documented as containing light brown/pink mottled chert flake (blade), one long primary Monterey chert flake, and a bluish color Olivella biplicate shell with a chipped spire, that could potentially be a bead. Based on initial observation, the site was interpreted as potentially dating to the Early Period. CA-SBA-2214 was originally formally recorded in 1988 by R.O. Gibson, who described the site as "a trace density concentration of chert flakes on a densely vegetated terrace overlooking the lower coastal terraces and the ocean to the south"; Gibson noted that the site appeared intact but had been subjected to fires that burned the surface. CA-SBA-2214 was revisited in 2009 by S. Garza and S. James who updated the site record describing no change in the constituents or condition of the site. CA-SBA-2213 has not been subjected to subsurface investigations to fully delineate the site boundary nor has it been evaluated for listing on the NRHP.

VAFB-ISO-318

VAFB-ISO-318 is a prehistoric isolate, found at an elevation of 230 ft. amsl, and is located approximately 9 m (30 ft) east of the Cypress Ridge Road firebreak portion of the ASA. VAFB-ISO-318 is documented as a well-shaped basalt hammerstone. It is standard practice that isolated artifacts are not eligible for listing in the NRHP or the CRHR; therefore, VAFB-ISO-318 has not been formally evaluated for listing on the NRHP or the CRHR.

VAFB-ISO-319

VAFB-ISO-319 is an isolate of unknown origin, found at an elevation of 200 ft. amsl, and is located approximately 201 m (660 ft) southeast of the Cypress Ridge Road firebreak portion of the ASA. VAFB-ISO-319 is documented as six to ten shell fragments. It is standard practice that isolated artifacts are not eligible for listing in the NRHP or the CRHR; therefore, VAFB-ISO-319 has not been formally evaluated for listing on the NRHP or the CRHR.

VAFB-ISO-320

VAFB-ISO-320 is an isolate of unknown origin, found at an elevation of 280 ft. amsl, and is located approximately 34 m (110 ft) east of the Cypress Ridge Road firebreak portion of the A8. VAFB-ISO-320 is documented as a light brown Monterey chert primary flake. It is standard practice that isolated artifacts are not eligible for listing in the NRHP or the CRHR; therefore, VAFB-ISO-320 has not been formally evaluated for listing on the NRHP or the CRHR.

Off-Base within Lompoc Valley. A cultural resource records search of the CHRIS revealed that large portions of the cultural resources study area located within off-base portion of the Lompoc Valley and surrounding areas have been previously surveyed for cultural resources resulting in the identification of at least 1,920 previously recorded cultural resources within this portion of the ASA. Of these resources, one archaeological site and eleven historic-age buildings fit the criteria previously outlined as those with above-ground buildings, structures, or objects that are NRHP-listed or eligible and could potentially be affected by launch noise vibrations and sonic boom overpressure.

Table 2. NRHP-listed or Eligible Cultural Resources Located - Lompoc Valley Area of CRSA

Reference Number	Resource Type	Resource Name or Type	Description	NRHP Evaluation
_70000147	Built Environment	La Purisima Mission	Adobe mission buildings	Listed
_78000891	Built Environment	Point Conception Lighthouse	Stucco, brink and wooden tower building	Listed
_90001818	Built Environment	Lompoc Public Library (Carnegie)	Masonry building	Listed
_16000664	Built Environment	Lompoc Veterans Memorial Building	Masonry building	Listed

Reference Number	Resource Type	Resource Name or Type	Description	NRHP Evaluation
_78000775	Built Environment	Mission de la Purisima Concepcion de Maria Santisima Site	Adobe mission buildings	Listed
OTIS ID: 488380	Built Environment	Artesia School	Wood-frame building	Eligible
P-42-003865	Built Environment	Well, Hill 4	Oil well	Eligible
OTIS ID: 565260	Built Environment	Spanne Building	Wood-frame building	Eligible
OTIS ID: 565254	Built Environment	105 H St Building	Wood-frame building	Eligible
OTIS ID: 689985	Built Environment	U.S. Army Disciplinary Barracks, U.S. Lompoc Prison	Masonry building	Eligible
OTIS ID: 533649	Built Environment	Lompoc Theater	Masonry building	Eligible
P-42-040480	Archaeological	Site of Original Mission and remaining ruins of buildings of Mission de la Purisima Conception de Maria Santisima	Adobe ruins	Eligible

Northern Channel Islands (San Miguel Island, Santa Rosa Island, and Santa Cruz Island). A cultural resource records search of the CHRIS conducted revealed that large portions of the cultural resources study area located within the NCI have been previously surveyed for cultural resources resulting in the identification of at least 2,204 cultural resources. All three islands, San Miguel, Santa Rosa, and Santa Cruz are NRHP-listed as archaeological districts encompassing the entirety of their respective islands. For the purposes of this study, all contributing resources within the districts are assumed eligible for the NRHP, Likewise, the historic buildings present on Santa Cruz Island are NRHP-listed as the Santa Cruz Island Ranching District. Historic properties on the NCI include historic ranches and archaeological deposits, and prehistoric Native American archaeological sites. Historic buildings and archaeological sites include wood-frame, masonry, adobe construction and adobe ruins. The prehistoric sites consist of Native American shell middens, burials, habitation sites, and lithic scatters.

Table 3. NRHP-listed/eligible Cultural Resources Located – Northern Channel Islands Area of CRSA

Reference Number	Resource Type	Resource Name or Type	Description	NRHP Evaluation
Santa Cruz Island				
_80000405 & _100007199	Archaeological	Santa Cruz Island Archeological District	Various types of archaeological sites	Listed
OTIS ID: 529803	Built Environment	Santa Cruz Island Ranching District	Various structure types: wood-frame, masonry, and adobe construction	Eligible

Reference Number	Resource Type	Resource Name or Type	Description	NRHP Evaluation
Santa Rosa Island				
_100007896	Archaeological	Santa Rosa Island Archaeological District	Various types of archaeological sites	Listed
OTIS ID: 529721	Built Environment	Santa Rosa Island Ranch – China Camp Cabin	Wood-frame building	Eligible
OTIS ID: 529722	Built Environment	Santa Rosa Island Ranch – Clapp Springs	Wood-frame building	Eligible
OTIS ID: 529725	Built Environment	Santa Rosa Island Ranch – Horse Barn	Wood-frame building	Eligible
OTIS ID: 529726	Built Environment	Santa Rosa Island Ranch – Main Ranch House	Wood-frame building	Eligible
OTIS ID: 529728	Built Environment	Santa Rosa Island Ranch – Old School House	Wood-frame building	Eligible
OTIS ID: 529738	Built Environment	Santa Rosa Island Ranch – Rope House	Wood-frame building	Eligible
OTIS ID: 529747	Built Environment	Santa Rosa Island Ranch – Army Camp Water System	Wood-frame building	Eligible
OTIS ID: 529748	Built Environment	Santa Rosa Island Ranch – South Point Lighthouse	Wood-frame building	Eligible
San Miguel Island				
_79000258	Archaeological	San Miguel Island Archaeological District	Various types of archaeological sites	Listed
4-SMI-456	Built Environment	Nidever Adobe	Adobe ruins	Eligible
Unknown	Built Environment	Waters Ranch House Site	Wood-frame building	Eligible

PEDESTRIAN SURVEY

An archaeological intensive pedestrian survey of the ASA (LZ/F) was completed by Langan's archaeological technician staff on March 1, 4, 5, 7, 20, and 21, 2024 under the direction of this study's Principal Investigator, Heather McDaniel McDevitt, RPA. Careful attention was given to barren ground including at the base of the chaparral, within ephemeral paths/trails, and any subsurface soils exposed by burrowing animals. Ground surface visibility within the proposed Project site was variable and as such, in areas of dense ground coverage, surface scrapes were occasionally implemented, when necessary, to enhance detection of archaeological materials that may have been obscured on the surface. Four distinct visibility conditions were afforded: 1) within the northwestern portion of ASA (representing approximately 10 percent of the surveyed area) that was relatively clear of vegetation with general ground visibility of good to excellent (60-100 percent); 2) within the southeastern portion of the ASA (representing approximately 5 percent of the surveyed area) that was relatively clear of dense vegetation but possessed a meadow of annual grasses and poppies with general ground visibility of fair to good (40-80 percent); 3) within the areas of the ASA (representing approximately 20 percent of the surveyed area) that possessed dense chaparral but within the dense vegetation there were sporadic areas of barren ground and within areas that were minimally cleared by animal trails or with hand tools in order to access the prescribed STP locations, these areas provided general ground visibility of good to excellent (60-00 percent); and 4) within the remainder of the ASA (representing approximately 65 percent of the surveyed area) that possessed dense chaparral with general ground visibility of none to poor (0-20 percent).

No cultural resources or evidence of the potential for the existence of cultural resources were observed during the intensive pedestrian surveys.

SUBSURFACE TESTING

Subsurface testing of the ASA (LZ/F) was completed by Langan's archaeological technician staff on March 5, 7, 12, 13, 14, 15, 19, 20, and 21, 2024 under the direction of this study's Principal Investigator, Heather McDaniel McDevitt, RPA, to determine the absence/presence of cultural artifacts or materials. The locations of the STPs were determined in consultation with the 30 CES/CEIEA and inconsideration of the previous subsurface testing conducted (Gerber et al. 2023) within and surrounding the ASA (LZ/F) and that no ground disturbance is proposed in the western portion of the ASA (LZ/F). All STPs were conducted consistent with the methods outlined in the "Methods" section of this report.

In total, fifty-two (52) STPs were attempted seven (7) (5, 6, 9, 10, 15, 16, and 17) of which were abandoned due to the presence of standing water at the ground surface in the central-western portion of the ASA (LZ/F). In addition to the seven STPs that were abandoned due to the presence of standing water, thirty-seven (37) STPs were prematurely terminated at depths between 20 and 140 cm (8 and 55 in) due to the presence of groundwater. The seven most westerly STPs (1, 2, 3, 4, 11, 12, and 13) encountered what appeared to be imported fill within the previously graded area to depths of approximately 40 cm (15 in). Three (3) STPs were prematurely terminated at depths between 100 and 120 cm (39 and 47 in) due to encountering impenetrable rock. Twenty-four (24) STPs were excavated to depths of at least 100 cm (39 in) and five (5) STPs were completed to the full prescribed depth of 150 cm (59 in).

No cultural resources were identified as a result of the subsurface testing which is consistent with the negative findings of the subsurface testing conducted by Gerber et al. in 2023. Table 4 provides the results and associated conditions of each STP and Figure 13 provides the locations of all STPs that have been conducted within the ASA (LZ/F) as a result of this investigation as well as those previously conducted in 2023. A detailed accounting of conditions observed during the excavation of each STP can be found in Appendix B and individual excavation can be provided upon request.

Table 4. Subsurface Testing Results

Soil Test Pit (STP)	Depth of Termination (cm)	Volume Excavated (m^3)	Reason for Termination	Cultural Material (Y/N)	Soil Type*
1	150	1.18	Completion of Prescribed Depth	N	GRLS, SL, C
2	150	1.18	Refusal - Groundwater	N	GRSL, SCL, C, SC, C
3	120	0.94	Refusal - Groundwater	N	VGRSL, SC, SCL, SC
4	20	0.16	Refusal - Groundwater	N	SC
5	0	0	Surface Water	N	
6	0	0	Surface Water	N	
7	150	1.18	Refusal - Groundwater	N	SICL, SIL, GRSIL
8	100	0.79	Refusal – Dense Mud (groundwater)	N	VGR/STSIL
9	0	0	Surface Water	N	
10	0	0	Surface Water	N	
11	120	0.94	Refusal - Groundwater	N	SL, GRSL
12	130	1.02	Refusal - Groundwater	N	GRSL, C, GRLS
13	150	1.18	Completion of Prescribed Depth	N	GRSL, SL, C, GRLS
14	140	1.1	Refusal – Impenetrable Rock	N	L, GRL, VGRSL, SL
15	0	0	Surface Water	N	
16	0	0	Surface Water	N	
17	0	0	Surface Water	N	
18	120	0.94	Refusal – Impenetrable Rock	N	GRL, GRSIL, GRSL
19	90	0.71	Refusal - Groundwater	N	GRL, L, C, GRSIL, S
20	120	0.94	Refusal - Groundwater	N	L, SICL, SC, S
21	140	1.1	Refusal - Groundwater	N	L, SICL, SC, S
22	150	1.18	Completion of Prescribed Depth	N	SL, GRSL, LS
23	120	0.94	Refusal - Groundwater	N	L, SICL, SC, S
24	80	0.63	Refusal - Groundwater	N	SIL, GR SICL, GRCL
25	110	0.86	Refusal - Groundwater	N	GRL
26	110	0.86	Refusal - Groundwater	N	VGRL, GRC, GRC
27	80	0.63	Refusal - Groundwater	N	GRL, GRCL, CL
28	80	0.63	Refusal - Groundwater	N	GRL, GRSICL, SICL
29	100	0.79	Refusal - Groundwater	N	GRSIL, SIL, SICL
30	80	0.63	Refusal - Groundwater	N	XGRL, GRSCL, GRSC
31	60	0.47	Refusal - Groundwater	N	VGRL, GRSL, SC, GRSC
32	140	1.1	Refusal - Groundwater	N	GRL, GRSC
33	70	0.55	Refusal - Groundwater	N	L, GRL
34	80	0.63	Refusal - Groundwater	N	L
35	80	0.63	Refusal - Groundwater	N	SIL, C
36	150	1.18	Completion of Prescribed Depth	N	L

Soil Test Pit (STP)	Depth of Termination (cm)	Volume Excavated (m³)	Reason for Termination	Cultural Material (Y/N)	Soil Type*
37	80	0.63	Refusal - Groundwater	N	SIL
38	80	0.63	Refusal - Groundwater	N	SIL
39	150	1.18	Completion of Prescribed Depth	N	L, GRL, SIL, GRSIL, SL
40	80	0.63	Refusal - Groundwater	N	L, SIL, GRSIL, SIL
41	80	0.63	Refusal - Groundwater	N	GRL, V/GRSIL, SICL
42	80	0.63	Refusal - Groundwater	N	GRL, SICL
43	80	0.63	Refusal - Groundwater	N	GRL, GRSIL, SIL, SICL
44	100	0.79	Refusal - Groundwater	N	L, GRSIL, SIL
45	140	1.1	Refusal - Groundwater	N	L, SIL
46	90	0.71	Refusal - Groundwater	N	L, SICL, SIL
47	80	0.63	Refusal - Groundwater	N	L, SIL
48	80	0.63	Refusal - Groundwater	N	SIL
49	130	1.02	Refusal - Groundwater	N	SIL, GRSIL
50	80	0.63	Refusal - Groundwater	N	GRSIL
51	80	0.63	Refusal - Groundwater	N	GRSIL, C
52	100	0.79	Refusal – Impenetrable Rock	N	GRSIL, SIL, GRSL

*Soil trait classifications based on United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) parameters C = clay; CL = clay loam; SIC = silty clay; SICL = silty clay loam; SIL = silt loam; SI = silt; L = loam; SC = sandy clay; SCL = sandy clay loam; SL = sandy loam; LS = loamy sand; S = sand; V = very; X = extremely; GR = gravelly; ST = stoney.

CONCLUSIONS

The Proposed Action is subject to NHPA Section 106 compliance and AFMAN 32-7003, Cultural Resources Management. Section 106 compliance also satisfies federal agencies' NEPA responsibilities to consider potential project-related effects on historic properties. The NHPA, Section 106, requires federal agencies to consider the effects of proposed federal undertakings on historic properties that are listed in or eligible for listing in the NRHP. If a cultural resource is listed in, or eligible for, the NRHP it is considered a "historic property" for purposes of Section 106 and is significant. Compliance with Section 106 requires the federal agency to determine either that the undertaking would have no effect, no adverse effect, or an adverse effect to historic properties (that is, to significant cultural resources). The Section 106 implementing regulations (36 CFR Part 800) prescribe the process for making these determinations.

In consultation with the 30 CES/CEIEA concerning the Proposed Action and its potential for direct and indirect effects to cultural resources resulting from any related construction, static fire, launches, and boost-back landings, an CRSA was determined relative to the auditory effects predicated on vibratory impacts. Based on standard thresholds for potential effects resulting from launch noise and sonic booms, this study was conducted to identify historic properties within areas where noise vibration levels exceed 120 dB and the sonic boom arc exceeds 2psf as a result of the Proposed Action. Additionally, and ASA was established to determine absence/presence of

NRHP eligible cultural resources within areas proposed for ground disturbing or landscape-altering activities.

The 120 dB launch noise contour would extend only slightly outside and east of the VSFB in an uninhabited area with no reported resources. All but one building located on VSFB are associated with launch complexes and supporting infrastructure and are built to withstand concussive forces. The only historic building located on VSFB that is not associated with launch complexes or supporting infrastructure is the former U.S. Coast Guard Lifeboat Rescue Station (P-42-040495). The Colonial Revival architectural style, wood-frame structure was built in 1936 as administrative barracks and ancillary structures. The structures have been subjected to many years of medium and heavy launches and boost-back landings at SLC-4 as well as launches conducted at nearby SLC-6 with no reported and observed effect. Accordingly, there would be no effect to any NRHP eligible resources in the built environment at VSFB from launch noise exceeding 120 dB.

Built environment and archaeological resources located within the CRSA could be subject to sonic booms of up to 4 and 5 psf. Specifically, the 2 psf and greater sonic boom impact area encompasses all of Santa Cruz, Santa Rosa, and San Miguel islands and may reach an overpressure of as much as 5 psf over a very narrow portion of land on the NCI; however, a large portion of the NCI will be exposed to an overpressure no more than of 2–3 psf. Sonic booms are dependent on launch trajectory, inclination, and atmospheric conditions. The Proposed Action is not expected to result in a repeated alignment of the sonic boom overpressure footprint within specific areas of the CRSA and the duration of the overpressure effects are estimated to last less than one second per sonic boom (personal communication with SpaceX staff 2023). Previous studies, experimental analysis and observations of archaeological sites located on VSFB have provided good evidence that archaeological sites consisting of only surface artifacts and/or buried archaeological material do not have the potential to be affected by rocket engine noise exceeding 120 dB and sonic booms exceeding 2 psf. Furthermore, both archaeological and built environment resources within the CRSA have been subjected to many years of medium and heavy launches and boost-back landings at SLC-4 as well as launches conducted at SLC-6 with no reported and observed effect.

A reasonable and good-faith effort to identify historic properties within the CRSA pursuant to 36 CFR 800.4(a)-(d) and 36 CFR 800.5(a)-(d) has been conducted by both the 30 CES/CEIEA and Langan. A desktop analysis of archaeological sites and historic-age buildings in the launch noise/sonic boom study area; fieldwork including intensive pedestrian surveys and subsurface testing was conducted within the ASA associated with proposed ground disturbing or landscape-altering activities; and identification of all NRHP eligible cultural resources in the CRSA was conducted and historic properties were assessed for their potential to be affected by the Proposed Action. Based on thresholds established by previous studies, the results of previous experiments and observational assessments (Fenton and Methold 20261; Gibbs 2017; Guest and Sloane 1972; Haber et al. 1989; NASA 2017; Nocerino et al. 2021; and Smallwood personal communication 2023), no NRHP eligible resources with the potential to be adversely effected by proposed actions were identified within the CRSA, and no eligible or NRHP-listed archaeological resources with the potential to be adversely effected proposed actions were identified within the ASA as a result of intensive pedestrian surveys and subsurface testing. Therefore, it is the conclusion of this investigation that it is highly unlikely that identified or yet unidentified historic properties located within the NRHP have the potential to be affected by the Proposed Action and the undertaking will have no effect on any known historic properties.

Please do not hesitate to contact Langan at any time with questions or concerns about this investigation. I can be reached at hmcdanielmcdevitt@langan.com or by calling 805-696-0957.

Heather McDaniel McDevitt, RPA
Principal Investigator
Langan Cultural Resources Practice Director

REFERENCES

Fenton, Richard and Rick Methold. 2024. MOD Shoeburyness & Pendine Noise and Vibration Study Criteria for the Assessment of Potential Building Damage Effects from Range Activities. Prepared for Ministry of Defense.

Gerber, Joyce, Eric S. Nocerino, Karin Pitts-Olemedo and Clayton G. Lebow. 2023. *Cultural Resource Investigations at SLC-3W, SLC-5, SLC-8, Lompoc Terrace, and the Boat Dock Vandenberg Space Force Base, California (813-19-033CRV).*

Gibbs, Yvonne. 2017 NASA Armstrong Fact Sheet: Sonic Booms. Found at: https://www.nasa.gov/ centers/armstrong/news/FactSheets/FS-016-DFRC.html.

Guest, S., and R. M. Slone, Jr. 1972 Structural Damage Claims Resulting from Acoustic Environments Developed During Static Firing of Rocket Engines. Paper presented at the NASA Space Shuttle Technology Conference.

Haber, Jerry, David Nakaki, Craig Taylor, George Knipprath, Vijay Kopparam, and Mark Legg. 1989. *Effects of Aircraft Noise and Sonic Booms on Structures: An Assessment of the Current State-of-Knowledge*. BBN Systems and Technologies Corp., Canoga Park.

KBR, Inc (Kevin A. Bradley and Clifton B. Wilmer). 2024. *Flacon 9 and Falcon Heavy Noise Assessment for Flight and Test Operations at Vandenberg Space Force Base*. Prepared for Space Exploration Technologies Incorporated.

Lebow, Clayton G., Rebecca L. McKim, Douglas R. Harro, and Michelle Newcomb. 2016. *Archaeological Investigations in 2014–2015 for Firebreaks and Fire Access Roads, Vandenberg Air Force Base, Santa Barbara County, California.*

Nationwide Environmental Title Research (NETRa). 2024. Historical Aerial Photographs of Project Site: 1981, 1994, 2005, 2008, 2009, 2010, and 2012. https://www.historicaerials.com/viewer/ Accessed May 2024.

Nationwide Environmental Title Research (NETRb). 2024. Historical Topographic Maps of Project Site: 1948, 1956, 1957, 1958, 1960, 1966, 1967 1968, 1986, 1987, 2012, 2015, 2018, and 2021. https://www.historicaerials.com/viewer/ Accessed May 2024.

Nocerino, Eric, Josh Small wood and Edward B. Yarbrough. 2021. Rocket Engine Noise Effects of Cultural Resources: Addendum to the Section 106 Compliance Report for the Blue Origin Orbital Launch Site Project, Vandenberg Space Force Base, Santa Barbara County, California. Prepared for Tetra Tech.

OHP, 1995. *Instructions for Recording Historical Resources*. Prepared by California Department of Transportation. Prepared for California Office of Historic Preservation.

P-42-001148H (CA-SBA-1148H) Site Record. 2012. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002032 (CA-SBA-2032) Site Record. 1998. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002212 (CA-SBA-2212) Site Record. 2009. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002213 (CA-SBA-2213) Site Record. 2009. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002214 (CA-SBA-2214) Site Record. 2009. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002217 (CA-SBA-2217) Site Record. 1996. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002218 (CA-SBA-2218) Site Record. 1996. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-002219 (CA-SBA-2219) Site Record. 1996. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

P-42-041202 Site Record. 2018. On File Vandenberg Space Force Base (VSFB) database. Accessed April 2024.

Smallwood, Josh and Christopher Ryan. 2016. *Identification of Historic Properties and Assessment of Effects Vandenberg Operational Lightning Tracking System (VOLTS) Project, Vandenberg Air Force Base, Santa Barbara County, California (813-17-060).*

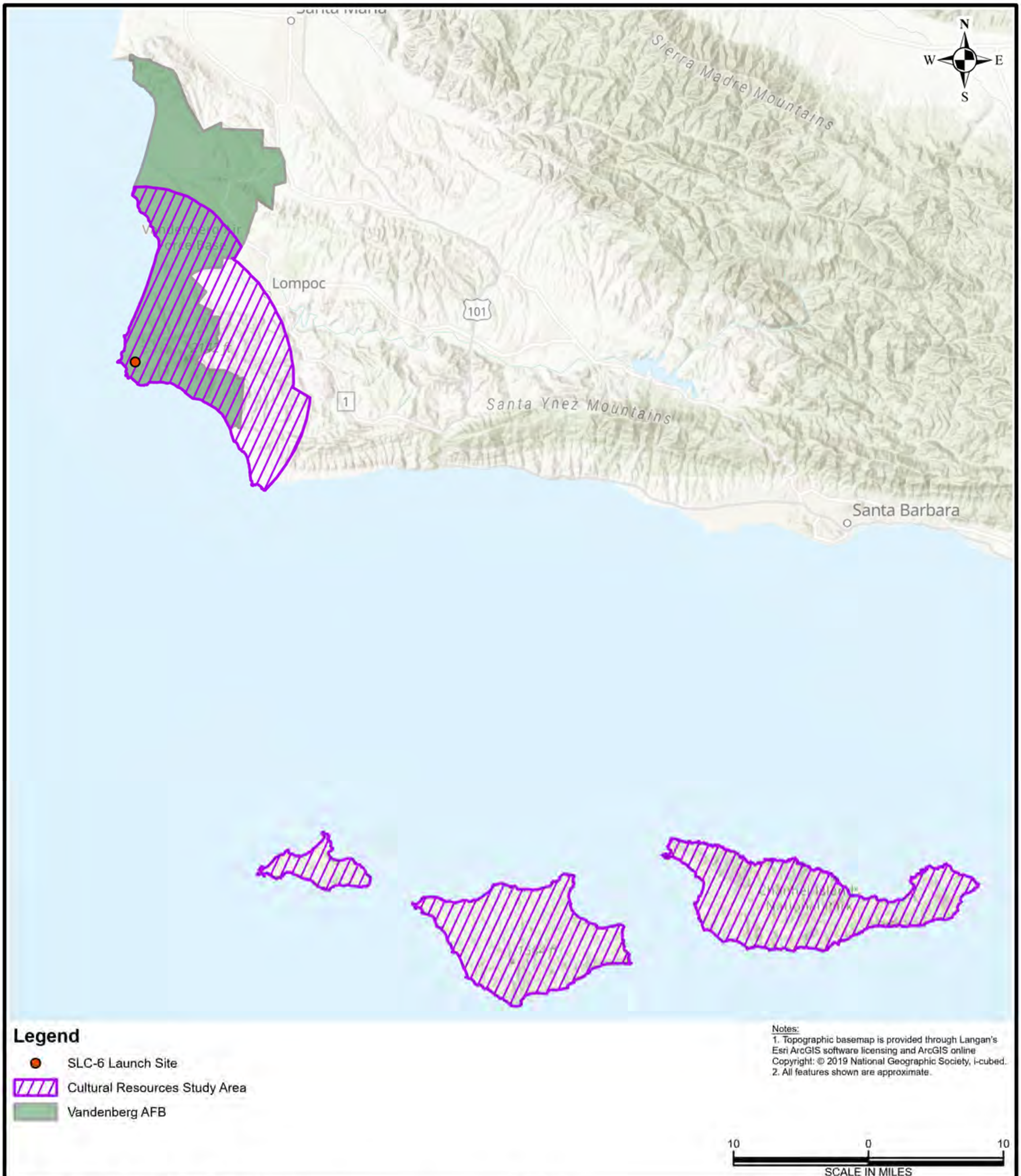
Smallwood, Josh. 2023. Personal Communication

SpaceX. 2023. Personal Communication

VAFB-ISO-318 Site Record. 2009. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

VAFB-ISO-319 Site Record. 2009. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.

VAFB-ISO-320 Site Record. 2009. On File Vandenberg Space Force Base (VSFB) database. Accessed November 2023.



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Project

FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION

LOMPOC

SANTA BARBARA COUNTY CALIFORNIA

Figure Title

CULTURAL RESOURCES STUDY AREA

Project No. 781017001

Date 4/18/2024

Scale 1" = 10 miles

Drawn By AC

Figure 1

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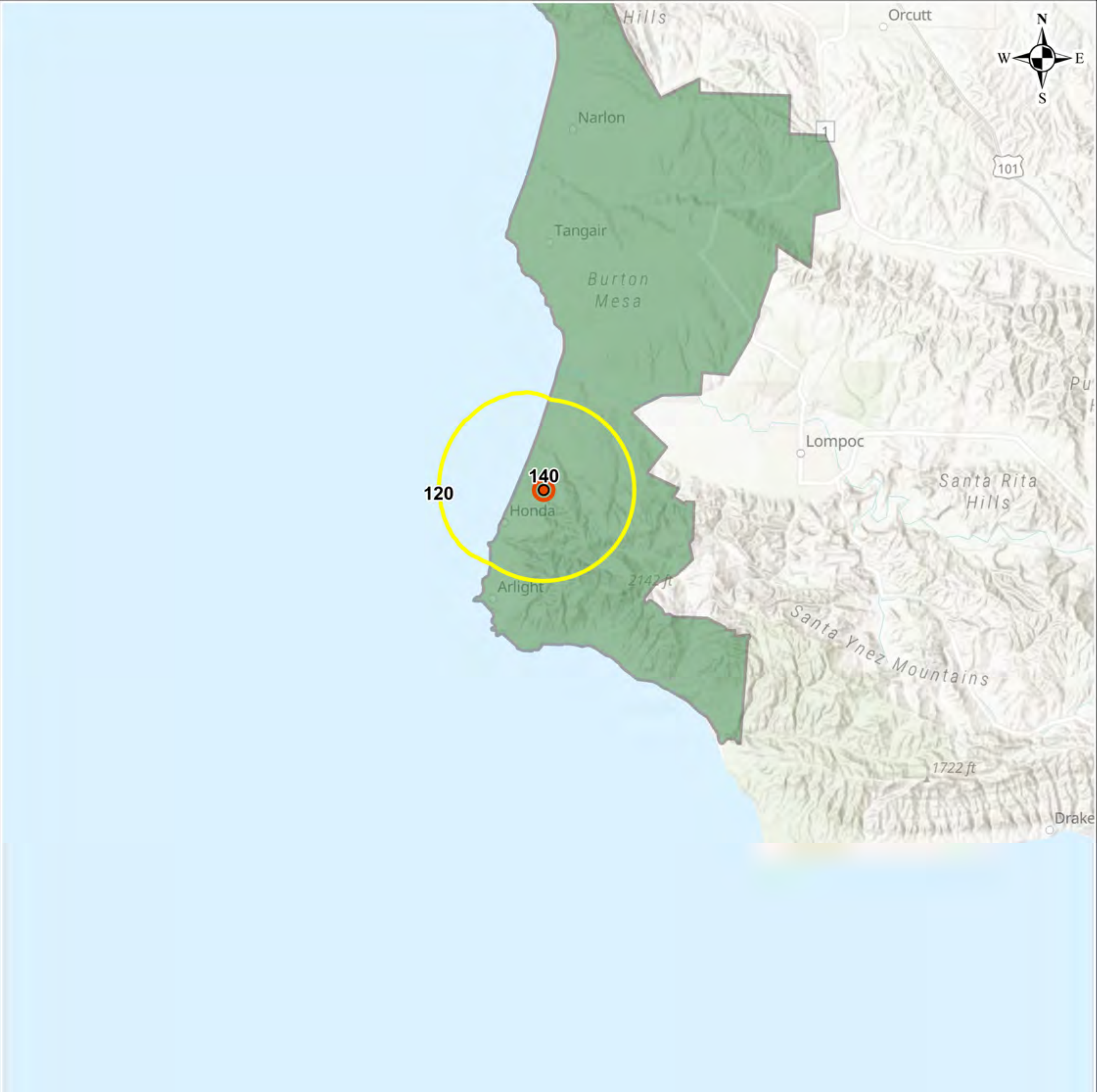

Legend

- SLC-4 Launch Site
- 120 dB
- 140 dB
- Vandenberg AFB

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LANGAN Langan CA, Inc. 924 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001 www.langan.com	Project FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	Figure Title FALCON 9 ORBITAL LAUNCH FROM SLC-4: MAXIMUM UNWEIGHTED SOUND LEVELS	Project No. 781017001 Date 4/23/2024 Scale 1" = 5 miles Drawn By AC	Figure 2

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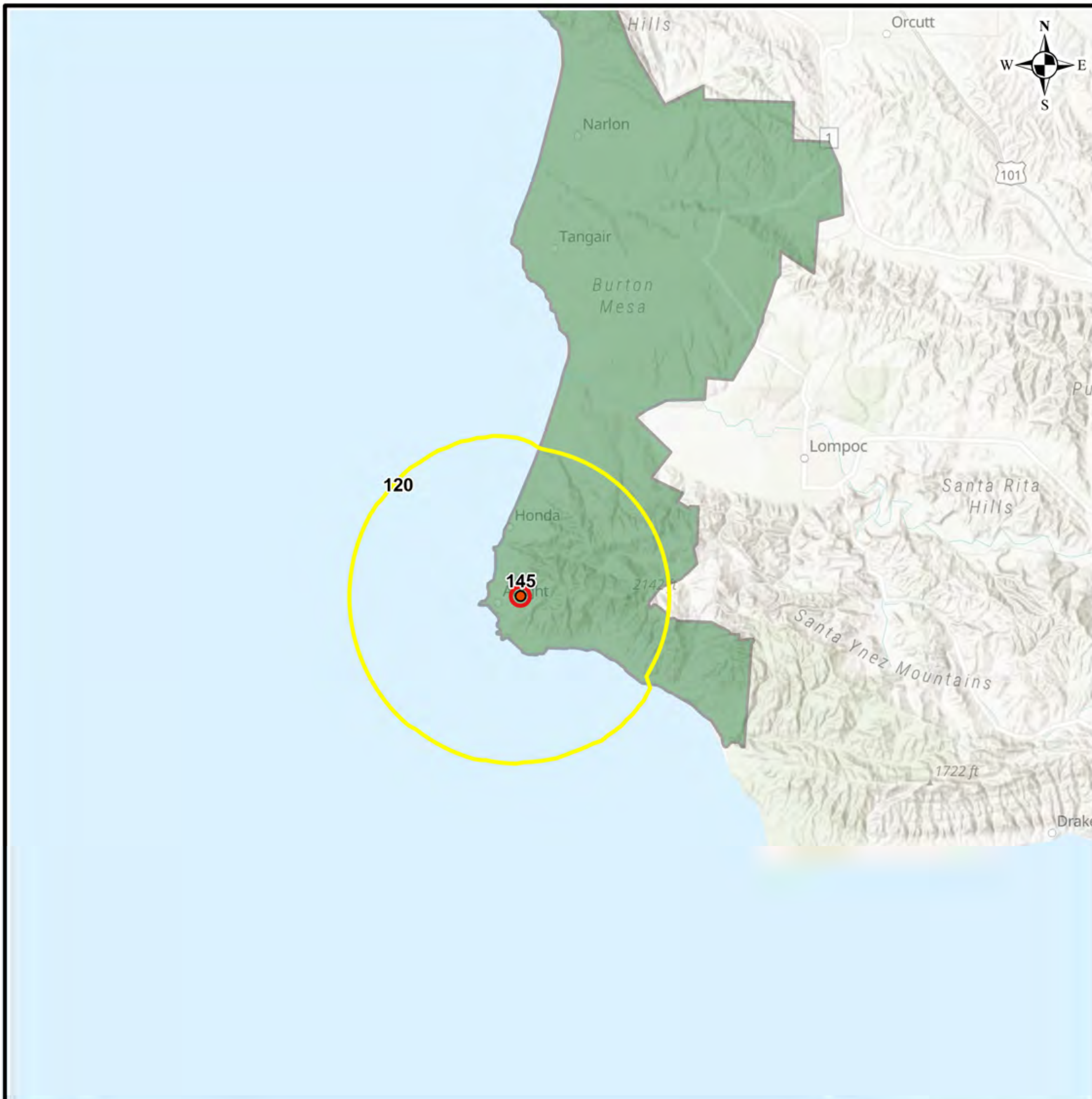

Legend

- SLC-6 Launch Site
- 120 dB
- 145 dB
- Vandenberg AFB

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Project	Figure Title	Project No.	Figure
FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 & FALCON HEAVY ORBITAL LAUNCH FROM SLC-6: MAXIMUM UNWEIGHTED SOUND LEVELS	781017001 Date: 4/23/2024 Scale: 1" = 5 miles Drawn By: AC	3

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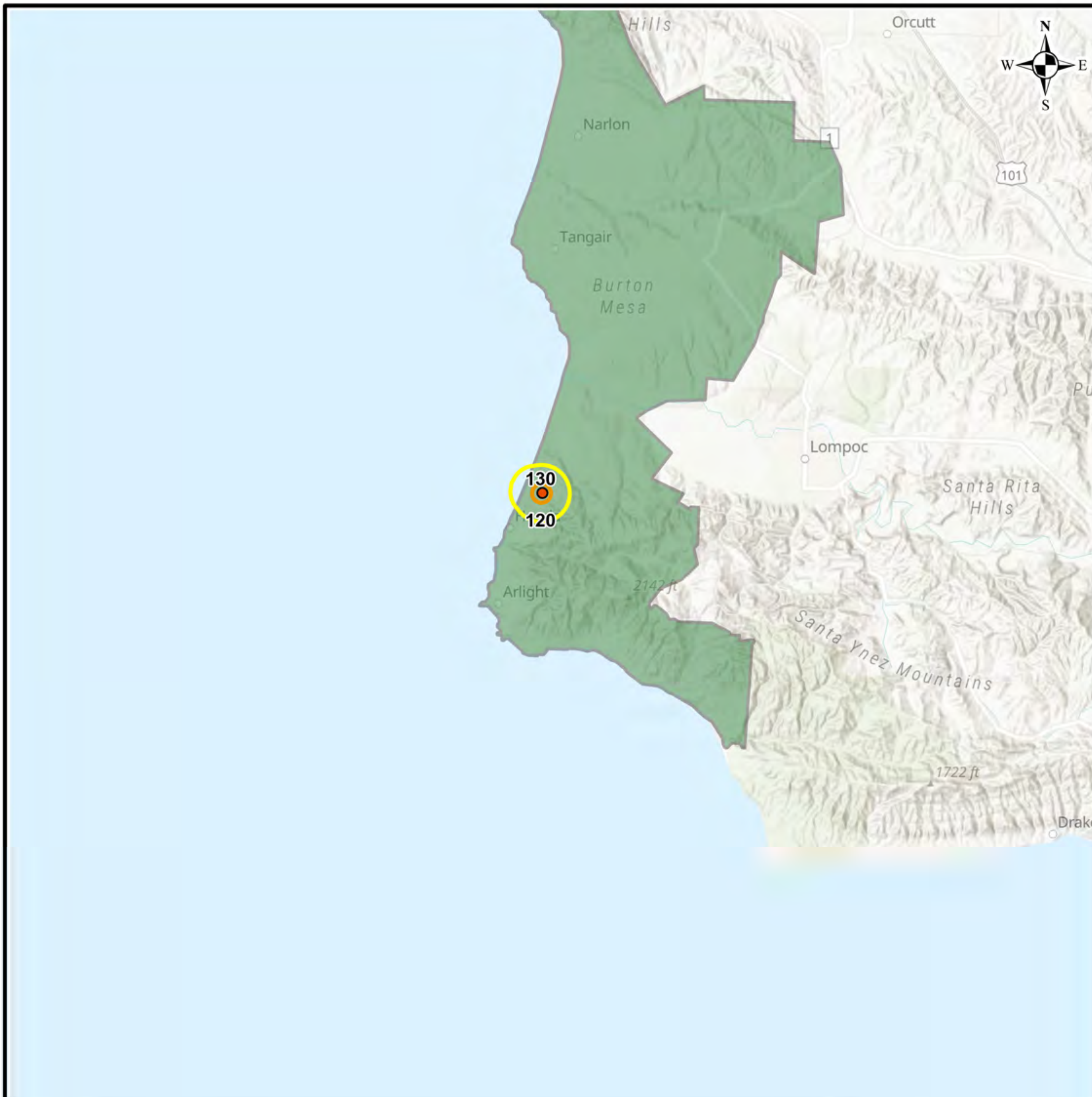

Legend

- SLC-4 Launch Site
- 120 dB
- 130 dB
- Vandenberg AFB

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Project	Figure Title	Project No. 781017001	Figure
FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 LANDING AT SLC-4: MAXIMUM UNWEIGHTED SOUND LEVELS	Date 4/23/2024 Scale 1" = 5 miles Drawn By AC	4

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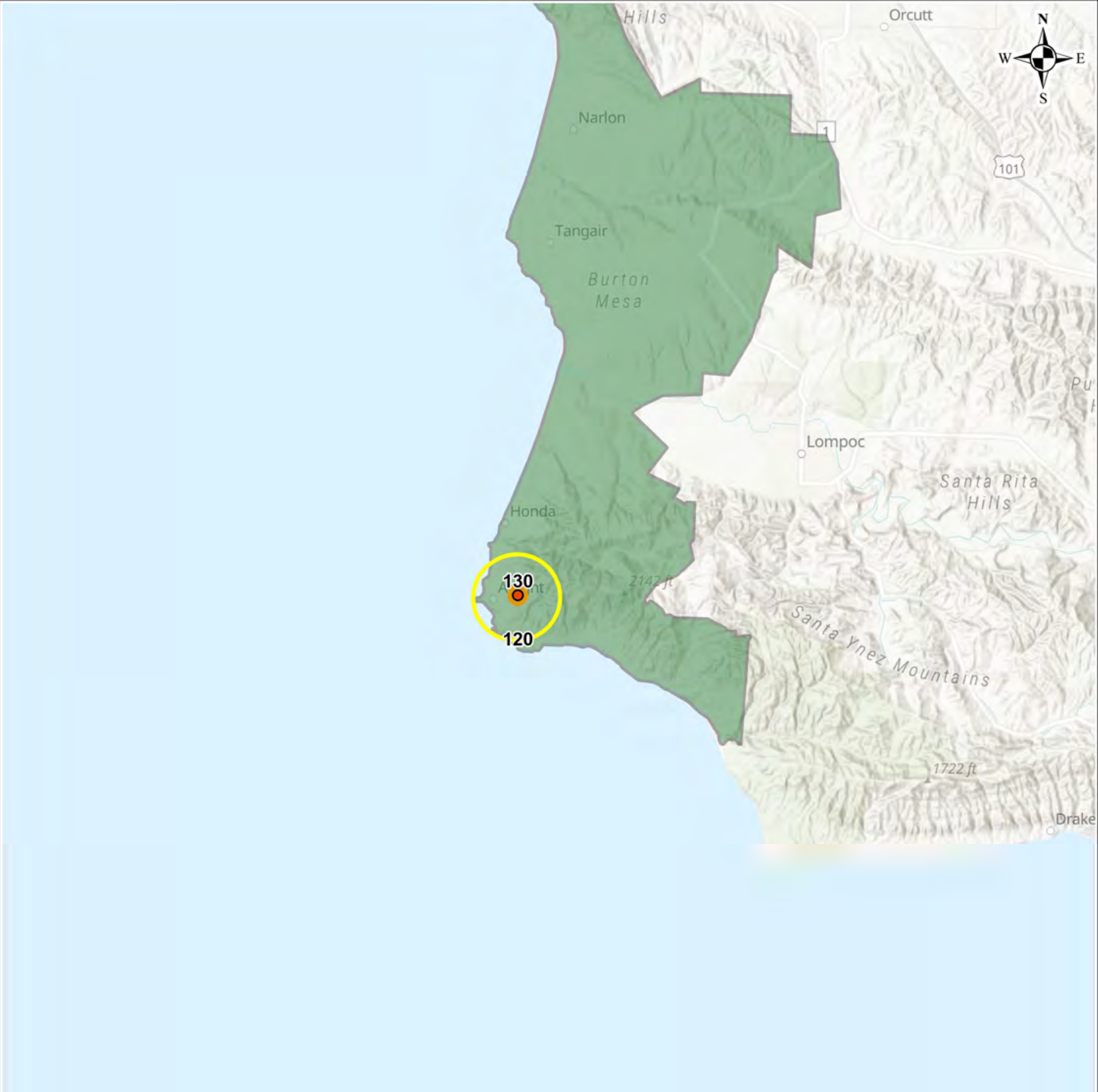

Legend

- SLC-6 Launch Site
- 120 dB
- 130 dB
- Vandenberg AFB

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Langan CA, Inc. 924 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001 www.langan.com	FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 & FALCON HEAVY LANDING AT SLC-6: MAXIMUM UNWEIGHTED SOUND LEVELS	781017001 Date 4/23/2024 Scale 1" = 5 miles Drawn By AC	5

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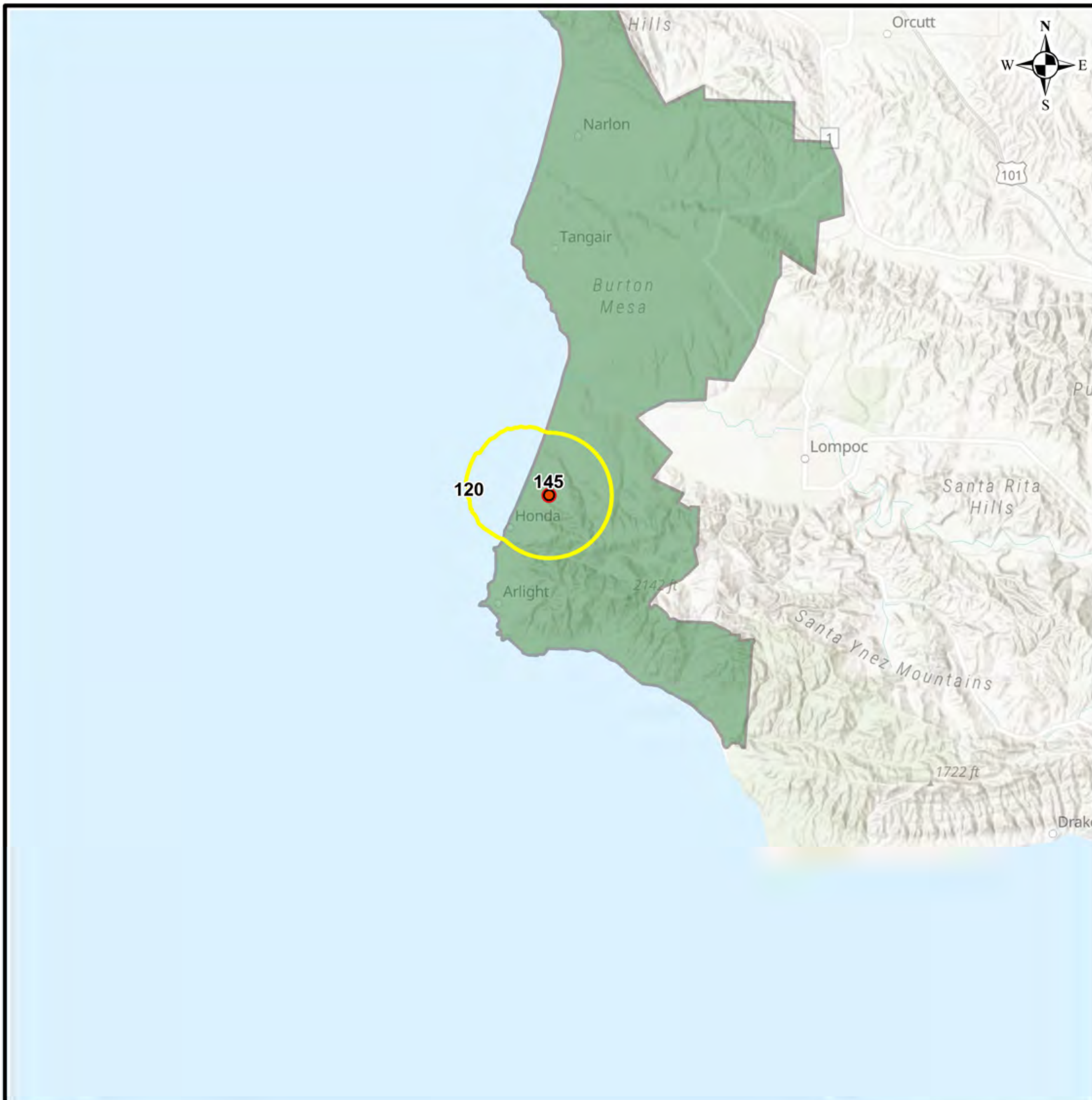

Legend

- SLC-4 Launch Site
- 120 dB
- 145 dB
- Vandenberg AFB

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Project	Figure Title	Project No.	Figure
FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 STATIC FIRE TEST AT SLC-4: MAXIMUM UNWEIGHTED SOUND LEVELS	781017001 Date 4/23/2024 Scale 1" = 5 miles Drawn By AC	6

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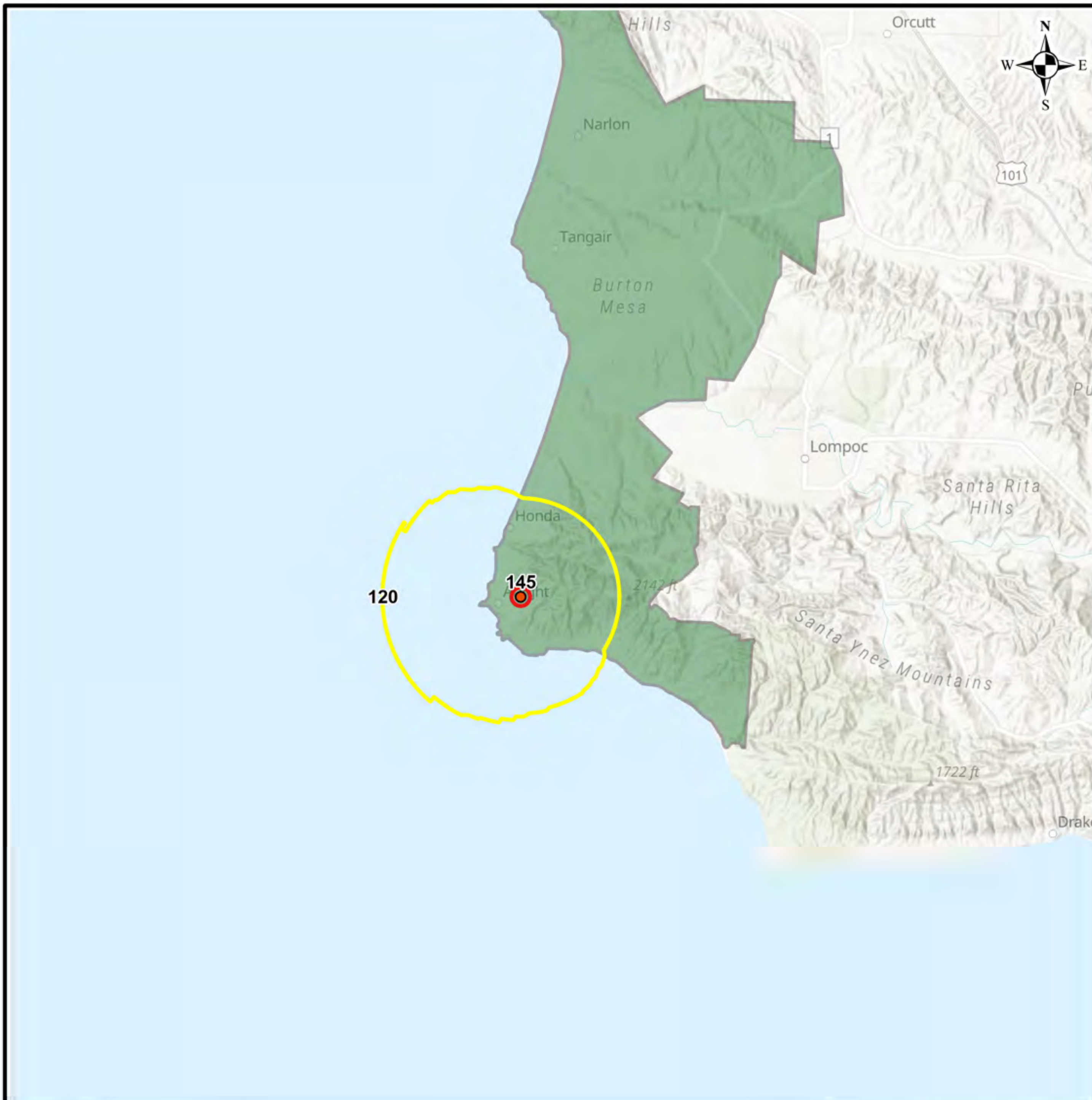

Legend

- SLC-6 Launch Site
- 120 dB
- 145 dB
- Vandenberg AFB

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LANGAN Langan CA, Inc. 924 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001 www.langan.com	Project FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	Figure Title FALCON 9 & FALCON HEAVY STATIC FIRE TEST AT SLC-6: MAXIMUM UNWEIGHTED SOUND LEVELS	Project No. 781017001 Date 4/23/2024 Scale 1" = 5 miles Drawn By AC	Figure 7

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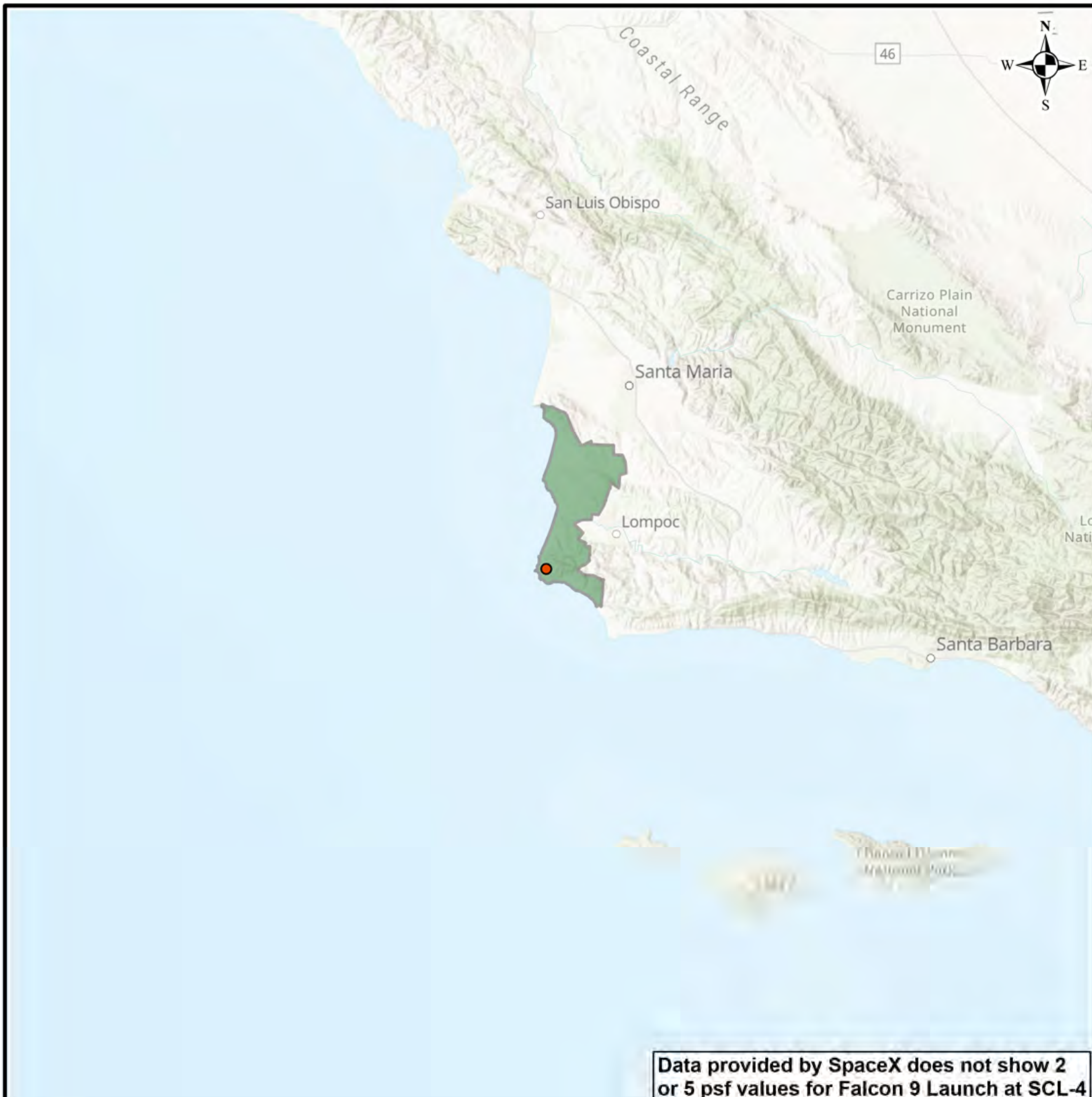

Legend

- SLC-4 Launch Site
- 2 psf
- 5 psf
- Vandenberg AFB

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Langan CA, Inc. 924 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001 www.langan.com	FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 LAUNCH AT SLC-4: SONIC BOOM PSF CONTOURS	Project No. 781017001 Date 4/23/2024 Scale 1" = 20 miles Drawn By AC	8

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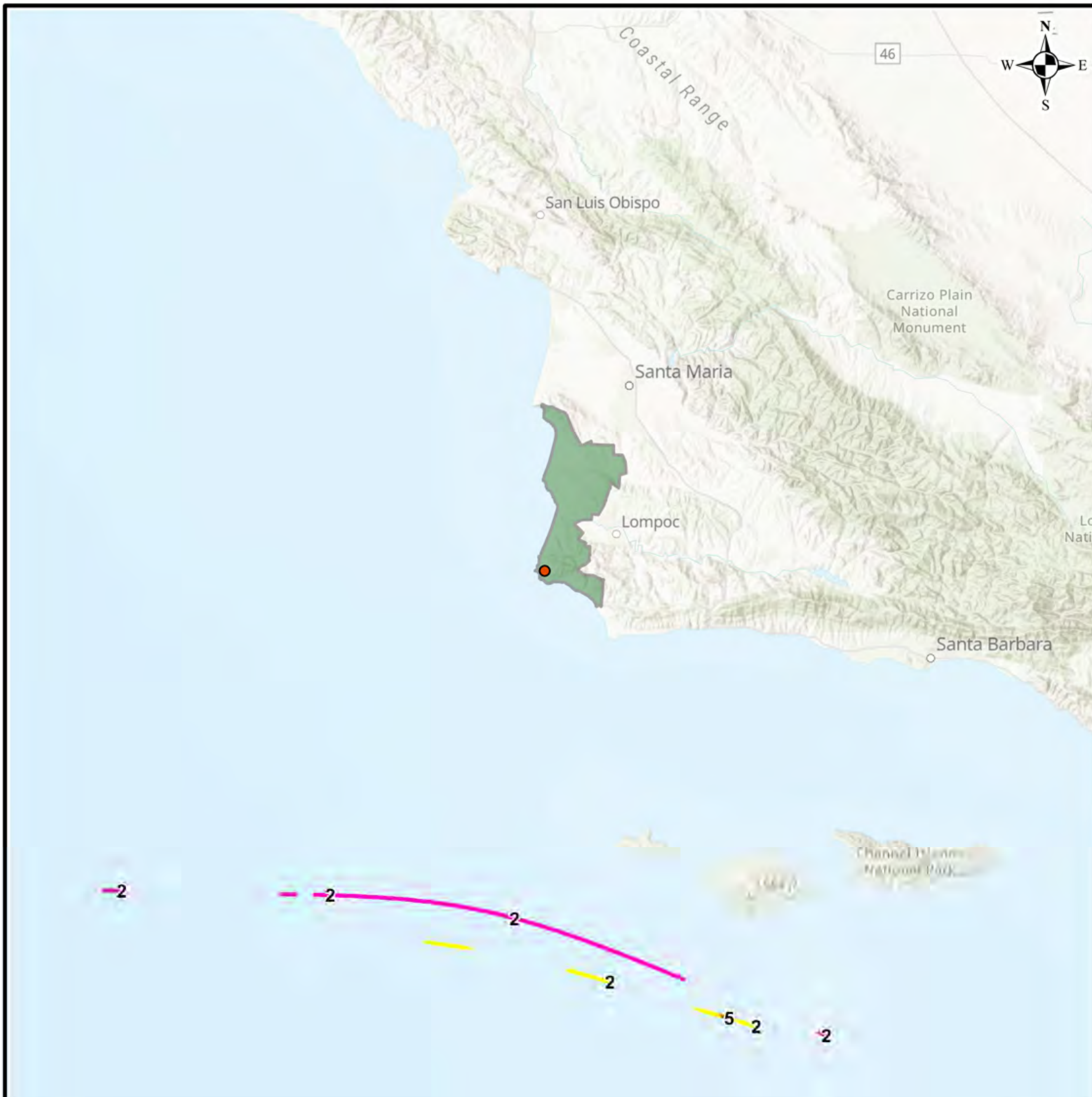

Legend

- SLC-6 Launch Site
- 2 psf contour from Falcon 9 Launch
- 5 psf contour from Falcon 9 Launch
- 2 psf contour from Falcon Heavy Launch
- Vandenberg AFB

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Langan CA, Inc. 924 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001 www.langan.com	FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 AND FALCON HEAVY LAUNCH AT SLC-6: SONIC BOOM PSF CONTOURS	781017001 Date 4/23/2024 Scale 1" = 20 miles Drawn By AC	9

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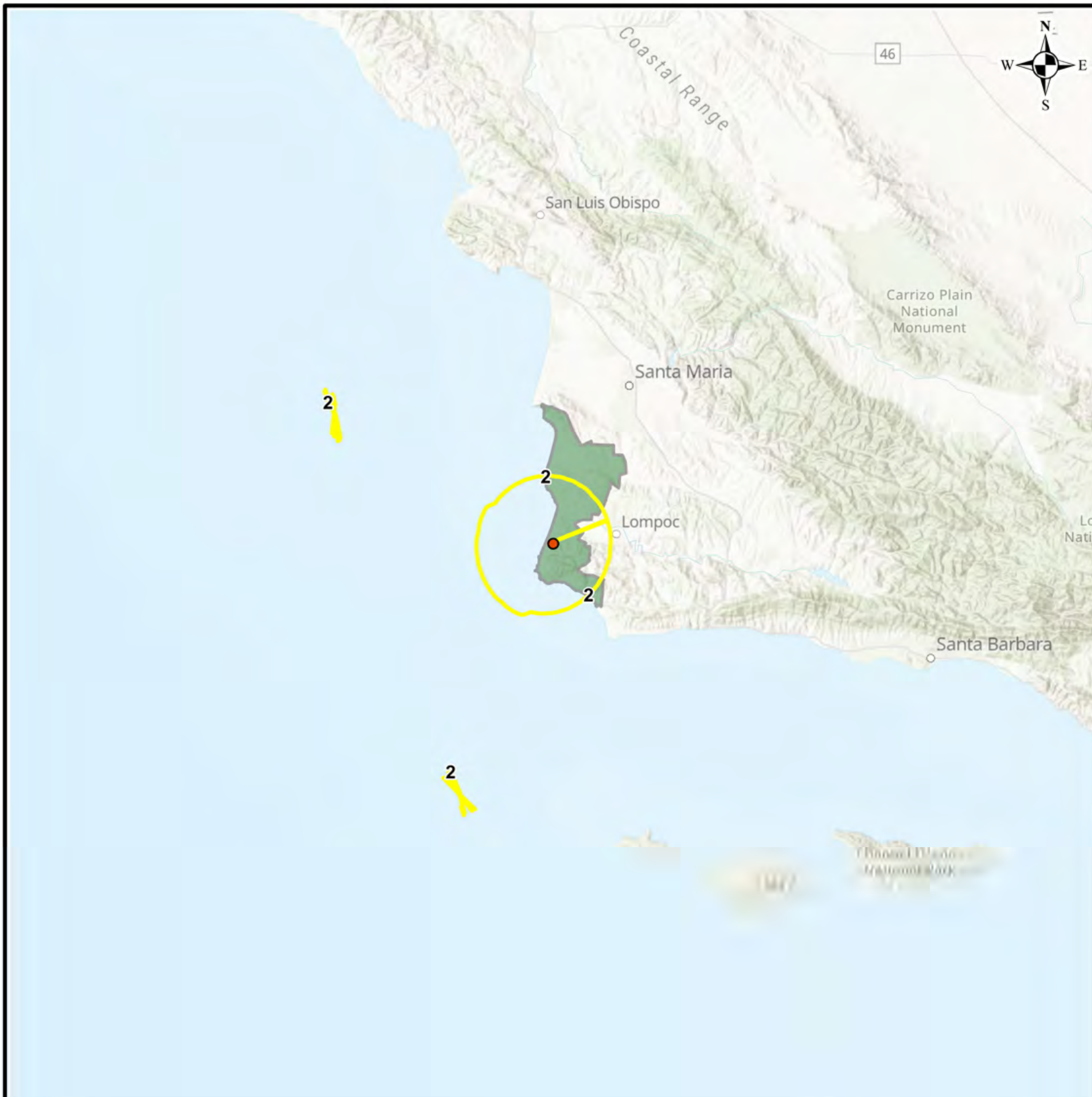

Legend

- SLC-4 Launch Site
- 2 psf
- 5 psf
- Vandenberg AFB

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Project	Figure Title	Project No. 781017001	Figure
FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	FALCON 9 LANDING AT SLC-4: SONIC BOOM PSF CONTOURS	Date 4/23/2024 Scale 1" = 20 miles Drawn By AC	10

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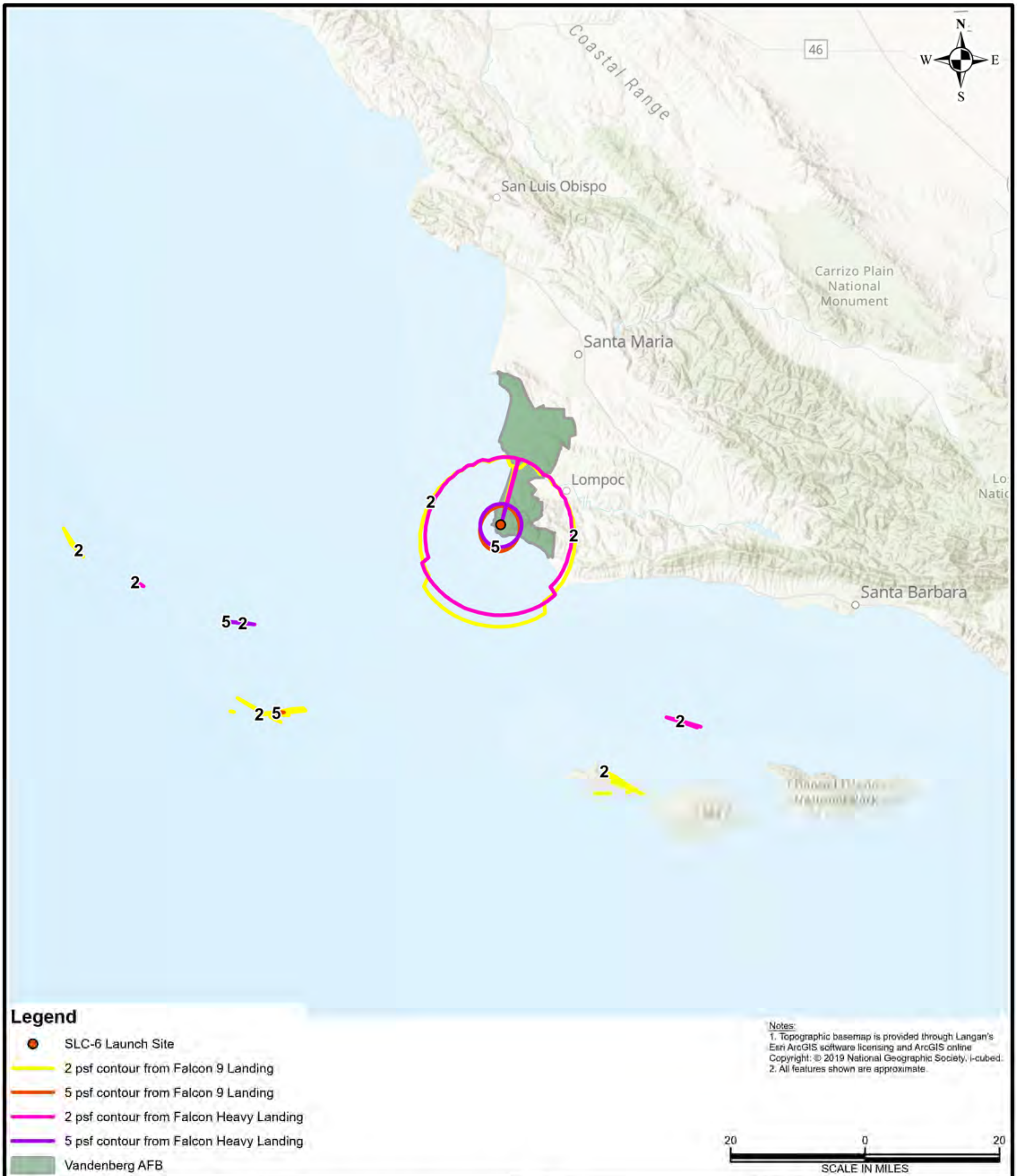

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LANGAN	Project	Figure Title	Project No.	Figure
Langan CA, Inc. 924 Anacapa Street, Suite 2X Santa Barbara, CA 93101 T: 805.957.6000 F: 805.957.6001 www.langan.com	FALCON LAUNCH CADENCE INCREASE AT SLC-4/SLC-6 & SLC-6 MODIFICATION LOMPOC SANTA BARBARA COUNTY CALIFORNIA	SONIC BOOM FROM FALCON 9 LANDING AT SLC-6: PSF CONTOURS	781017001 Date: 4/23/2024 Scale: 1" = 20 miles Drawn By: AC	11

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APPENDIX B
United States Fish and Wildlife Service Consultation

DEPARTMENT OF THE AIR FORCE
UNITED STATES SPACE FORCE
SPACE LAUNCH DELTA 30

9 April 2025

Gretchen Swinehart
30 CES/CEI
1028 Iceland Avenue
Vandenberg SFB CA 93437-6010

Ms. Catherine Darst
United States Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, CA 93003

Dear Ms. Darst

In accordance with section 7 of the Endangered Spceies Act of 1973, Vandenberg Space Force Base requests reinitiation of Biological Opinion 2022-0013990-S7-001 for Launch, Boost-Back and Landing of the Falcon 9 First Stage at Space Launch Complex (SLC) -4 at Vandenberg Air Force Base, Santa Barbara County, California to include an increase in launch cadence and SLC-6 modifications and launch operations. The potential impacts of increased noise from launch and landing activities are comprehensively discussed within the attached Biological Assessment (BA).

This BA evaluates the potential effects of a proposed increase in Falcon launch cadence and modifications to SLC-6 on federally listed (endangered and threatened) species and their Critical Habitat.

Due to the critical timeline, we request the opportunity to review a Draft Biological Opinion by 22 July 2025. Please contact me at gretchen.swinehart@spaceforce.mil or Tiffany Whitsitt-Odell at tiffany.whitsitt-odell@spaceforce.mil if you have any questions.

Sincerely

SWINEHART.GRETCHEN.1230170823 Digitally signed by SWINEHART.GRETCHEN.1230170823 Date: 2025.04.09 15:36:15 -07'00'

GRETCHEN SWINEHART
Chief, Installation Management Flight

Attachment:
Biological Assessment for Falcon Cadence Increase and SLC-6 Modifications at Vandenberg Space Force Base, California

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-R003

April 24, 2025

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

Subject: Acknowledgment of Request to Initiate Formal Consultation for the Launch, Boost-Back, and Landing of Falcon 9 First Stage cadence increase at Space Launch Complex 4 and 6, with introduction of Falcon Heavy vehicle and modifications of SLC-6, Vandenberg Space Force Base, Santa Barbara County, California.

Dear Beatrice Kephart:

This letter acknowledges our receipt of your request, dated April 9, 2025, for initiation of formal consultation, pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended (Act). The requested consultation concerns the potential effects of the U.S. Space Force's (Space Force) authorization of the Launch, Boost-Back, and Landing of Falcon 9 First Stage cadence increase at Space Launch Complex (SLC) 4 and 6, with introduction of Falcon Heavy vehicle and modifications of SLC-6 on the federally endangered California least tern (*Sterna antillarum browni*), short tailed albatross (*Phoebastria albatrus*), southwestern flycatcher (*Empidonax traillii extimus*), least bell's vireo (*Vireo bellii pusillus*), Hawaiian petrel (*Pterodroma sandwichensis*), Santa Barbara Distinct Population Segment of California tiger salamander (*Ambystoma californiense*), California condor (*Gymnogyps californianus*), unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), tidewater goby (*Eucyclogobius newberryi*), arroyo toad (*Anaxyrus californicus*), light-footed Ridgway's rail (*Rallus obsoletus levipes*), the federally threatened marbled murrelet (*Brachyramphus marmoratus*), California gnatcatcher (*Polioptila californica californica*), California red-legged frog (*Rana draytonii*), southern sea otter (*Enhydra lutris nereis*), and western snowy plover (*Charadrius nivosus nivosus*) and its critical habitat.

All information required of you to initiate consultation was either included with your request letter, the revised biological assessment, or is otherwise accessible for our consideration and reference, and we are in coordination with your staff regarding additional supplemental information. We have assigned file number 2022-0013990-S7-001-R003 to this consultation. Please refer to that number in future correspondence on this consultation. We expect to provide you with our draft biological opinion on or before July 23, 2025. Once complete, this consultation will supersede all previous consultations for Space Force's authorization of SpaceX's Falcon 9 program at Vandenberg Space Force Base, including the conclusions, incidental take statements, reasonable and prudent measures, and terms and conditions.

As a reminder, the Act requires that, after the initiation of formal consultation, the lead federal agency may make no irreversible or irretrievable commitment of resources that could preclude the formulation or implementation of reasonable and prudent alternatives to avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying critical habitat [Section 7(d)]. If you have any questions or concerns about this consultation or the consultation process in general, please feel free to contact our office at fw8venturasection7@fws.gov.

Sincerely,

Christopher J. Diel
Assistant Field Supervisor

cc:
Darryl York
Samantha Kaisersatt
Tiffany Whitsitt-Odell

Biological Assessment for

Falcon Cadence Increase and SLC-6 Modifications at Vandenberg Space Force Base, California

9 April 2025

Prepared for

Space Launch Delta 30, Installation Management Flight Environmental Assets
1028 Iceland Avenue, Bldg. 11146
Vandenberg Space Force Base, California 93437

Prepared by

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

Table of Contents

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

%	percent
ac	acre(s)
AGE	aerospace ground equipment
ARTO	arroyo toad
BA	Biological Assessment
BO	Biological Opinion
CAGN	coastal California gnatcatcher
CDFW	California Department of Fish and Wildlife
C.F.R.	Code of Federal Regulations
CNDDB	California Natural Diversity Database
CRLF	California red-legged frog
DAF	Department of the Air Force
dB	decibel(s) unweighted
dBA	A-weighted decibel(s)
DPS	Distinct Population Segment
E	east
ESA	Endangered Species Act
ESBB	El Segundo blue butterfly
FR	Federal Register
ft	foot or feet
ft^2	square foot or feet
GTP	Gaviota tarplant
HIF	Horizontal Integration Facility
INRMP	Integrated Natural Resources Management Plan
IPaC	Information for Planning and Consultation
kHz	kilohertz
LBVI	least Bell's vireo
LETE	California least tern
LOX	liquid oxygen
MAMU	marbled murrelet
mi	mile(s)
MSRS	ManTech SRS Technologies, Inc.
OCA	other carnivores in-air
OHV	off-highway vehicle
PBO	Programmatic Biological Opinion
PCE	primary constituent elements
PPV	peak particle velocity
psf	pounds per square foot
PTS	permanent threshold shift
RIRA	light-footed Ridgeway's rail
RP-1	rocket propellant 1
RORO	roll-on-roll-off
SLC	Space Launch Complex
SLC-4E	Space Launch Complex 4 East
SLC-4W	Space Landing Complex 4 West
SLM	sound level meter

SNPL	western snowy plover
SpaceX	Space Exploration Technologies
SSO	southern sea otter
TTS	temporary threshold shift
TWG	tidewater goby
ULA	United Launch Alliance
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTS	unarmored threespine stickleback
VSFB	Vandenberg Space Force Base (formerly Vandenberg Air Force Base [VAFB])
W	west

1 Introduction

1.1 Background & Consultation History

The purpose of this Biological Assessment (BA) is to address the effects of a proposed increase in Falcon launch cadence and modifications to Space Launch Complex (SLC) 6 on federally listed (endangered and threatened) species and their Critical Habitat as required by section 7 of the Endangered Species Act (ESA) of 1973 (16 United States Code [U.S.C.] section 1536). The Department of the Air Force's (DAF) Proposed Action is to authorize an increase in the annual Falcon launch cadence at Vandenberg Space Force Base (VSFB) through launch and landing operations at SLC-4 and SLC-6, including modification of SLC-6 for Falcon 9 and Falcon Heavy launch vehicles to support future United States (U.S.) Government and commercial launch service needs. The DAF would also authorize an increase in Falcon 9 launches from SLC-4. No modification of SLC-4 is proposed. The overall launch cadence for Falcon 9 and Falcon Heavy at both SLCs, combined, would be 100 launches per year. The DAF is the Action Agency and the Applicant is Space Exploration Technologies (SpaceX) Pursuant to section 7(a) of the ESA of 1973 (16 U.S.C. section 1536(a)), as amended, the DAF, is required to consult with the United States Fish and Wildlife Service (USFWS) for those actions it has determined may affect ESA-listed species or their Critical Habitat. The DAF is the lead agency for the purposes of this BA.

1.1.1 SLC-4 Consultation History

The USFWS has previously analyzed effects from the SpaceX Falcon 9 launch program at SLC-4. Specifically, the USFWS completed five biological opinions (BO; USFWS 2010, 2011, 2014a, 2017a, 2023, 2024a) and issued four concurrence letters (USFWS 2014b, 2015a, 2022a; 2024b) regarding the effects of the Falcon launch program at SLC-4, which are summarized below.

In the BO dated 10 December 2010 (USFWS 2010), the USFWS consulted on the modification and operation of Space Launch Complex 4 East (SLC-4E) for the new Falcon 9 and Falcon Heavy Space Vehicle Program. The USFWS concurred that modification of SLC-4E, launch noise, and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect the California least tern (LETE, *Sternula antillarum browni*), western snowy plover (SNPL, *Charadrius nivosus*), or southern sea otter (SSO; *Enhydra lutris nereis*). Although Falcon Heavy launches at SLC-4 were included in the agency action evaluated in the 2010 BO, infrastructure to support Falcon Heavy was never constructed. Thus, SLC-4 would require extensive modification and Falcon Heavy is no longer planned to operate at SLC-4.

The DAF requested reinitiation for SLC-4 on 25 May 2011 due to a change in the effects determination for the California red-legged frog (CRLF; *Rana draytonii*), from "no effect" to "may affect, not likely to adversely affect." In the resulting BO (USFWS 2011), the USFWS again concurred that launch noise and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect the CRLF, LETE, SNPL.

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

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

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

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

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

Impacts due to DAF maintenance of firebreaks surrounding both SLC-4E and SLC-4W and activities conducted at the harbor were addressed in the Programmatic Biological Opinion (PBO) under routine operations and maintenance activities at VSFB (USFWS 2015).

On 21 March 2023, the USFWS issued a BO (2022-0013990-S7-001; USFWS 2023) to the DAF for an increase in the SpaceX Falcon 9 launch cadence from 12 to 36 launches per year at SLC-4 on VSFB. The USFWS concurred that these activities may affect, but were not likely to adversely affect MAMU, SSO, California condor, unarmored threespine stickleback (UTS; *Gasterosteus aculeatus williamsoni*), and tidewater goby (TWG; *Eucyclogobius newberryi*) and may affect, and would likely adversely affect CRLF, LETE, and SNPL.

On 28 August 2024, the USFWS issued a BO (2022-0013990-S7-001-R001; USFWS 2024a) to the DAF to conduct up to 16 Falcon 9 launches from SLC-4 between 1 October and 31 December 2024 on VSFB. The USFWS concurred that the addition of 16 launches between 1 October 2024 and 31 December 2024, may affect, but was not likely to adversely affect the UTS, TWG, California tiger salamander (CTS; *Ambystoma californiense*), arroyo toad (ARTO; *Anaxyrus californicus*), MAMU, California gnatcatcher (CAGN; *Polioptila californica californica*), California condor, coastal light-footed Ridgeway's rail (RIRA; *Rallus obsoletus levipes*), and SSO, and Critical Habitat for these species, where designated. The USFWS also concurred that the Proposed Action would likely adversely affect the CRLF, SNPL, LETE, and the proposed threatened southwestern pond turtle (*Actinemys pallida*, 88 Federal Register [FR] 68370-68399). This consultation also included informal conference on the proposed western spadefoot (*Spea hammondii*), which is under review for potential listing under the ESA. The USFWS concurred that the Proposed Action may affect but is not likely to adversely affect the western spadefoot toad on the basis of insignificant effects (USFWS 2024a). In an email communication dated 17 December 2024, in response to a DAF request, the USFWS extended the 2024 BO (USFWS 2024a) to include 16 additional Falcon 9 launches from SLC-4 between 1 January and 28 February 2025 (USFWS 2024b).

1.1.2 SLC-6 Consultation History

The USFWS issued DAF a BO for the Evolved Expendable Launch Vehicle (EELV) Program, which included the Delta IV program at SLC-6 on 9 August 2001 (1-8-99-F-27; USFWS 2001) which analyzed the impacts from the EELV launch vehicle and associated harbor dredging on the UTS, TWG, brown pelican (*Pelecanus occidentalis*; since delisted), CRLF, SNPL, and SSO. BO 1-8-99-F-27 remains the active BO for SLC-6 activities.

On 2 June 2006, the USFWS provided DAF with another BO for landscape maintenance activities associated with the EELV program (1-8-06-F-18; USFWS 2006a) that analyzed the effects on Gaviota tarplant (GTP; *Deinandra increscens* ssp. *villosa*). Subsequently, a genetic study was conducted in 2006 to clarify taxonomic status of GTP. Based on this study, GTP was limited geographically to the type locality in Gaviota, California (Point Conception, Sudden Peak (outside of the VSFB boundary), and Lion's Head on north VSFB (Baldwin 2009). Therefore, the tarplant originally identified as GTP at SLC-6 was determined not to be GTP based on this study and subsequent morphological analysis.

On 2 November 2006, the USFWS issued DAF another BO for the EELV program and associated landscape maintenance activities (1-8-07-F-1R; USFWS 2006b) that analyzed the effects from the proposed project on the El Segundo blue butterfly (ESBB; *Euphilotes battoides allyni*). However, results of a study published in 2020 indicated the ESBB occurring in Los Angeles County are genetically distinct from the *Euphilotes* species found in northern Santa Barbara County and the *Euphilotes* on VSFB and adjacent areas are not the federally endangered ESBB (Dupuis et al. 2020).

1.1.3 Purpose of Current Consultation

The purpose of this BA is to review the potential effects of an increase in the SpaceX Falcon 9 launch cadence from 36 launches per year (approved under BO 2022-0013990-S7-001) and an additional 16 launches approved between October and December 2024 (approved under BO 2022-0013990-S7-001-R001) to 100 launches per year at VSFB and modifying SLC-6 to support the Falcon 9 and Falcon Heavy launches and landings on the federally listed TWG, UTS, CTS, CRLF, ARTO, MAMU, southwestern willow flycatcher (SWFL; *Empidonax traillii extimus*), least Bell's vireo (LBVI; *Vireo bellii pusillus*), SNPL, LETE, California condor, CAGN, RIRA, short-tailed albatross

(*Phoebastria* (=*Diomedea*) *albatrus*), Hawaiian petrel (*Pterodroma sandwichensis*), SSO, and Critical Habitat for these species, where designated. Following each launch, SpaceX would perform a landing of the first stage(s), either downrange on a droneship or at landing zones at VSFB. The proposed annual numbers and locations of launches and landings of each vehicle are discussed in detail in Section 2.2.5 (Launch and Landing Operations).

1.2 Other Species Considered

Three additional ESA-listed species were considered during the analysis of this project for inclusion in this BA, but it was determined that Lompoc yerba santa, beach layia, and GTP don't occur within the Action Area. Lompoc yerba santa (*Eriodictyon capitatum*) and beach layia (*Layia carnosa*) occur in the region; however, the habitat where ground disturbing activities would occur is not suitable for beach layia, and Lompoc yerba santa was not found during biological surveys of the Action Areas during October and November 2023. Physical impacts will not extend into areas occupied by these species. In addition, SpaceX will not use solid rocket fuel, so there is no potential deposition of acidic compounds on the landscape. Therefore, consideration of these species is not included in this BA. Although suitable habitat for GTP exists in the Action Area, where physical impacts would occur, the area was surveyed by a qualified biologist and only the common unlisted grassland tarplant (*Deinandra increscens* ssp. *increscens*) was present. The area was surveyed outside of the peak blooming period, but plants were still extant and identifiable. Based on plant morphology and the characteristics of the flowers still present, none of the tarplant stands matched the accepted phenotype of Gaviota tarplant. Therefore, consideration of these three species is not included in this BA.

The non-listed monarch butterfly (*Danaus plexippus*) overwinters on VSFB and has been proposed for listing as threatened (89 FR 100662-100716). Although there are no requirements in the ESA to consult or confer on actions due to their effects on candidate species, the Department of Defense (DOD) proactively initiated formal conference with the USFWS under Section 7(a)(4) of the ESA pursuant to the DOD's 7(a)(1) Conservation Strategy for the Monarch Butterfly for Mission and Mission Sustainment Operations within the Continental United States. The Proposed Action included a Conservation Strategy and routine mission and mission sustainment activities that may affect monarch habitat and/or individuals. The Conservation Strategy was developed in collaboration with the USFWS to ensure the program will serve the purposes of advancing monarch conservation and continuing to fulfill DOD's responsibilities under 7(a)(1). The USFWS issued a Conference Opinion (CO) on 10 December 2024, which determined that the DOD's proposed launch, reentry, and infrastructure improvement activities are not likely to jeopardize the continued existence of the monarch butterfly (USFWS 2024c). Therefore, monarch butterfly is not considered further in this BA.

2 Project Description

2.1 Project Location

VSFB occupies approximately 99,100 acres (ac) of central Santa Barbara County, California, and is approximately halfway between San Diego and San Francisco (Figure 2.1-1). VSFB occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species. The Santa Ynez River and State Highway 246 divide VSFB into two distinct parts: North Base and South Base. SLC-4 is located on South Base, approximately 4.0 miles (mi) south of the Santa Ynez River and 0.9 mi east of the Pacific Ocean. SLC-4E is the existing launch facility for the Falcon 9 program and SLC-4W is the existing landing facility for the Falcon 9 program. SLC-6 is 3.6 mi south of SLC-4, approximately 1.0 mi east of the Pacific Ocean (Figure 2.1-1).

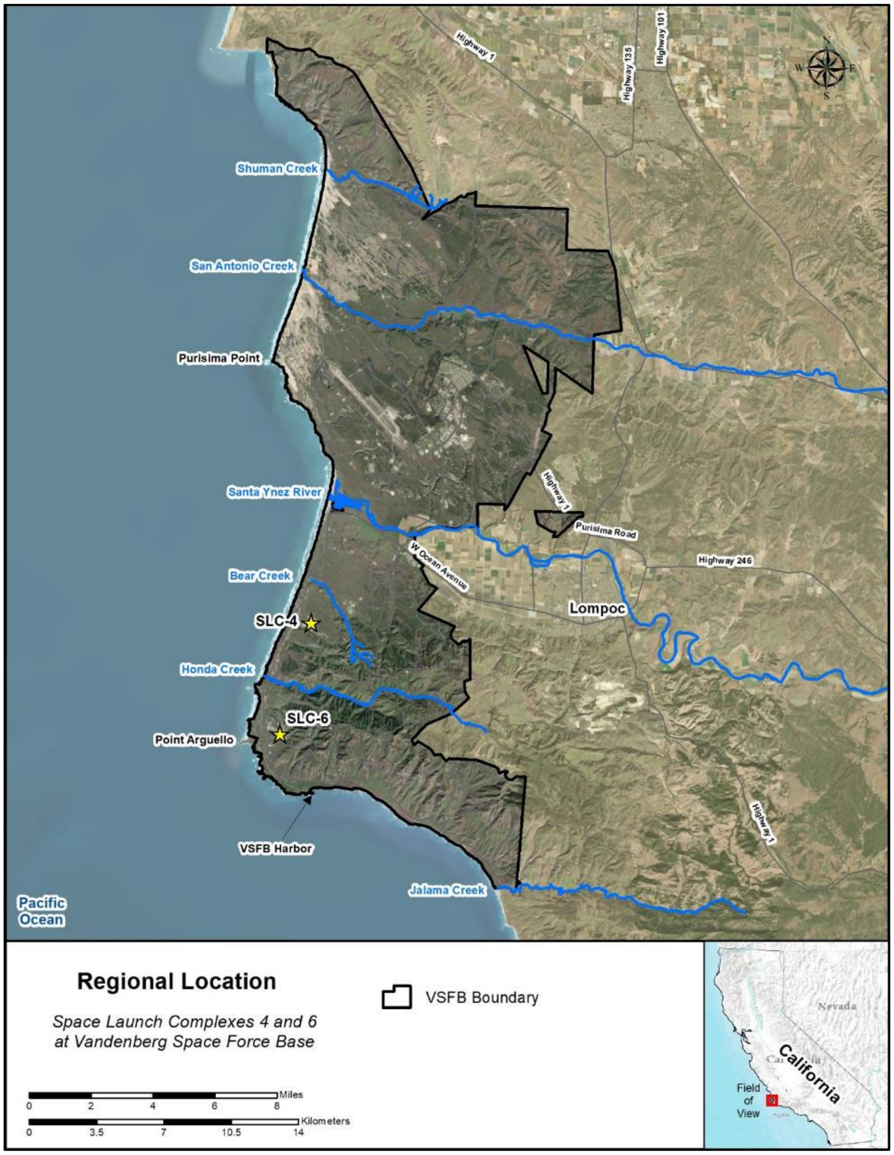

Figure 2.1-1. Regional location of SLC-4 and SLC-6.

2.2 Proposed Action

The Proposed Action is to increase the annual Falcon 9 launch cadence at VSFB and modify SLC-6 to support the Falcon launch vehicles. Under the Proposed Action, SpaceX would launch Falcon 9 and Falcon Heavy vehicles from VSFB up to 100 times per year from SLC-6 and SLC-4 combined. Following each launch, SpaceX would perform a boost-back and landing of the first stage and side boosters (side boosters would only land for Falcon Heavy missions) up to 100 times, either downrange on a droneship or at landing zones at SLC-4 and SLC-6. As approved in prior environmental documents, no more than 12 first stage landings would occur at SLC-4 per year. SpaceX proposes to construct landing zones adjacent to SLC-6 to support up to 17 landing operations per year from SLC-6, as described below.

2.2.1 Launch Vehicle

A detailed description of Falcon 9 can be found in the prior 2017, 2023, and 2024 BOs (USFWS 2017a, 2023, 2024a). There are no significant changes to the Falcon 9 compared to the iteration of the vehicle analyzed in prior BOs. Falcon Heavy is a heavy-lift vehicle with the ability to lift approximately 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core of the Falcon Heavy is equivalent to a single Falcon 9 rocket and the two side boosters are essentially the same design as a Falcon 9 first stage booster; thus, Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9. A comparison of Falcon 9 and Falcon Heavy is shown in Figure 2.2-1.

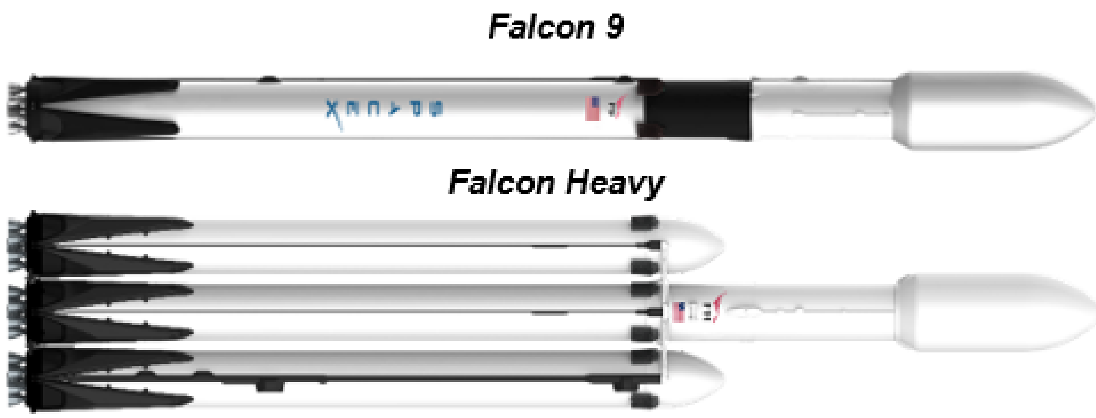

Figure 2.2-1. Falcon 9 and Falcon Heavy launch vehicles.

2.2.2 SLC-6 Modifications

2.2.3 Construction and Demolition Activities at SLC-6

SpaceX would modify SLC-6 to support Falcon 9 and Falcon Heavy launches. Construction is expected to take approximately 18 months and would start in late 2025, depending on acquisition of the lease by SpaceX. However, construction could occur more quickly than this timeline. Initial demolition of large structures that cannot support Falcon vehicles would occur concurrently with construction of Falcon-specific infrastructure. The major construction activities would occur during approximately the first 12 months of construction. The remaining construction time would primarily involve construction and activation of infrastructure such as fluid systems.

Proposed infrastructure includes commodity storage tanks, a vehicle erector, water tower(s), ground supporting equipment, and a rail system from the hangar to the launch pad (Figure 2.2-2). Where practicable, existing infrastructure would be modified. This could include modifications to the liquid oxygen storage, launch pad apron, access road between the launch pad and a new hangar, and fence line. The existing flame trench would be retained and converted to a unidirectional water-cooled flame diverter, and a deluge/acoustic suppression system would be installed. A water reclamation system may be used that could pump residual deluge water back into the water storage tanks. Work would generally occur in previously disturbed areas and on existing impervious surfaces, but some earthwork is anticipated. Construction may occur at any time of the day or night.

A hangar would be required for vehicle processing. The DAF would authorize SpaceX to construct a new approximately 62,000 square foot (ft^2) hangar north of the launch pad to support Falcon 9 and Falcon Heavy integration and processing (Figure 2.2-2). Areas around the hangar would be filled and graded to provide rear access to the hangar. Approximately 40,000 cubic yards of fill would be required and would be sourced locally. Approximately 244,000 ft^2 of additional impervious area would be added to construct this hangar. Existing stormwater infrastructure is expected to be adequate to support this additional impervious area but would be confirmed during final design of the site. SpaceX would modify the existing access road by widening the road and adding a rail system between the launch pad and the existing Horizontal Integration Facility (HIF) for transport of the Falcon vehicle between a new hangar to the launch pad (Figure 2.2-2). The SLC-6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

Four existing structures would be demolished (mobile service tower, mobile assembly shelter, fixed umbilical tower, and launch crown; Figure 2.2-2). Mechanical shears would be used to cut the building sections into manageable sizes. Cranes would be utilized in order to assist with any heavy lifts of the structure. An excavator with a thumb attachment would be used to move the manageable pieces to a dump truck that would haul out the material. The excavators and backhoes to be used would be track mounted. Any staging or temporary storage of materials would occur in the areas of disturbance shown on the figure. Demolition work would occur during daylight hours. The duration of demolition activities may last up to 6 months.

Table 2.2-1 summarizes potential noise levels from typical construction equipment used in demolition and how far that sound typically propagates. Daily sound levels would vary depending on the type of activity occurring that day and equipment used, but generally sound would remain within the vicinity of SLC-6.

Table 2.2-1. Estimated received sound levels of standard construction equipment at various distances used during demolition activities.

Estimated Received Noise Levels (unweighted dB^)	Distance from Source (ft)			
	Shears*	**Jackhammer***	**Crane***	**Welder/Torch***
120	3.2	1.5	--	--
110	10	4.5	1.8	--
100	32	14	5.6	2.5
90	100	45	18	7.9
80	320	140	56	25

* Source: Washington State Department of Transportation 2012

^ dB = decibels

Explosives would be used in one instance to remove one structure, during which four approximately 50-pound explosive charges would be detonated simultaneously. This will cause a short impulsive sound, similar to those experienced during first stage landing events at SLC-4, but over a much smaller area. A linear propagation model (International Ammunition Technical Guidelines 2021) was used to estimate the resultant noise levels and affected areas. The distance at which the impulsive noise caused by the explosion would attenuate to 140 dB L_{max} (4.17 psf) is estimated to be approximately 0.57 mi from SLC-6, 130 dB L_{max} (1.32 psf) at approximately 1.19 mi, and 120 dB L_{max} (0.42 psf) at approximately 3.79 mi (Figure 2.2-3).

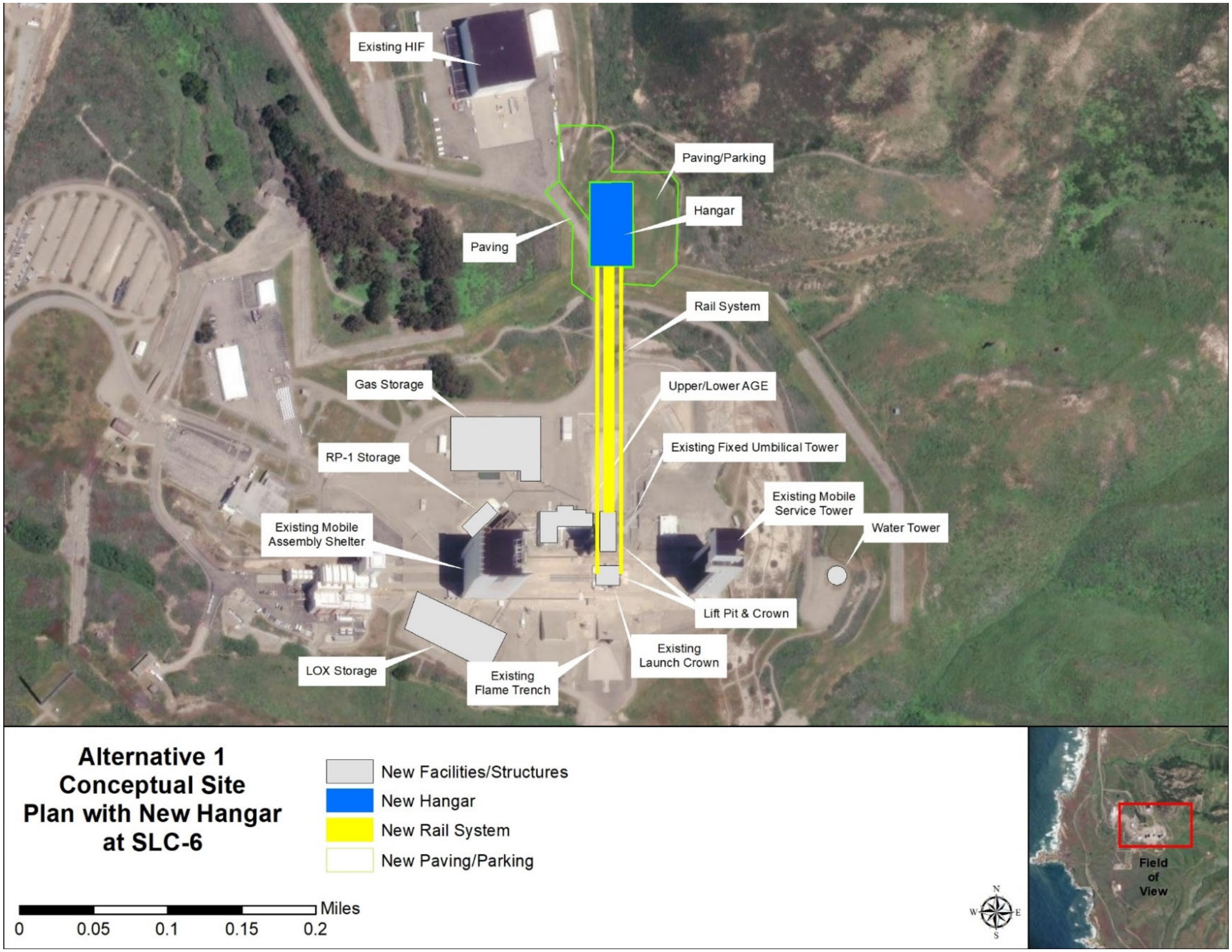

Figure 2.2-2. SLC-6 conceptual site plan; AGE = aerospace ground equipment, LOX = liquid oxygen, RP-1 = rocket propellant-1

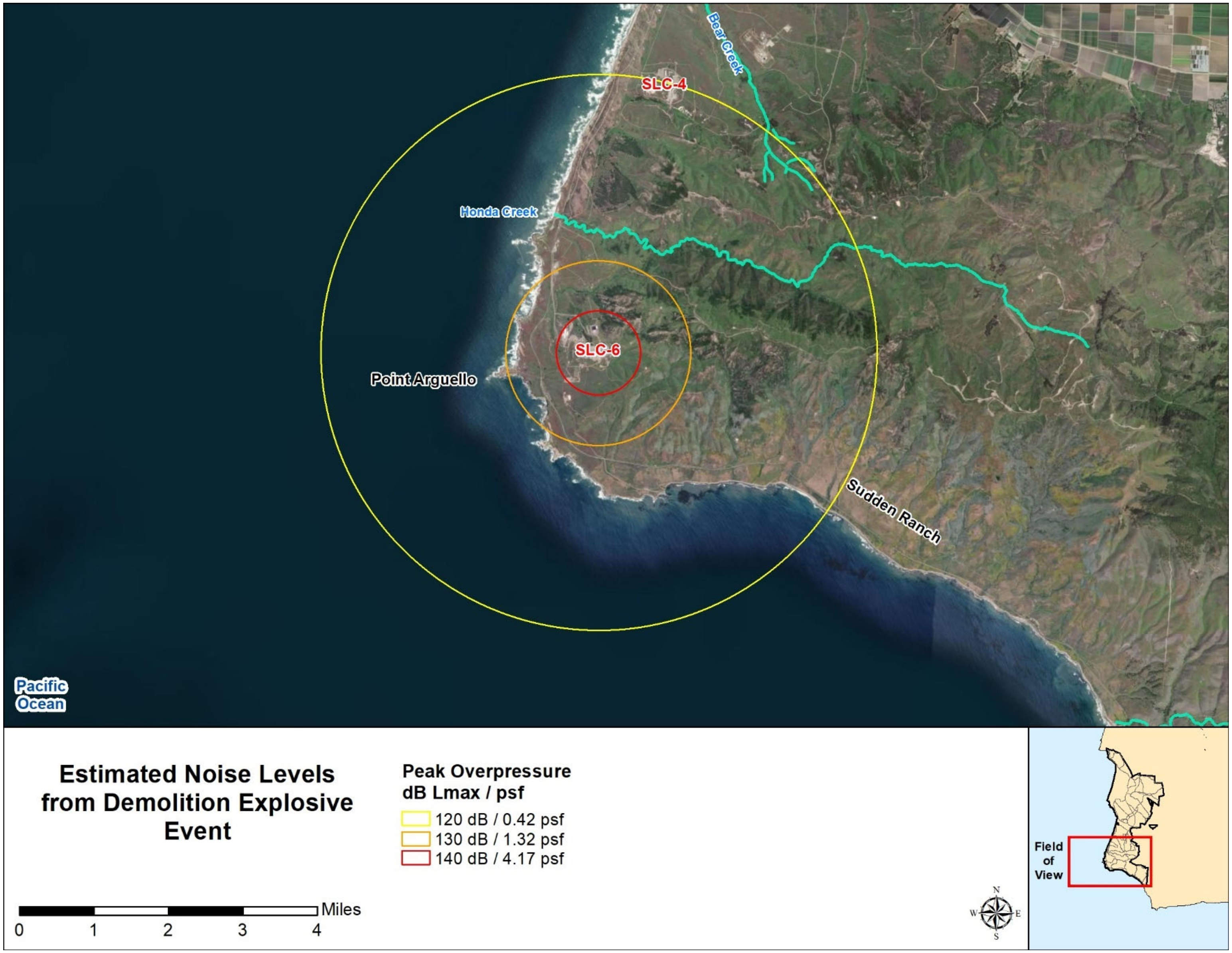

Figure 2.2-3. Estimated impulsive noise levels from explosives used during demolition.

2.2.4 Construction of SLC-6 Landing Zones & Firebreaks

SpaceX would construct two landing zones south of SLC-6 to support landing of first stage Falcon boosters launching from SLC-6. Each landing zone would be made up of a 280-ft diameter concrete pad surrounded by a 60-ft gravel apron, for a total diameter of 400 ft. SpaceX would construct a new nitrogen gas line from SLC-6 to a fluids bay at the landing zones. The fluids bay is used to send nitrogen to different systems of the booster after landing. A 30-ft by 30-ft pedestal, which is approximately 15-ft tall, would be constructed at each landing pad. The first stage booster is lifted onto the pedestal during post-flight processing to remove the landing legs prior to transport. Crane storage, a cleared area to lay down cranes when not in operation, is proposed on the western site boundary. Each landing zone would have a connection to the existing road to support booster transport. Approximately 16 acres would be cleared to construct the landing zones and approximately 7 acres would be impervious upon completion of construction. A conceptual layout of the landing zones is shown in Figure 2.2-4. Any fill would be purchased from local existing off base suppliers, and/or if using any sources on-base, the fill would be obtained from preexisting, established borrow pits, which are covered under an existing BO (8-8-10-F-5) and related regulatory permitting. Proposed landing zones at SLC-6 would take approximately 2 to 4 months to construct, including the length of time for the concrete to cure.

A new firebreak is proposed south of the landing zones. Cypress Ridge Road and N Road would also be improved to ensure suitable access for fire defense. These improvements are anticipated to be within the existing roadway footprints. The proposed firebreak is approximately 50 ft wide, shown in Figure 2.2-5 and would connect to the existing firebreak for SLC-8. Cypress Ridge Road, an existing fire access road, would be improved within its existing footprint to protect against potential erosion. Vegetation maintenance would occur within the vegetation maintenance area depicted in Figure 2.2-4 and Figure 2.2-5.

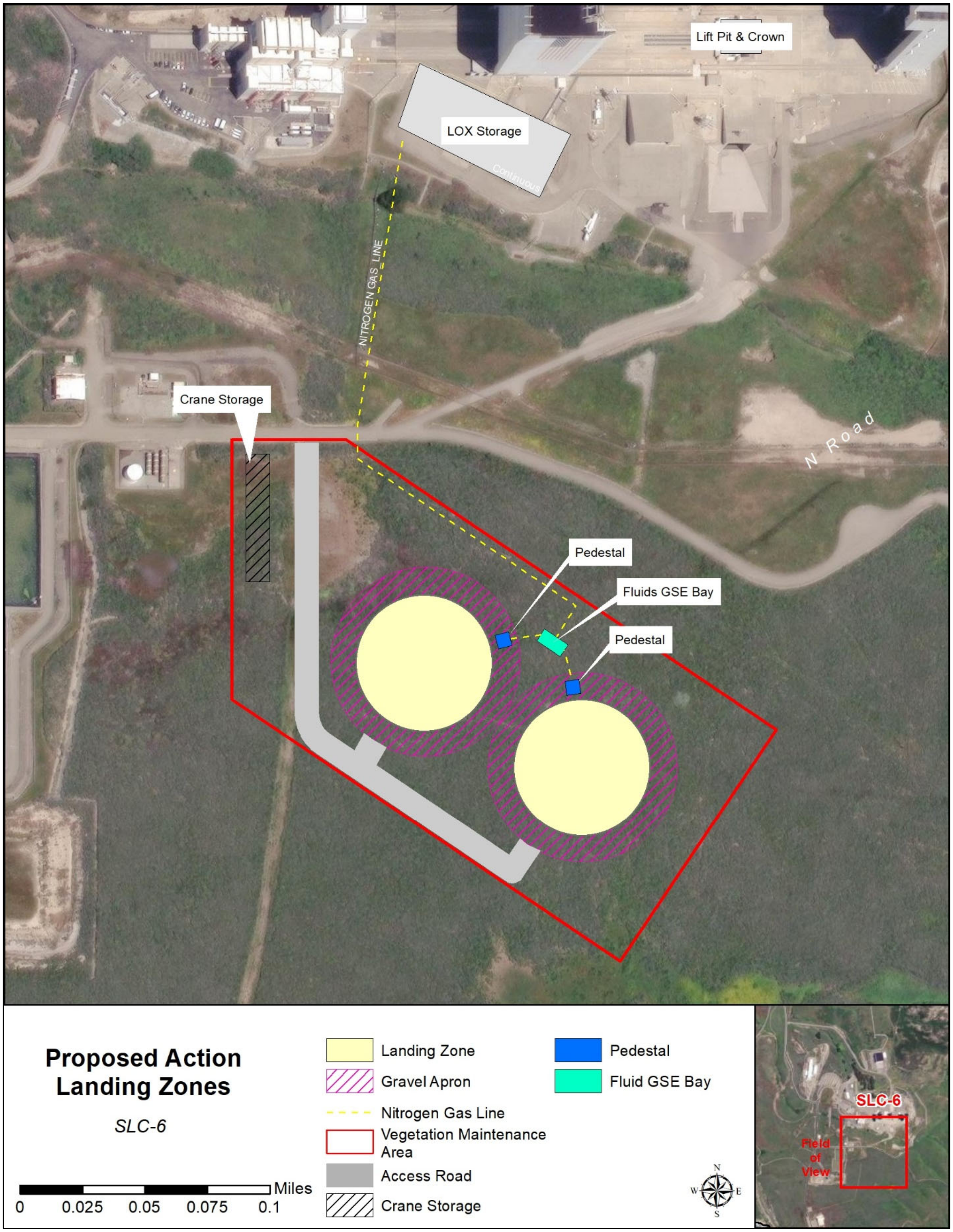

Figure 2.2-4. Conceptual site layout for construction of new landing zones.

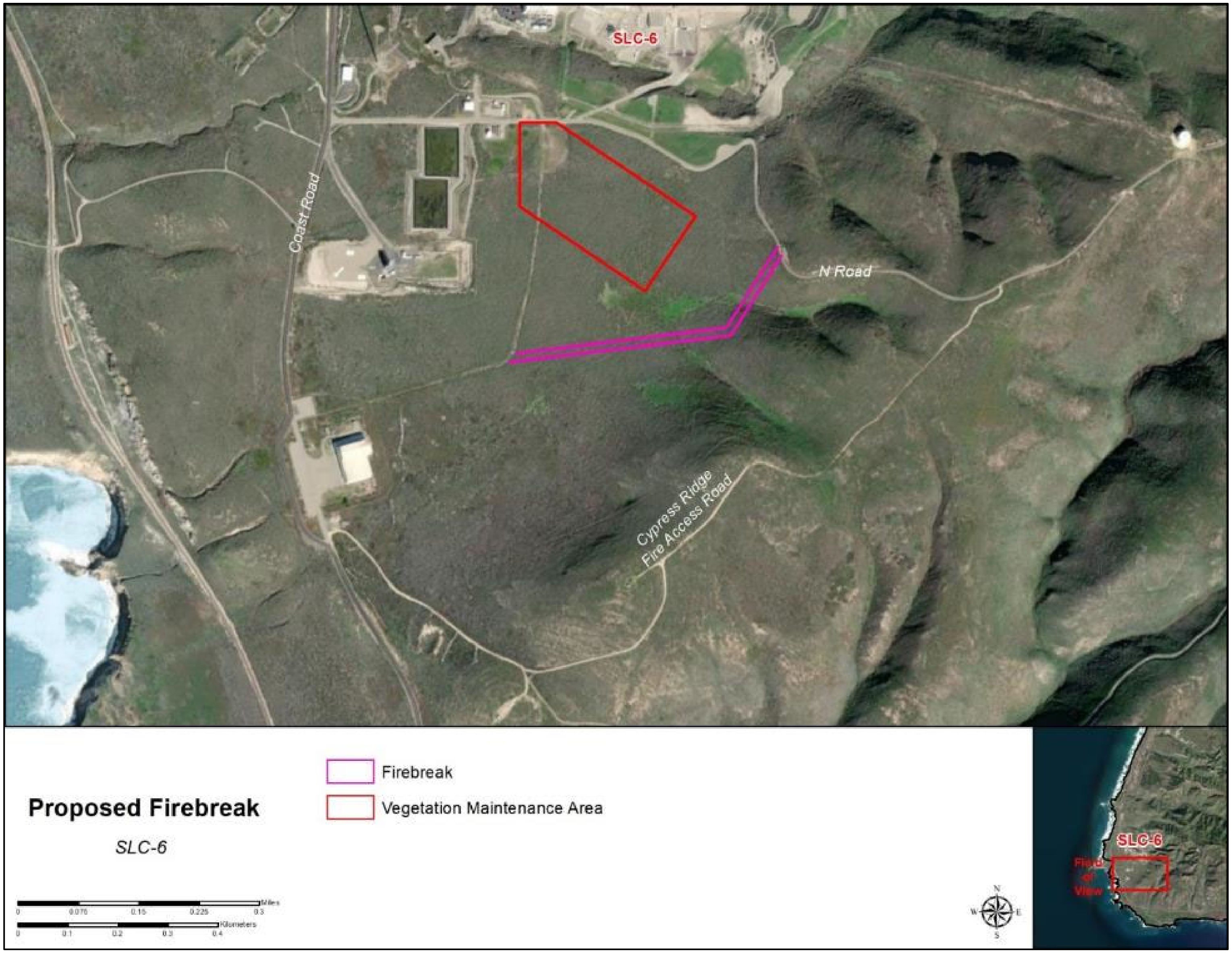

Figure 2.2-5. Proposed Firebreak.

2.2.5 Launch and Landing Operations

One to three days before each launch, a static fire test, which lasts a few seconds, may be conducted. The need to conduct a static fire test depends on the mission, but there would be no more than 50 static fire events per year (up to 30 at SLC-4 and 20 at SLC-6). Due to weather conditions, orbital mechanics (i.e. destination orbit, inclination, eccentricity, and altitude), airspace considerations, and range availability, launch operations could occur at any time of day or night and at any time during the year.

DAF proposes to authorize an increase in SpaceX's Falcon launch cadence at VSFB to 100 launches per year. SpaceX has continued to improve its turn-around time between launches, which has provided more opportunity for launches at SLC-4. The introduction of SLC-6 provides additional capacity for Falcon launches, including Falcon Heavy. SpaceX would launch Falcon Heavy up to 5 times per year at SLC-6. Launches of Falcon 9 would be spread between SLC-4 and SLC-6. At full cadence launches would typically occur one to four days apart. However, launches could occur from both launch complexes on the same day, though this is expected to be infrequent. An estimated launch schedule is included in Table 2.2-2, which is based on SpaceX's anticipated manifest over the next five years.

Table 2.2-2. Past and estimated future Falcon launch frequency.

Year	SLC-4	SLC-6		Total
	Falcon 9	Falcon 9	Falcon Heavy	
2019	2	-	-	2
2020	1	-	-	1
2021	3	-	-	3
2022	13	-	-	13
2023	28	-	-	28
2024	46	-	-	46
2025	70	-	-	70
2026	70	11	1	82
2027	70	25	5	100
2028	70	25	5	100
2029	70	25	5	100
2030	70	25	5	100

Trajectories from SLC-4 would remain within the previously analyzed azimuth range of 140 to 325 degrees. Trajectories from SLC-6 would also fall within this range. Although trajectories from both SLCs would vary between 140 and 325, depending on mission-specific requirements, up to 100 missions per year could fly an easterly trajectory with a launch azimuth between 140 and 155 degrees. For missions launching from SLC-4, SpaceX would land the first stage, either downrange on a droneship in the Recovery Area (Figure 2.2-6) or at the existing landing zone at SLC-4 or at the proposed landing zones at SLC-6 (Figure 2.2-4). SpaceX would continue to land up to 12 first stages at SLC-4 each year. In addition, up to 12 missions each year would utilize the proposed landing zones at SLC-6, including 10 boosters landing simultaneously during a maximum of 5 Falcon Heavy missions per year, which would land the two side boosters at the same time at SLC-

6. The Falcon Heavy center core first stage booster is typically expended each launch but may land on an offshore droneship. Estimated first stage booster landings are included in Table 2.2-3. Including potential Falcon 9 expendable missions, up to 10 launches per year may include expendable first stages that would be deposited anywhere within the recovery area depicted in Figure 2.2-6

Table 2.2-3. Launches with First Stages/Boosters to VSFB.

Year	SLC-4	SLC-6	Total
2025	12	2	14
2026	12	12	24
2027	12	12	24
2028	12	12	24
2029	12	12	24
2030	12	12	24

When first stages and fairings land in the downrange recovery area (Figure 2.2-6), the droneship would continue to transport first stage boosters and fairings from the Port of Long Beach to the VSFB harbor via a "roll-on-roll-off" (RORO) barge, as described in the 2023 BO (USFWS 2023), or over roads if ocean conditions are too rough to support barge operations. The Proposed Action would include up to 100 events per year utilizing RORO operations.

SpaceX would utilize approximately 70,000 gallons of water per launch at SLC-4, as described in the 2023 BO (USFWS 2023). Falcon Heavy would use up to approximately 1.5 million gallons of water per launch and Falcon 9 would use up to approximately 200,000 gallons per launch at SLC-6. More water is required at SLC-6 because the existing flame bucket is substantially larger than at SLC-4, thus requiring more water to achieve the same operational objectives in reducing vibration below the vehicle. In addition, a maximum of 1.37 million gallons (4.20 ac-ft) per year would be required to support the personnel and operational activities at SLC 4, a maximum of 1.19 million gallons (3.64 ac-ft) per year to support personnel at Buildings 398 and 520, and 1.10 million gallons (3.36 ac-ft) per year would be required to support the personnel and operational activities at SLC-6. Therefore, at maximum cadence, the Proposed Action would use up to 21.1 million gallons (65.6 ac-ft) of water per year. VSFB primarily relies on State Water, which is sourced from precipitation and groundwater, primarily from snowmelt in the Sierra Nevada mountains. However, during annual maintenance that lasts two to three weeks, VSFB utilizes four water wells in the San Antonio Creek Basin.

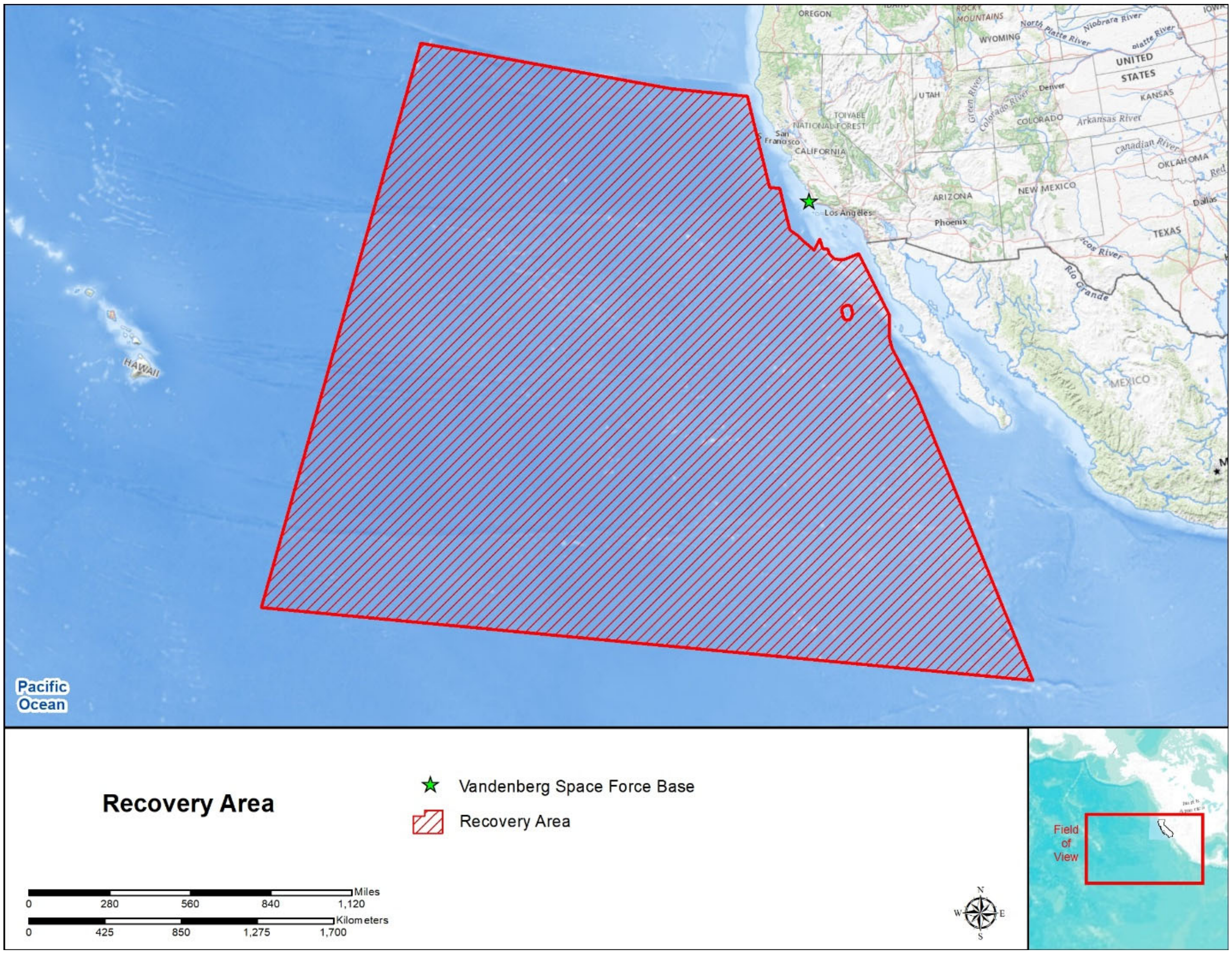

Figure 2.2-6. Recovery area.

2.2.6 Launch and Landing Noise

Rockets create two different types of noises during ascent and descent: 1) noise generated from the rocket engines (rocket engine noise) during launch and landing; and 2) sonic boom noise caused by the overpressure (i.e., shock wave) that is generated as the vehicle reaches supersonic speeds during its ascent and descent. The potential levels and impact locations of these different types of noises must be modeled by different methods because the physics and mathematical calculations in predicting their attributes are also very different. Sonic boom levels are typically presented in psf values; however, they can be directly translated into dB as well. To aid reviewers in assessing and understanding potential effects of sonic booms, Table 2.2-4 provides various sonic boom levels described in this document and their corresponding dB values.

Table 2.2-4. Pounds per square foot to peak dB (unweighted) conversion chart.

PSF	Peak dB (L_{max})
1	127.58
2	133.60
3	137.12
4	143.15
5	141.56
6	143.15
7	144.48
8	145.64
9	146.67
10	147.58
11	148.41
12	149.17
13	149.86

Falcon rocket engine noise was modeled using a software package called RNoise (KBR 2024). This sophisticated model incorporates numerous components, including the acoustic power of the rocket engine source, forward flight effects, the angle from the source to the receiver (directivity), Doppler effect, propagation between the source and receiver (ray path), atmospheric absorption, and ground interference to estimate received noise levels. RNoise assumes the surface of the earth is flat and therefore does not account for attenuation due to landforms. Therefore, the estimates of engine noise levels below are conservative for areas shielded by hills, bluffs, or other features, such as buildings or dense vegetation.

Figures depicting launch and landing noise modeling results are included in Chapter 4 under relevant species accounts (see Figure 4.3-1 through Figure 4.16-5). During Falcon 9 launches from SLC-4 and SLC-6, engine noise produced during launches would be audible across VSFB and the surrounding areas. Engine noise during Falcon 9 first stage landings at SLC-4 and SLC-6 would impact a smaller area, between Purisima Point and Point Conception along the coast and inland to Lompoc. During the 5 annual projected Falcon Heavy launches from SLC-6, a larger area would receive engine noise since there are 3 first stages on the launch vehicle. Noise during Falcon Heavy launches would reach the Santa Maria Valley and the Gaviota Coast. When landing at SLC-4 or SLC-6, landing engine noise follows the associated launch engine noise by approximately 5 to 7 minutes and typically occurs slightly before or simultaneous with the sonic boom that impacts land. Static fire engine tests at SLC-4 and SLC-6, which typically occur 1 to 3 days prior to launch and last up to 7 seconds per event, would also generate engine noise across VSFB and off base areas, including the Santa Rita Hills and Gaviota Coast.

Falcon Heavy sonic boom impacts were modeled using PCBoom software (KBR 2024). During ascent, a sonic boom (overpressure of impulsive sound) typically with a peak of approximately 3.0 to 5.0 psf, but up to approximately 8.0 psf, would be generated. Depending on the launch trajectory, the sonic boom may or may not impact the surface of the earth. Since 2017, approximately 10 percent of the ascent sonic booms generated during Falcon 9 launches from

SLC-4 did not impact the surface of the earth because the ascent of the rocket was too steep. When ascent sonic booms do impact the earth's surface, they primarily impact the Pacific Ocean, but often overlap the Northern Channel Islands (NCI; see example shown in Figure 4.9-8). From 2017 through 20 October 2024, of the launches that produced ascent sonic booms that impacted the surface of the earth, approximately 67% have impacted the NCI. As discussed in the 2023 Section 7 consultation (USFWS 2023), modeling determined that sonic booms generated during ascent for missions with northerly mission profiles (launch azimuth between 305 and 325 degrees) will only impact the ocean's surface with no impacts to land.

For easterly trajectories (launch azimuth between 140 and approximately 150 degrees), ascent sonic booms may impact eastern Santa Barbara County, Ventura County, and Los Angeles County on the mainland (Figure 2.2-7). The vast majority of the ascent sonic booms that would overlap these areas are predicted to be less than 1.0 psf. The highest level predicted to potentially impact each species' populations varies for each of the species considered in this BA and is presented in Section 5.1. Even with identical trajectories, atmospheric conditions create considerable variation in where ascent sonic booms impact and the level at which they impact. To account for this variation, PCBoom can utilize meteorological parameters in the model that affect where and at what level a sonic boom may impact the surface of the Earth. In the late 1990's, SRS Technologies, Inc. assembled a series of daily meteorological profiles across 10 years (1984-1994, one per day for 10 years) from radiosonde data for weather balloons released by the VSFB weather squadron. These data include pressure, temperature, wind speed, and wind direction along an elevational profile from ground, every 1,000 ft, to 110,000 ft. Figure 2.2-7 depicts the overlaid output from PCBoom for 8 representative SpaceX easterly trajectories using this meteorological data. Each trajectory was run between 29 and 40 times, with each run representing 1 of between 29 and 40 randomly selected meteorological profiles that capture potential weather conditions throughout the year (308 model outputs total). Only 13% of model runs resulted in sonic booms that overlapped eastern Santa Barbara County, 85% of model runs resulted in sonic booms that overlapped Ventura County and 58% of model runs resulted in sonic booms that overlapped western Los Angeles County (Figure 2.2-7). Of the sonic booms model results that overlapped each county, the proportion of the ranges of predicted boom levels across each area is shown in Table 2.2-5.

Table 2.2-5. Proportion of sonic boom ranges in level (psf) overlapping eastern Santa Barbara, Ventura, and Los Angeles Counties as depicted in Figure 2.2-7.

County	Percentage of Sonic Boom Levels Overlapping			
	0-1 psf	**1-2 psf**	**2-3 psf**	**3+ psf**
Santa Barbara	12.0%	7.8%	1.3%	0.3% (3.7 psf)
Ventura	84.7%	19.5%	2.9% (2.3 psf)	0%
Los Angeles	100% (0.8 psf)	0%	0%	0%

During first stage landings at SLC-4, PCBoom modeling has predicted that landing (i.e., descent) sonic booms may reach up to approximately 7 psf in the area around SLC-4 (see Figure 4.3-2 for an example from the Bandwagon-2 mission in December 2024, but also Appendix A for potential variability). However, during the Transporter 10 mission, a 9.86 psf sonic boom was measured at Honda Creek, 2.1 mi south of SLC-4 (Appendix B). The 1 psf contour may extend as much as approximately 27 mi north of SLC-4 and up to approximately 38 mi to the east (see Appendix A for examples).

Falcon 9 first stage landings at SLC-6 would have similar extents and levels as landings at SLC-4, although shifted to the south. For Falcon Heavy missions at SLC-6, two boosters would land nearly simultaneously at SLC-6. Modeling predicted that the boosters would produce sonic booms up to 13 psf in the immediate area surrounding SLC-6 and the 1 psf contour would extend approximately 17 mi north and 40 mi to the east of SLC-4 (Figure 4.3-5). Focal booms (relatively small areas where high sonic boom levels may occur) are predicted to reach up to an estimated 5 psf approximately 40 mi to the east (Figure 4.3-5).

Although unlikely, sonic booms up to 3.1 psf may also impact the NCI during landing events at SLC-4, SLC-6, or on droneships in offshore areas near VSFB, depending on the landing trajectory and weather conditions. However, during the majority of downrange droneship landings in the proposed landing areas, sonic booms would be directed entirely at the ocean surface without impacting any land. Landing sonic booms can vary substantially depending on mission requirements and the associated landing trajectories and various examples of sonic booms model results for Falcon 9 landings at SLC-4 are included in Appendix A to depict that variability.

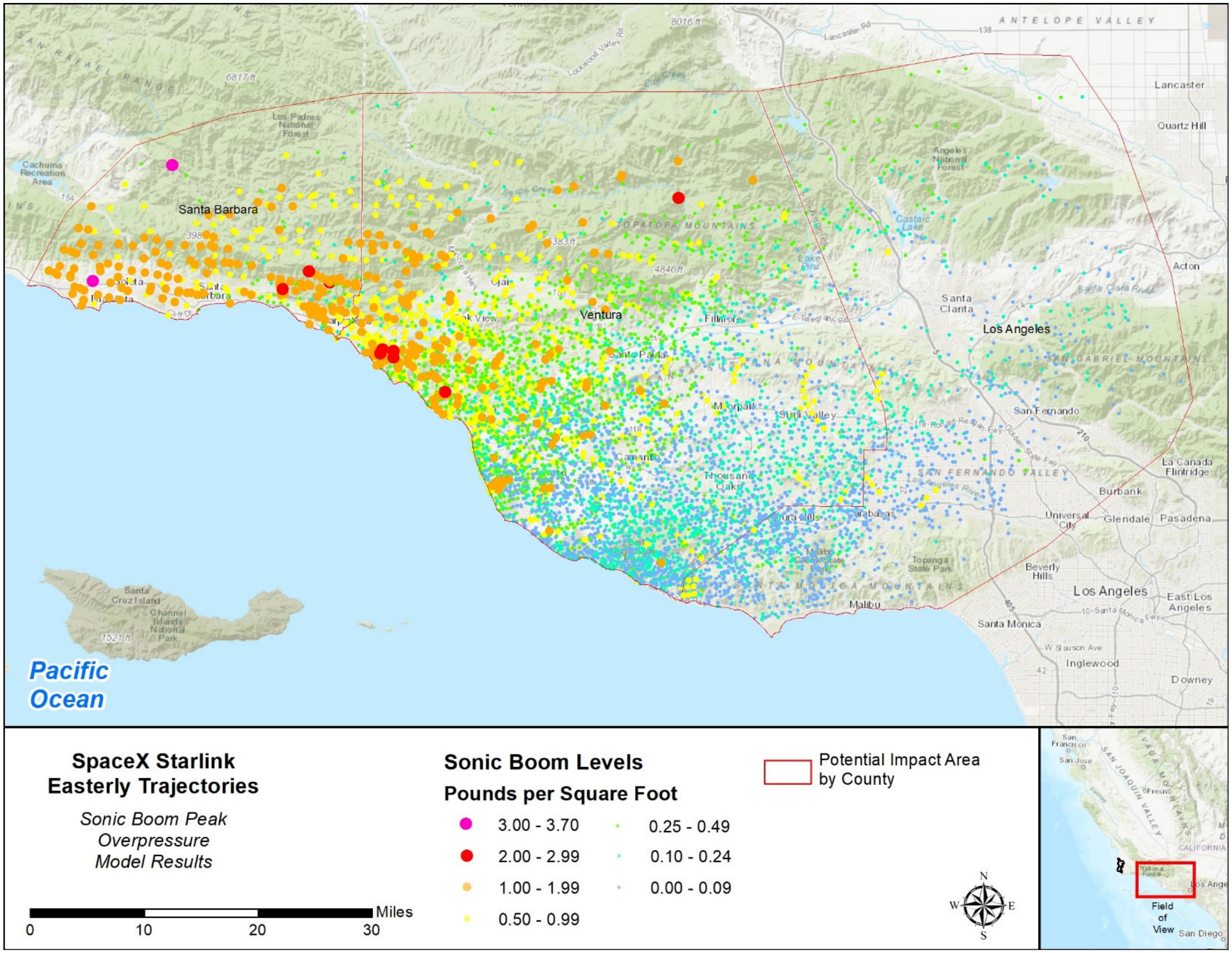

Figure 2.2-7. Potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties. Note: the model output represents 190 model runs (190 potential meteorological profiles) and is cropped to only show those results that overlaid mainland California.

2.3 Conservation Measures

The conservation measures listed below would be implemented to avoid, minimize, and monitor the effects of the Proposed Action on the CRLF, SNPL, LETE, SWFL, LBVI, and SSO. These measures are intended to supersede all measures included in prior SpaceX Falcon launch program BOs. There are no conservation measures proposed for TWG, UTS, or CTS. Without altering trajectories or landing locations which are driven by mission-specific requirements, there are no feasible methods to minimize the intensity of the sonic boom. Applying water deluge during launch reduces engine noise in the vicinity of the launch pad. The estimates of engine noise levels are also conservatively high, since the modeling does not consider attenuation due to landforms.

Conservation Measures included in this BA require various levels of biological competency from personnel completing specific tasks, as defined below:

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

The Action Agency will require 30 CES/CEIEA and USFWS approval of all USFWS Approved Biologists, which will be personnel who are familiar with and possess necessary qualifications to be approved for capture, handle, and release species as stated above. These biologists will be responsible for monitoring, surveying, and other biological field activities. They will also be responsible for relocating species at risk of being directly killed or injured by project related activities (such as CRLF).

2.3.1 General Conservation Measures

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

- A USFWS-approved biologist shall brief all construction personnel prior to participating in construction and demolition activities at SLC-6. At a minimum, the training would include a description of the listed species and sensitive biological resources occurring in the area, the general and specific measures and restrictions to protect these resources during project implementation, applicable provisions of the ESA and the necessity of adhering to those provisions, and the penalties associated with violations of the ESA.

- The Applicant would develop a lighting management plan for SLC-6. The Action Agency would provide a copy of the plan to the USFWS.
- The Applicant will ensure that construction and demolition disturbances be kept to the minimum extent necessary to accomplish project objectives.
- The Applicant will ensure that all human-generated trash at the project site will be disposed of in proper containers and removed from the work site and properly secured in a suitable trash container at the end of each workday, all food waste will be properly contained, and trash will be removed from the work area weekly throughout the course of the proposed project.
- The Applicant will ensure that a Qualified Biologist inspects any construction equipment left overnight prior to the start of work the following day. The Qualified Biologist will check equipment for presence of special-status species in the vicinity and for fluid leaks and immediately let 30 CES/CEIEA know to coordinate subsequent actions prior to the start of work.
- The Action Agency will ensure that the Applicant implements the following measures at SLC-4 and SLC-6: (1) the site-specific Stormwater Pollution Prevention Plan; (2) the Best Management Practices within the latest California Stormwater Quality Association's Stormwater Best Management Practices Handbook; (3) collect any rocket propellant seen floating in the retention basin using absorbent pads prior to discharge to the spray field; and (4) the procedures in VSFB's Hazardous Materials Emergency Response Plan in the event of a hazardous materials spill.

2.3.2 California Red-legged Frog

- Qualified biological monitors, approved by USFWS and 30 CES/CEIEA, including personnel who are familiar with and possess necessary qualifications to be approved for capture, handle, and release of CRLF, shall be present to monitor construction and demolition activities at SLC-6 where deemed necessary by the Action Agency throughout the length of the project to minimize impacts on this species. The biological monitors shall be responsible for delineating areas where special-status species are located or concentrated, relocating special-status species in jeopardy of being killed or injured by construction, and inspecting equipment and equipment staging areas for fluid leaks. Prior to the onset of construction activities, qualification submittals of biologist(s), who would conduct the monitoring, surveying, species relocation, and other biological field activities shall be submitted by 30 CES/CEIEA to the USFWS for approval.
- Prior to construction activities at SLC-6, any CRLF shall be removed by a USFWS-approved biologist from an exclusion area within the project site and relocated, to the nearest suitable habitat location at least 500 ft away to decrease the likelihood of recapture through the process described below. These activities would be accomplished prior to the start of construction and only under the direct supervision of a USFWS-approved biologist.

- Exclusion Area. An exclusion area (or potentially multiple separate exclusion areas) would be established around previously undisturbed areas where construction activities would occur and require vegetation removal, fill placement, and CRLF removal/exclusion to avoid impacts to this species.
    - Under direction of a qualified biologist, the exclusion area would be encircled with minimum 3-ft-high silt fencing, anchored with metal T-posts, and buried along the bottom edge to the best extent possible to prevent terrestrial wildlife, including CRLF, from entering the site.
    - Following completion of the installation of exclusion fencing, USFWS-approved biologists would conduct a pre-project survey of the exclusion area for wildlife and special-status species, including CRLF. All CRLF captured would be transported to the nearest suitable habitat outside of the exclusion area and released by a USFWS-approved biologist. The USFWS-approved biologist will repeat these surveys following any precipitation event greater than 0.2 inch during a 24-hour period.
    - A USFWS-approved biologist will monitor any initial ground disturbance or vegetation removal within suitable aquatic, adjacent upland, or dispersal habitat identified following the adaptive habitat assessment procedures (as described in the PBO, USFWS 2018). However, after the initial ground disturbance/vegetation removal is complete, no further monitoring would be required within these bare-dirt areas.
    - Relocation: If CRLF are found within the project area during pre-project surveys, daily monitoring where required, or at any other time, all construction activity within the vicinity of the CRLF occurrence (if any) will cease. If the project site is large and if the USFWS-approved biologist is satisfied that work in a different area of the project can continue with no threat to CRLF, then that work would continue. Construction activities within the vicinity of the CRLF occurrence will not begin or resume until the CRLF are relocated by a USFWS-approved biologist or the individual has left the construction area of its own volition. The USFWS-approved biologist will relocate all life stages of CRLF the shortest distance possible to a location that is (1) within the same drainage, (2) contains suitable aquatic/upland habitat, and (3) is outside of the project impact area. All animals would be held in 5-gallon buckets until release. All animals held would be segregated by size and species such that predation would be unlikely. The holding time would be minimized to the greatest extent feasible and the health of all held animals would be continuously monitored to evaluate the need for additional measures to protect the animals, such as aeration of water in holding buckets.
    - The exclusion fencing would be removed at the completion of construction activities.
- To avoid transferring disease or pathogens between aquatic habitats during the course of surveys and handling of amphibians, the biologist(s) shall follow decontamination procedures described in the Declining Amphibian Population Task Force’s Code of Practice (USFWS 2002a).

- Any open holes or trenches will be covered with plywood or metal sheets and/or supplied with an escape ramp if left overnight to minimize the risk of entrapment of CRLF or other wildlife.
- Construction activities will not occur in previously undisturbed areas with potential for CRLF occurrence until 24 hours after an actual precipitation event greater than 0.2-inch accumulating within a 24-hour period.
- No overnight staging of equipment or supplies would occur within 0.10 mi of aquatic habitat. Measures would be implemented that prevent CRLF from accessing the staging area (e.g., drift fence barrier installed).
- The Applicant will maintain exhaust ducts and associated v-ditch at SLC-4 and SLC-6 to be free of standing water to the maximum extent possible between launches to help minimize the potential to attract CRLF to SLC-4 and SLC-6.
- The Applicant would continue to remove nonnative, invasive predators captured incidentally during the monitoring efforts described below (e.g., bullfrogs [*Lithobates catesbeianus*]).
- The Applicant will continue to implement long-term monitoring of population and distribution trends associated with CRLF populations within Jalama Creek, Honda Creek, Bear Creek, and the Santa Ynez River, as described below:
    - The Applicant will conduct quarterly night surveys for CRLF and spring tadpole surveys of lower Honda Creek, Bear Creek, the Santa Ynez River, and Jalama Creek to compare baseline CRLF detection rate and occupancy data collected over the past 10 years and assess if there are any changes in CRLF habitat occupancy, breeding behavior (calling), and breeding success (egg mass and tadpole densities). Data analysis will incorporate past and future habitat assessments to account for variables including but not limited to observed variation in extent of wetted habitat, quantified predator removal, and climatic factors. Within-site population trends will be assessed in relation to intensity of launch impacts experienced at each site to evaluate whether proximity to launch sites is related to occupancy, breeding behavior (calling), and breeding success (egg masses and tadpole densities). The Applicant will record and measure the following during the surveys:
        - CRLF detection density following the same survey methods conducted previously at these sites and throughout VSFB (see MSRS 2024a);
        - CRLF locations and breeding evidence (e.g., calling, egg masses);
        - environmental data during surveys (temperature, wind speed, humidity, and dewpoint) to determine if environmental factors are affecting CRLF detection or calling rates;
        - annual habitat assessments to measure flow rates, stream morphology, depths, quantify suitable occupied habitat and sediment to determine if any changes in CRLF metrics are associated with other environmental factors, such as drought; and
        - locations and densities of co-occurring anurans, including bullfrogs and Baja California tree frogs (*Pseudacris hypochondriaca*).

  - The Applicant will continue to perform passive bioacoustics monitoring (Wildlife Acoustics Song-Meter 4 or similar technology) and will establish frog calling behavior baseline within each impacted breeding feature (Jalama Creek, Honda Creek, Bear Creek, and Santa Ynez River) and a control site at Arroyo Quemado for purposes of signal characteristic comparison. CRLF calling behavior baseline will include applicable call characteristics (e.g., changes in signal rate, call frequency, amplitude, call timing, call duration, etc.). The Applicant will ensure that bioacoustic monitoring conducted is designed to best address confounding factors in order to appropriately characterize impacts of launch, static fire, and landing events on calling behavior. The CRLF call characteristics described above will be analyzed from the sites on VSFB and Arroyo Quemado to determine if there are any differences that may be due to launch-related causes. In addition, the results will be analyzed in conjunction with long term population data to ensure that any observed changes in signal characteristics are not resulting in observable declines in population.
  - The Applicant will discontinue monitoring after 5 years from initiation of monitoring, which began with the 2023-2024 breeding season.

2.3.3 Western Snowy Plover

- The Action Agency will continue to implement long-term monitoring of annual population and distribution trends associated with SNPL along Surf Beach.
  - The Applicant will perform acoustic monitoring (rocket engine noise and sonic boom) at South Surf Beach during the first three Falcon Heavy missions to validate noise model predictions.
  - The Applicant will perform geospatial analysis annually to identify declines in the SNPL population, nesting activity, and reproductive success that may result from cumulative effects of multiple Falcon launches and landings from SLC-4 and SLC-6. The Applicant will discontinue this analysis after 5 years from initiation, which began with the 2024 SNPL breeding season.
- The Applicant will use motion triggered video cameras during the breeding season (1 March through 30 September) to determine nest fates and potential impacts to nests during the first three Falcon Heavy launches and landings.
  - The Applicant will monitor active nests at South Surf Beach with motion triggered video cameras during the breeding season at whichever of the following is greater within the modeled 4.0 psf zone to assess potential novel effects that may result from frequent launching: (i) 10% of active SNPL nests, or (ii) 4 active SNPL nests. The Applicant will monitor at whichever of the following is greater within the modeled 3.0 to 4.0 psf zone: (iii) 10% of active SNPL nests, or (iv) 2 active SNPL nests. The Applicant will monitor at whichever of the following is greater within the modeled 2.0 to 3.0 psf zone: (v) 5% of active SNPL nests, or (vi) 4 active SNPL nests.

    - Cameras will be placed in a manner to minimize disturbance to nesting plovers; this will be determined in the field based on the best judgement of a permitted biologist.
    - The Applicant will employ camera technology that is capable of long-term recording and time marking the moment of disturbance events.
- The Applicant will review SNPL nest camera recordings as soon as possible after the Falcon Heavy launch/landing events.

2.3.4 California Least Tern

- The Action Agency will continue to implement long-term monitoring of annual population and distribution trends associated with LETE.
    - The Applicant will perform statistical analysis annually to identify declines in the LETE population, nesting activity, and reproductive success that may result from cumulative effects of multiple Falcon launches and landings from SLC-4 and SLC-6. The Applicant will discontinue this analysis after 5 years from initiation, which would begin with the 2024 LETE breeding season.
- The Applicant will perform acoustic monitoring (rocket engine noise and sonic boom) during the first three Falcon Heavy missions at the Purisima LETE colony to validate noise model predictions.
- Motion triggered video cameras will be used during the breeding season (typically 15 April to 15 August) to determine nest fates and potential impacts to nests during the first three Falcon Heavy launches and landings to reduce disturbance associated with human activity within breeding habitat.
    - The Applicant will monitor at whichever of the following is greater within the Purisima Point colony: (i) 10% of active LETE nests, or (ii) 4 active LETE nests.
    - Cameras will be placed in a manner to minimize disturbance to nesting terns; this will be determined in the field based on the best judgement of a permitted biologist.
    - The Applicant will employ camera technology that is capable of long-term recording and time marking the moment of disturbance events.
    - The Applicant will review LETE nest camera recordings as soon as possible following the Falcon Heavy launch/landing events.

2.3.5 Southern Sea Otter

- The Action Agency will continue to conduct SSO population surveys at the current levels to monitor the densities and distribution of SSO along VSFB's coastline.

2.3.6 Conservation Measures Implemented under the Programmatic Biological Opinion

In addition to the measure proposed above, the Action Agency will continue to implement the following measures that are relevant to MAMU, California condor, and SSO, as required under the Programmatic Biological Opinion (PBO 8-8-12-F-49R):

- The Action Agency will ensure that annual MAMU population surveys will continue to be conducted at the current levels to monitor the frequency and distribution of MAMU within the action area.
- Prior to any launch, the Action Agency will determine if any California condors are present by coordinating with Service and Ventana Wildlife Society personnel. The Action Agency will contact the USFWS 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 USFWS to analyze data before, during, and after launch events to determine whether any changes in movement occur. The Action Agency will coordinate with current USFWS personnel, including Arianna Punzalan, Supervisory Wildlife Biologist, USFWS California Condor Recovery Program, at arianna_punzalan@fws.gov or (805) 377-5471; 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.
- The Action Agency will require that project-related boats that utilize the harbor during hours of darkness operate under a lighting management plan to reduce potential impacts to rafting SSO and other marine mammals from visual disturbance.
- As depicted in the 2022 Programmatic Biological Assessment, the Action Agency will require the project proponent to adhere to the following measures in regard to watercraft speed within and adjacent to the VSFB Harbor: a) Within the harbor during hours of daylight, personnel will maintain a speed of less than 11.5 miles per hour (10 knots) if SSO are present and maintain a minimum of 80 feet of separation from rafting SSO; b) Within the harbor during hours of darkness, personnel will maintain a speed of less than 11.5 miles per hour (10 knots) at all times; c) Outside the harbor, personnel will maintain speeds of less than 17 miles per hour (15 knots) within depths of less than approximately 80 feet which correlates to approximately 5.5 mi from shore; d) Outside the harbor during hours of daylight, personnel will maintain a minimum of 325 feet of separation from rafting SSO and 30 feet of separation from kelp. If this separation distance is determined to be infeasible in coordination with the Qualified Biologist, personnel will maintain a 'no wake' speed (5 miles per hour/4.3 knots) when within 30 feet of kelp.
- The Action Agency would continue to conduct surveys for SWFL and LBVI within suitable habitat on VSFB during the breeding season every third year contingent upon funding.

3 Methods and Action Area

3.1 Action Area

The USFWS's regulations define the "Action Area" as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 Code of Federal Regulations [C.F.R.] section 402.02). Impacts on listed species were considered for all areas potentially impacted by the potential disturbances caused by construction, launch and landing activities (visual impacts, engine noise, sonic booms, fairing and first stage recovery), and increased water use to support increased launch cadence. The resulting Action Area (Figure 3.1-1 through Figure 3.1-3) encompasses the following:

- construction site at SLC-6 (Figure 2.2-2 and Figure 2.2-4 through **Error! Reference source not found.**);
- landing and recovery area (Figure 2.2-6);
- potential launch and landing sonic boom footprints, areas potentially impacted by sonic boom of 1 psf or greater during landing at VSFB, areas potentially impacted by launch and landing sonic booms of 1 psf or greater at the NCI, areas potentially impacted by sonic booms during first stage/booster landings on a barge in the Pacific Ocean, and areas of southern Santa Barbara, Ventura, and northern Los Angeles Counties that may be impacted by sonic booms of 1 psf or greater during ascent;
- 100 dB (unweighted) contour modeled for Falcon Heavy launch engine noise (which encompasses both the launch and landing engine noise footprints for Falcon 9 and Falcon Heavy at SLC-4 and SLC-6); and
- San Antonio Creek Basin, which is utilized for two to three weeks each year as the source of VSFB water during annual maintenance of the State Water system.

The portion of the Action Area defined by the potential ascent sonic boom footprint over mainland southern California included all areas that could potentially receive a sonic boom of 1 psf or greater, although the statistical likelihood of a 1-psf-or-greater sonic boom would also be very low for much of this area.

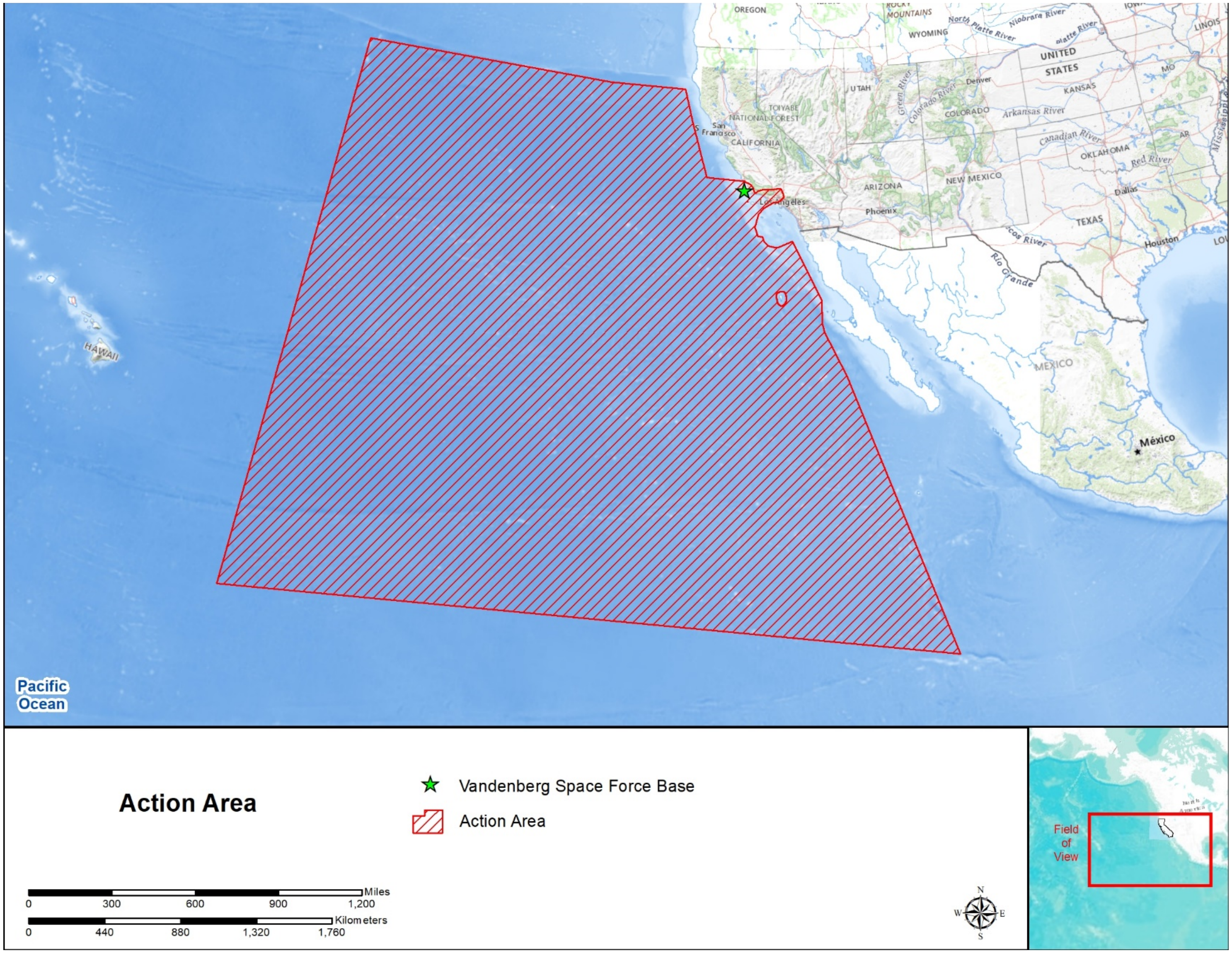

Figure 3.1-1. Action Area.

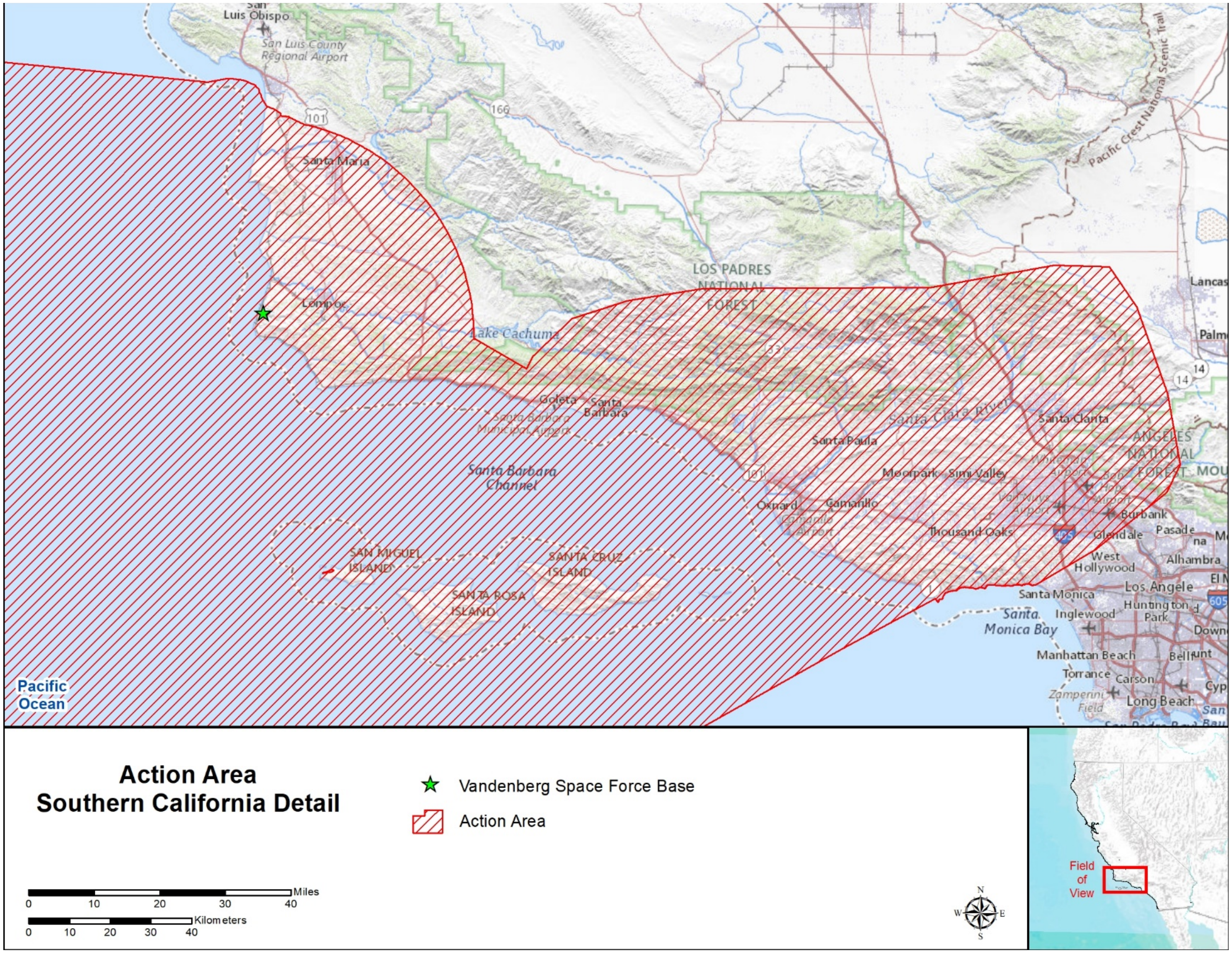

Figure 3.1-2. Action Area - Southern California Detail.

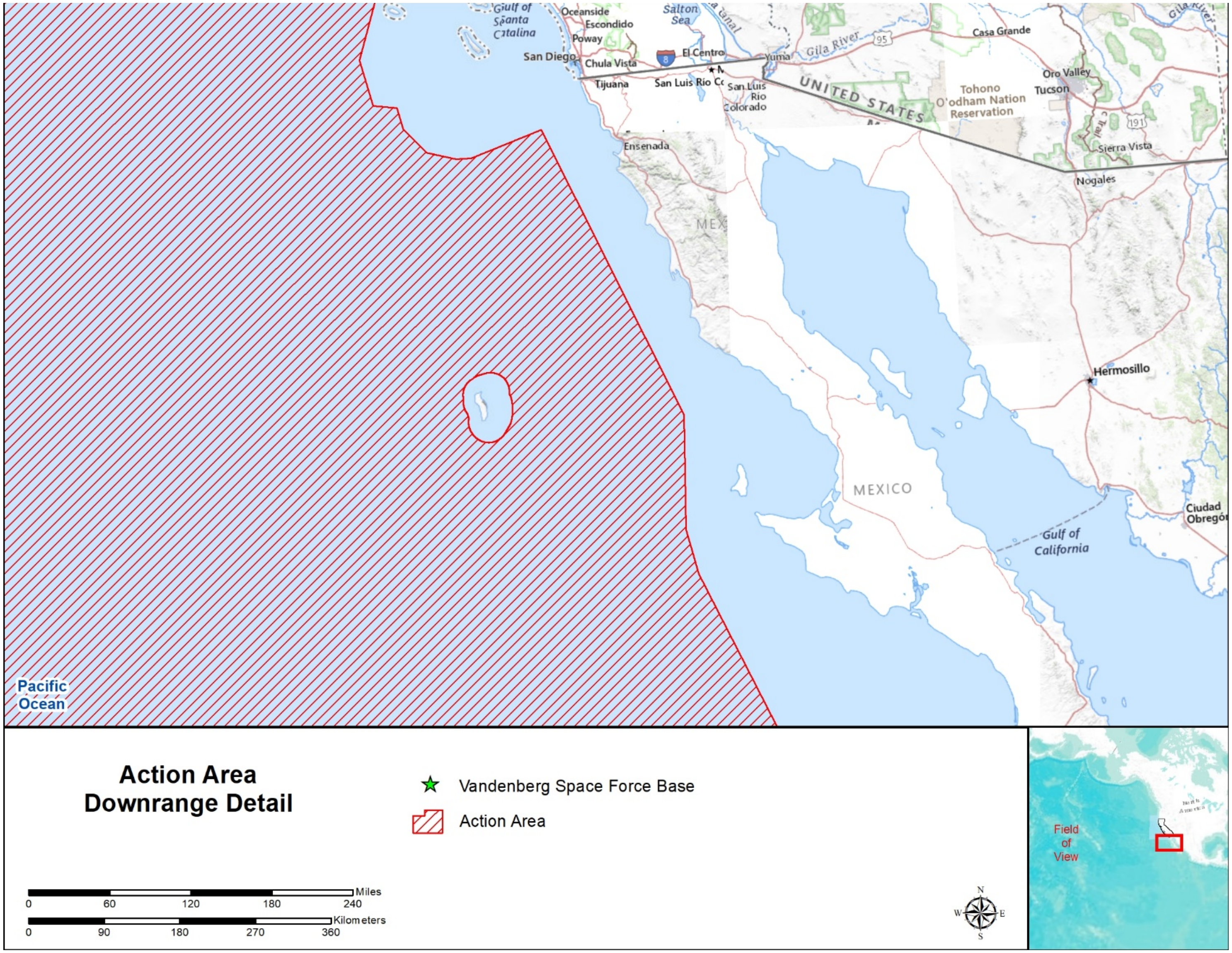

Figure 3.1-3. Action Area - Downrange Detail.

3.2 Methods

Biological surveys of the area surrounding SLC-4 were performed as part of the 2017 BA (ManTech SRS Technologies, Inc. [MSRS] 2017a). There was no need to perform additional field surveys at SLC-4 for this BA because the Proposed Action does not require any construction-related ground disturbance at this location, the maximum number of first stage landings (12) at SLC-4W would not change from what was described in the 2023 and 2024 BOs (USFWS 2023, 2024), and recent survey data are available for all relevant species in the areas potentially impacted at that location. Biological surveys of the proposed construction areas at SLC-6 were performed during October and November 2023. A qualified biologist performed meandering surveys throughout the areas where construction is proposed, mapping any federally listed species encountered and assessing habitat for suitability and potential occurrence of these species. Existing special status species monitoring data, survey reports, and California Natural Diversity Database (CNDDB) records (California Department of Fish and Wildlife [CDFW] 2024), and the USFWS Information for Planning and Consultation (IPaC) website were reviewed to assess the potential occurrence, distribution, and habitat use of federally listed species around SLC-6 and within the broader Action Area.

4 Status of the Species

Table 4.0-1 summarizes all federally listed, proposed, and candidate species and critical habitat occurring within the Action Area that were not dismissed from analyses of effects. Specific discussion on species occurrence in the Action Area and overlap with Critical Habitat are included in the descriptions of the status of each species below.

Table 4.0-1. Federally listed species and critical habitat occurring within the Action Area.

Common Name	Scientific Name	Federal Listing	Critical Habitat Occurrence in the Action Area	Source
Tidewater Goby	*Eucyclogobius newberryi*	Endangered	Yes	IPaC, CNDDB, VSFB survey records
Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	Endangered	No	IPaC, CNDDB, VSFB survey records
California Tiger Salamander Santa Barbara (DPS)	*Ambystoma californiense*	Endangered	Yes	IPaC, CNDDB
California Red-legged Frog	*Rana draytonii*	Threatened	Yes	IPaC, CNDDB, VSFB survey records
Arroyo Toad	*Anaxyrus californicus*	Endangered	Yes	IPaC, CNDDB
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	No	IPaC, CNDDB, VSFB survey records, eBird 2024
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Yes	IPaC, CNDDB, VSFB survey records
Least Bell's Vireo	*Vireo bellii pusillus*	Endangered	Yes	IPaC, CNDDB, VSFB survey records
Western Snowy Plover	*Charadrius nivosus*	Threatened	Yes	IPaC, CNDDB, VSFB survey records
California Least Tern	*Sternula antillarum browni*	Endangered	No	IPaC, CNDDB, VSFB survey records

Common Name	Scientific Name	Federal Listing	Critical Habitat Occurrence in the Action Area	Source
California Condor	*Gymnogyps californianus*	Endangered	Yes	IPaC, CNDDB, VSFB survey records
California Gnatcatcher	*Polioptila californica californica*	Threatened	Yes	IPaC, CNDDB, VSFB survey records
Light-footed Ridgeway's Rail	*Rallus obsoletus levipes*	Endangered	No	IPaC, CNDDB, VSFB survey records
Short-tailed Albatross	*Phoebastria (=Diomedea) albatrus*	Endangered	No	IPaC
Hawaiian Petrel	*Pterodroma sandwichensis*	Endangered	No	IPaC
Southern Sea Otter	*Enhydra lutris nereis*	Threatened	No	IPaC, VSFB survey records, USGS 2020

4.1 Tidewater Goby (Federally Listed Endangered Species)

4.1.1 Status

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

4.1.2 Life History

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

(Swift et al. 1989). Breeding may occur year-round (Swenson 1999), with peak spawning activity usually occurring during the spring and a second peak during the late summer (Swift et al. 1989).

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

4.1.3 Occurrence within the Action Area

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

Potential habitat for TWG within the Action Area includes Honda Creek, the Santa Ynez River, Jalama Creek, and San Antonio Creek. TWG were first found in the Honda estuary lagoon in 1995 (Lafferty et al. 1999). The species was again documented in 2001; however, seine net surveys conducted in Honda Creek in 2008 indicated that TWG were no longer present (MSRS 2009a). Seine net surveys were again conducted in Honda Creek in 2015 and 2016 with no TWG present (MSRS 2016a, 2018a). Despite being easily detectable in shallow water with a flashlight during night frog surveys, no TWG were observed during night CRLF surveys of the Honda Creek estuary for SpaceX launch monitoring activities in January 2022 (J. LaBonte, pers. obs.). Seine surveys conducted in 2024 also failed to document any TWG in Honda Creek (MSRS, unpubl. data).

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

On VSFB, TWG currently occur in the Santa Ynez River from the estuary to 13th Street Bridge and San Antonio Creek, being mostly concentrated in the San Antonio Creek lagoon as compared to its channel (Swift 1999; MSRS 2018b). TWG also occur in Jalama Creek (MSRS 2016a). To the southeast of VSFB, in the region potentially impacted by ascent sonic booms during missions with easterly trajectories, TWG occur in most coastal streams, bays, and estuaries in southeastern Santa Barbara, Ventura, and southwestern Los Angeles Counties (Figure 4.1-1; CDFW 2024).

4.1.4 Critical Habitat

The USFWS issued a final rule for designation of Critical Habitat for the TWG on 6 February 2013 (78 FR 8745-8819). VSFB was exempted from Critical Habitat designation under Section 4(a)(3) of the ESA. USFWS has adopted VSFB's Integrated Natural Resources Management Plan (INRMP; U.S. Air Force 2021), prepared under Section 101 of the Sikes Act (16 U.S.C. 670a). The potential ascent sonic boom footprint from missions with easterly trajectories overlaps Critical Habitat Units SB-8, 9, 10, 11, and 12, VEN-1, 2, 3, and 4, and LA-1, 2, 3, and 4 (**Figure 4.1-2**).

The primary constituent elements (PCE) for TWG Critical Habitat include the following:

> (1) Persistent, shallow (in the range of approximately 0.3 to 6.6 ft) still-to-slow-moving lagoons, estuaries, and coastal streams with salinity up to 12 parts per thousand, which provide adequate space for normal behavior and individual and population growth that contain one or more of the following:
>
> > (a) Substrates (e.g., sand, silt, mud) suitable for the construction of burrows for reproduction;
> >
> > (b) Submerged and emergent aquatic vegetation, such as *Potamogeton pectinatus*, *Ruppia maritima*, *Typha latifolia*, and *Scirpus* spp., that provides protection from predators and high flow events; or
> >
> > (c) Presence of a sandbar(s) across the mouth of a lagoon or estuary during the late spring, summer, and fall that closes or partially closes the lagoon or estuary, thereby providing relatively stable water levels and salinity.

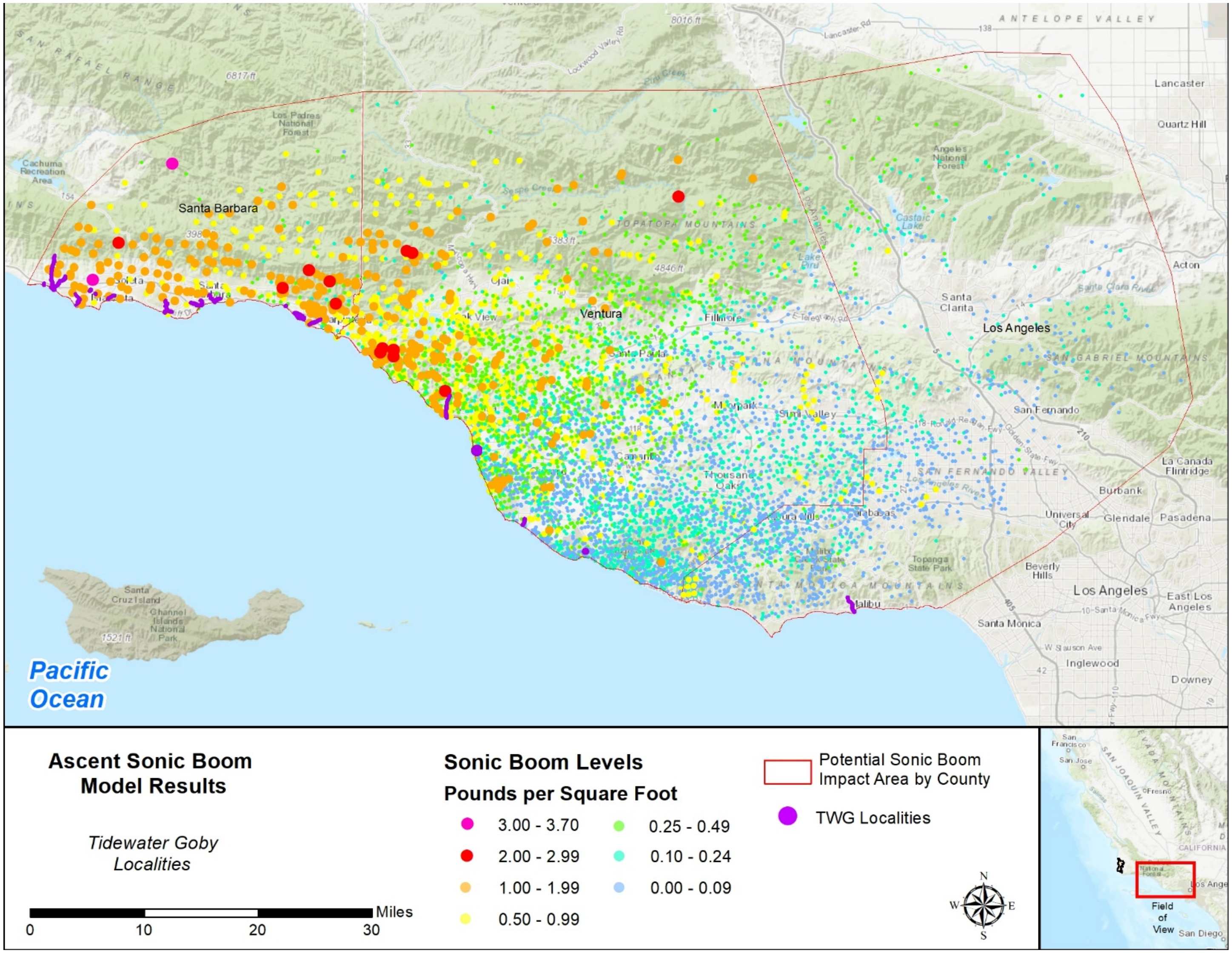

Figure 4.1-1. TWG localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.6).

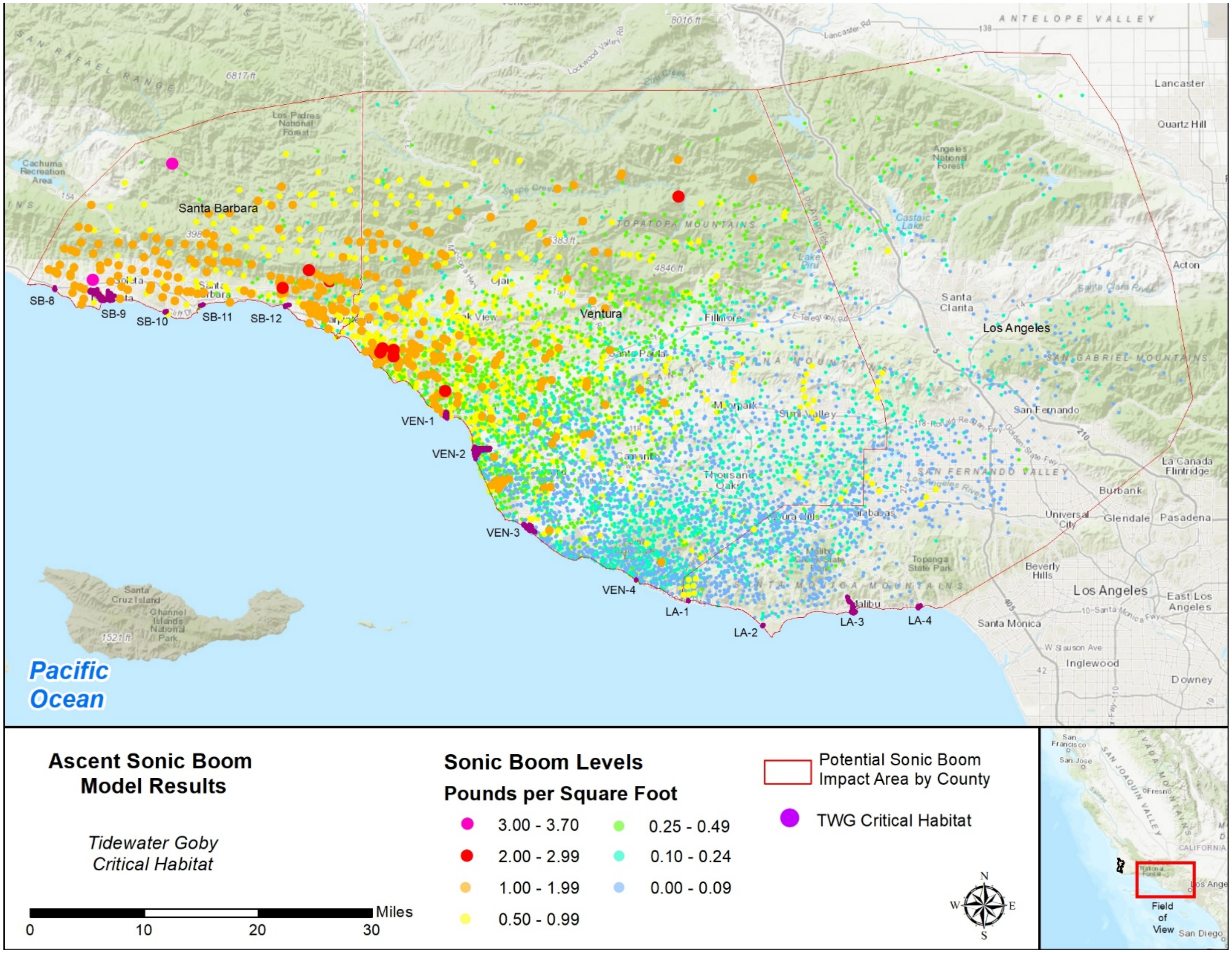

Figure 4.1-2. TWG Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.2 Unarmored Threespine Stickleback (Federally Listed Endangered Species)

4.2.1 Status

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

4.2.2 Life History

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

4.2.3 Occurrence in the Action Area

UTS were abundant throughout the Los Angeles basin but were reported to be extirpated by 1942. As of 1985, UTS was generally restricted to the Santa Clara River drainage in Ventura and Los Angeles Counties (Figure 4.2-1) and the San Antonio Creek drainage in Santa Barbara County (USFWS 1985a, CDFW 2024). On VSFB, UTS have been found in San Antonio Creek from Barka Slough to the lagoon with UTS primarily occupying the creek channel (ManTech 2009a, Swift 1999).

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

4.2.4 Critical Habitat

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

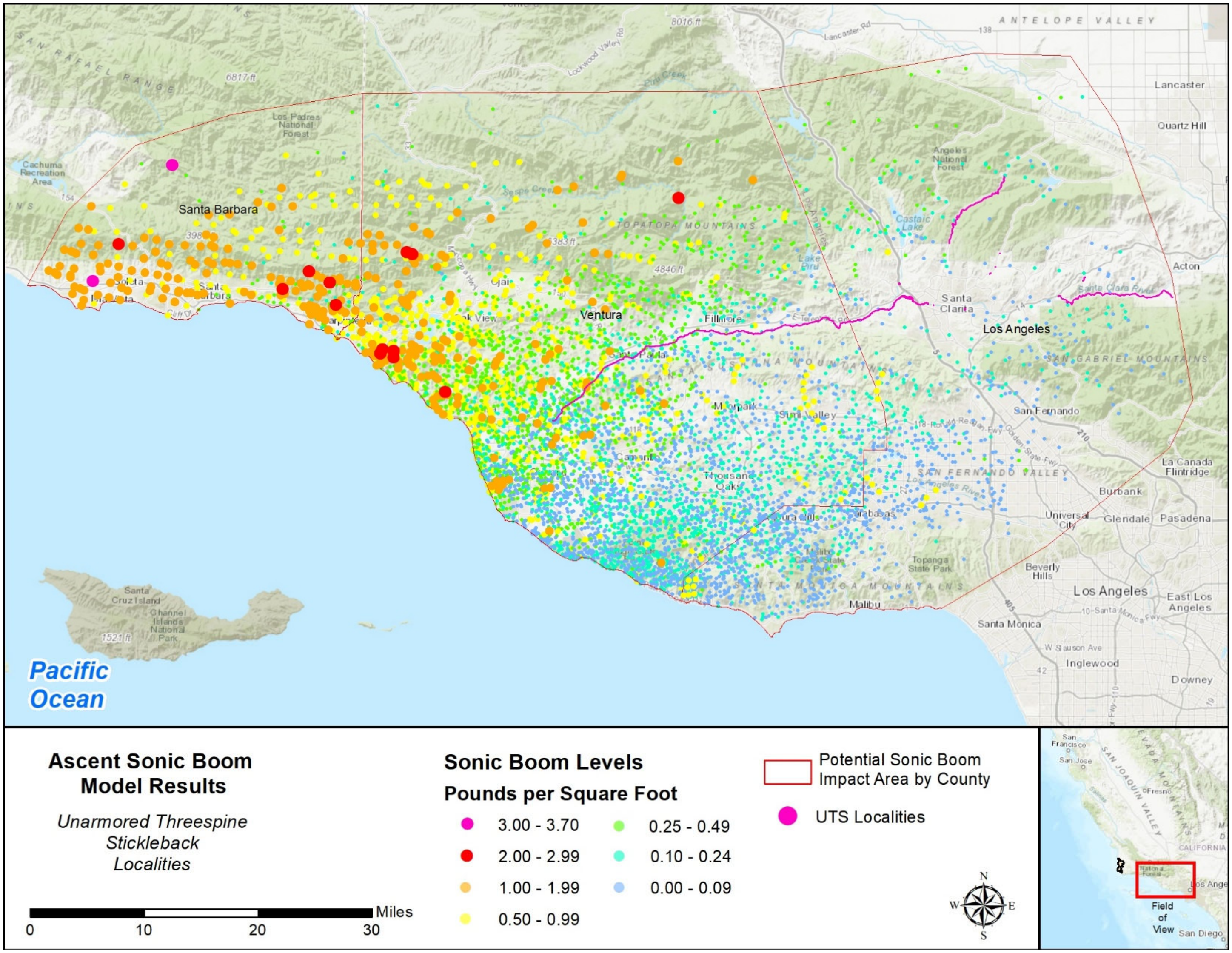

Figure 4.2-1. UTS localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.3 California Tiger Salamander (Federally Listed Endangered Species)

4.3.1 Status

The USFWS listed the CTS Santa Barbara DPS as federally endangered on 21 September 2000 (65 FR 57242). The USFWS finalized a recovery plan for the Santa Barbara DPS in 2016 (USFWS 2016).

4.3.2 Life History

CTS is a large, stocky salamander that inhabits low-elevation (under 1,500 ft) seasonal ponds and grasslands. Manmade livestock and other ponds have become an important component of the specie's habitat. The species spends most of its life underground in small mammal burrows. Outside of the breeding season, CTS are typically found in burrows at depths between 0.2 m and 1.36 m underground, where it is believed that they remain active year-round (Barry & Shaffer 1994). CTS occupied burrows are typically within 1 mi of their breeding ponds. (Barry & Shaffer 1994; Nafis 2023).

Winter rain events trigger CTS to emerge from burrows to seek breeding ponds, usually between November and January, depending on timing of heavy rain events (Loredo & Van Vuren 1996; Trenham et al. 2000; Cook et al. 2006; USFWS 2016). CTS may migrate up to one mi or more before reaching a breeding pond. Males typically arrive before females and remain aboveground longer than females. After mating, the salamander returns to its burrow. Eggs, which are laid underwater on features such as blades of grass and twigs, typically hatch 10 to 28 days after deposition. Although larvae development can be delayed during periods of persistent cold weather, CTS typically emerge as terrestrial metamorphic salamanders between May and August and disperse into upland subterranean habitat.

CTS larvae prey on a variety of invertebrates, including zooplankton and crustaceans, as well as aquatic insects. Larger larvae also eat tadpoles. Adults may eat small invertebrates and vertebrates (USFWS 2016). The key threats to conservation of CTS include habitat loss and fragmentation; invasive species that prey on CTS or may hybridize with them; drought; disease; predation; and some agricultural and rangeland activities.

4.3.3 Occurrence within the Action Area

The Santa Barbara County Distinct Population Segment (DPS) of CTS is the southernmost extent of the species. USFWS has identified six metapopulation areas within this DPS and estimates that there are 60 known breeding ponds within these metapopulation areas scattered through the Santa Maria Valley, south to the Santa Rita Hills (Figure 4.3-1 through Figure 4.3-5). CTS does not occur on VSFB. The nearest CTS breeding pools are approximately 14 mi east of SLC-4 in the Santa Rita Hills. CTS have not been detected on VSFB during regular protocol surveys of suitable habitat since 2006 (Collins 2006; Sweet et al. 2008, 2010; MSRS 2016b, 2020, 2022a).

4.3.4 Critical Habitat

The USFWS designated Critical Habitat for the Santa Barbara County DPS on 24 November 2004 (69 FR 68568) and does not include VSFB. The Action Area includes designated Critical Habitat Units 1, 2, 3, 4, 5, and 6 for the Santa Barbara DPS of the CTS (Figure 4.3-1 through Figure 4.3-5). The PCE's for CTS Critical Habitat include the following:

(1) Standing bodies of fresh water (including natural and manmade (e.g., stock ponds), vernal pools, and other ephemeral or permanent water bodies which typically support inundation during winter rains and hold water for a minimum of 12 weeks in a year of average rainfall.

(2) Upland habitats adjacent and accessible to and from breeding ponds that contain small mammal burrows or other underground habitat that CTS depend upon for food, shelter, and protection from the elements and predation.

(3) Accessible upland dispersal habitat between occupied locations that allow for movement between such sites.

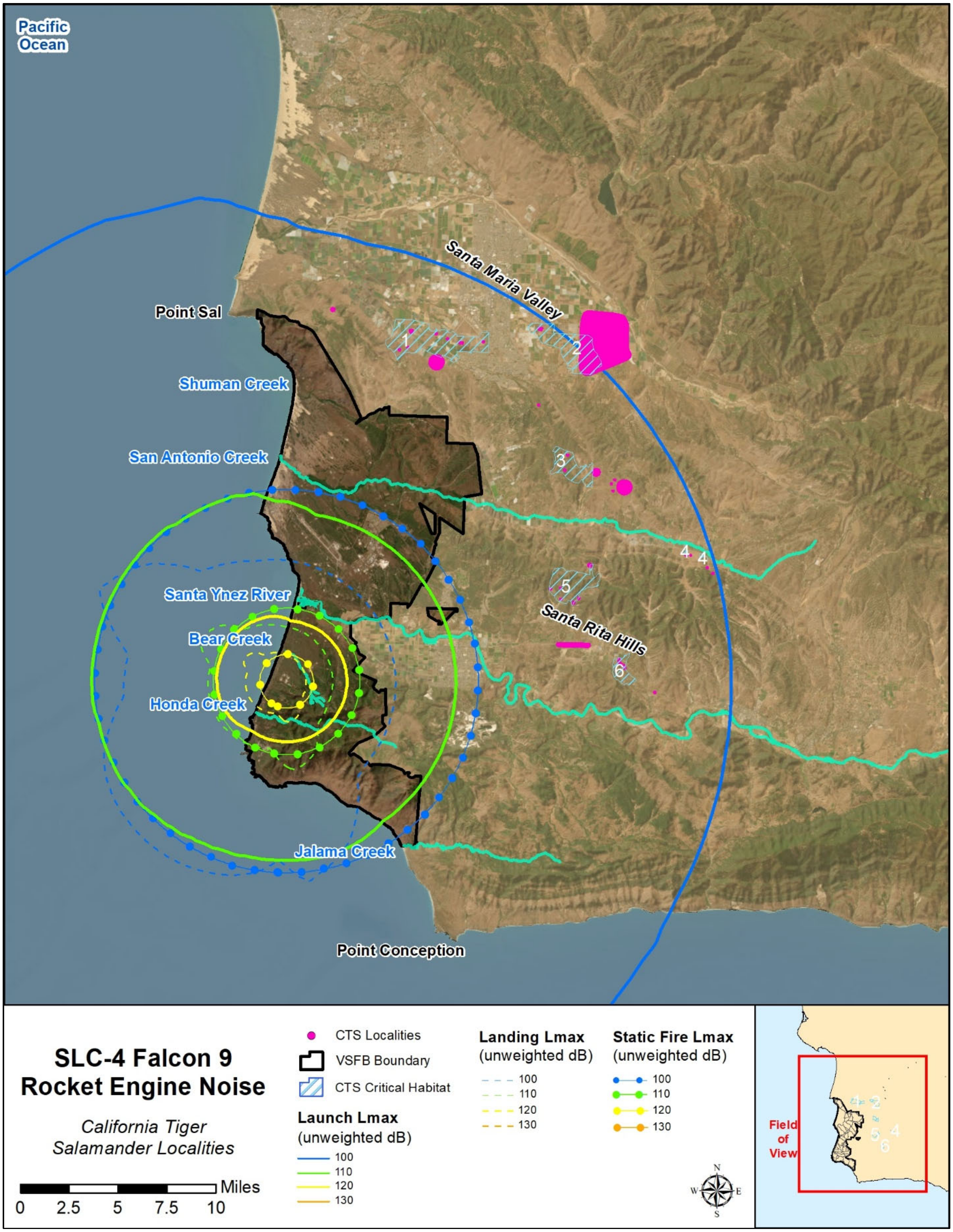

Figure 4.3-1. California tiger salamander localities, Critical Habitat, and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

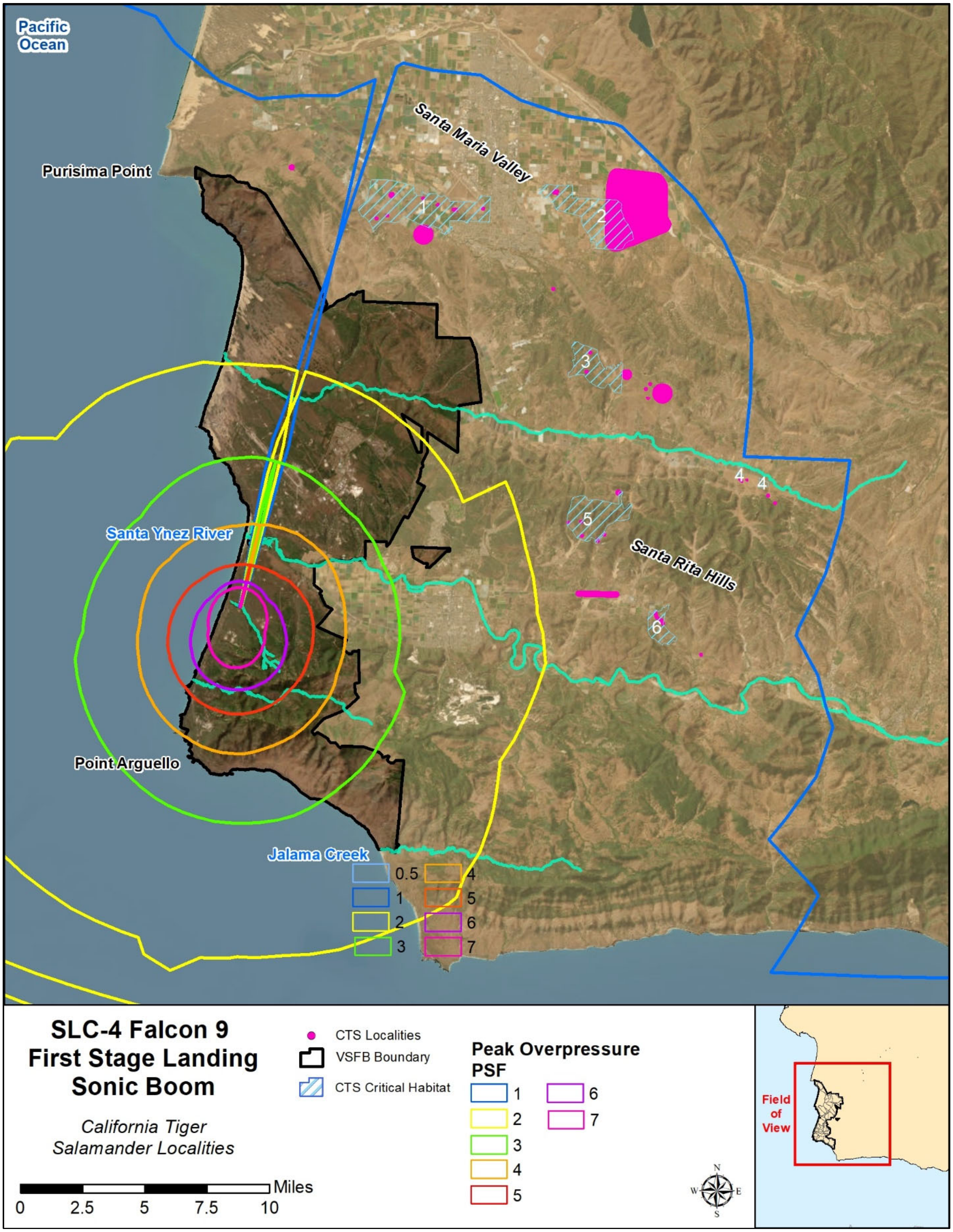

Figure 4.3-2. California tiger salamander localities, Critical Habitat, and sample SLC-4 landing sonic boom model result.

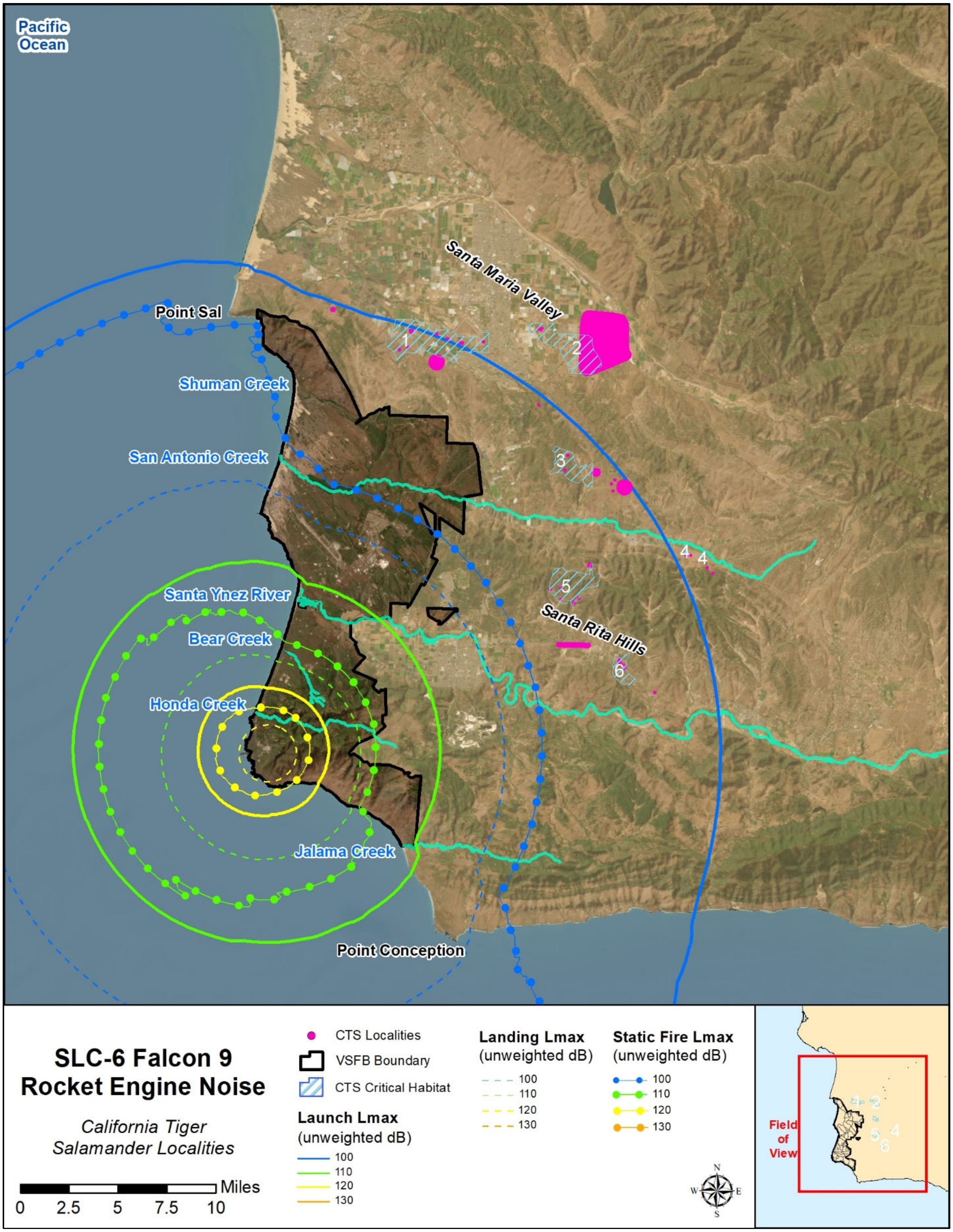

Figure 4.3-3. California tiger salamander localities, Critical Habitat, and modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

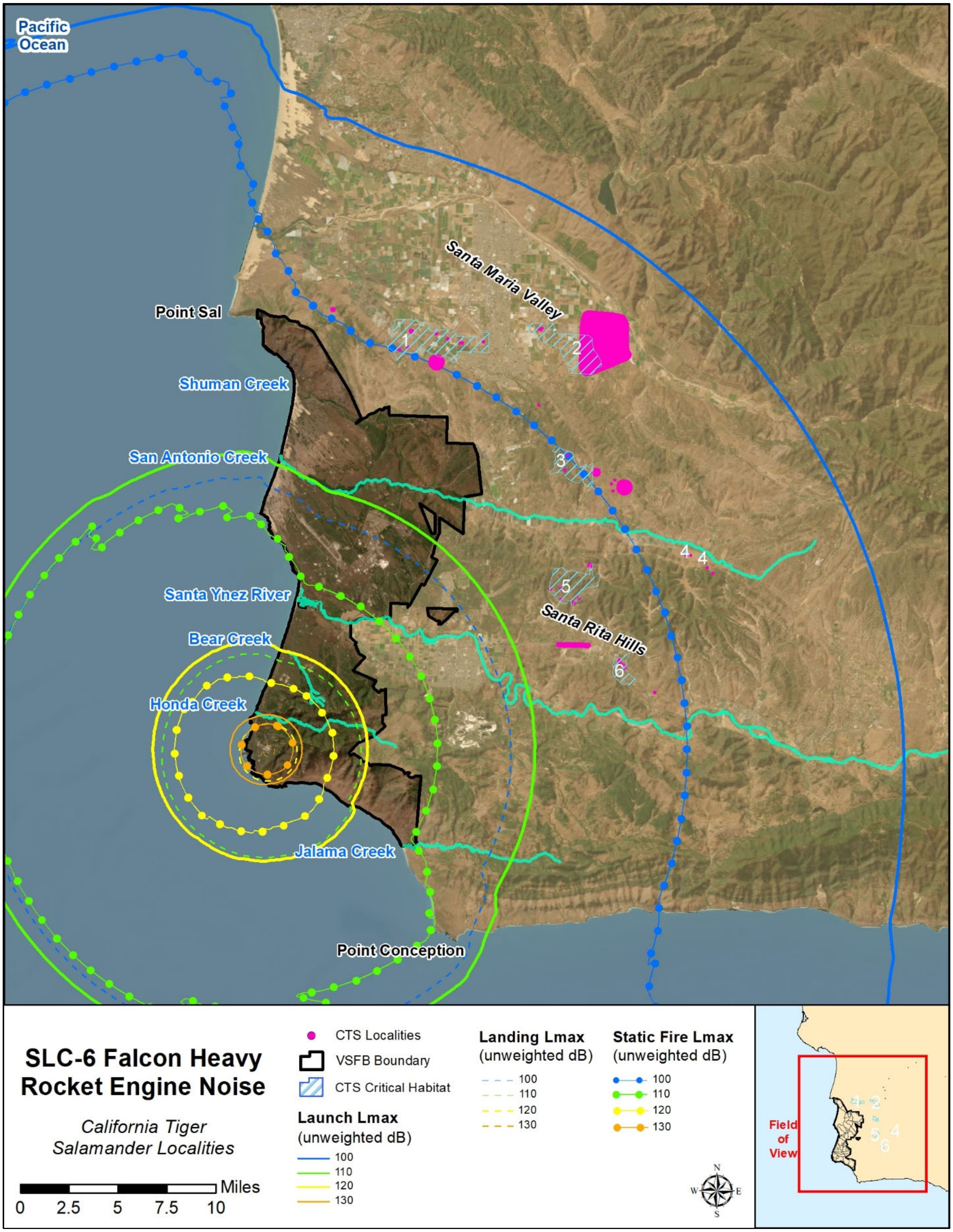

Figure 4.3-4. California tiger salamander localities, Critical Habitat, and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

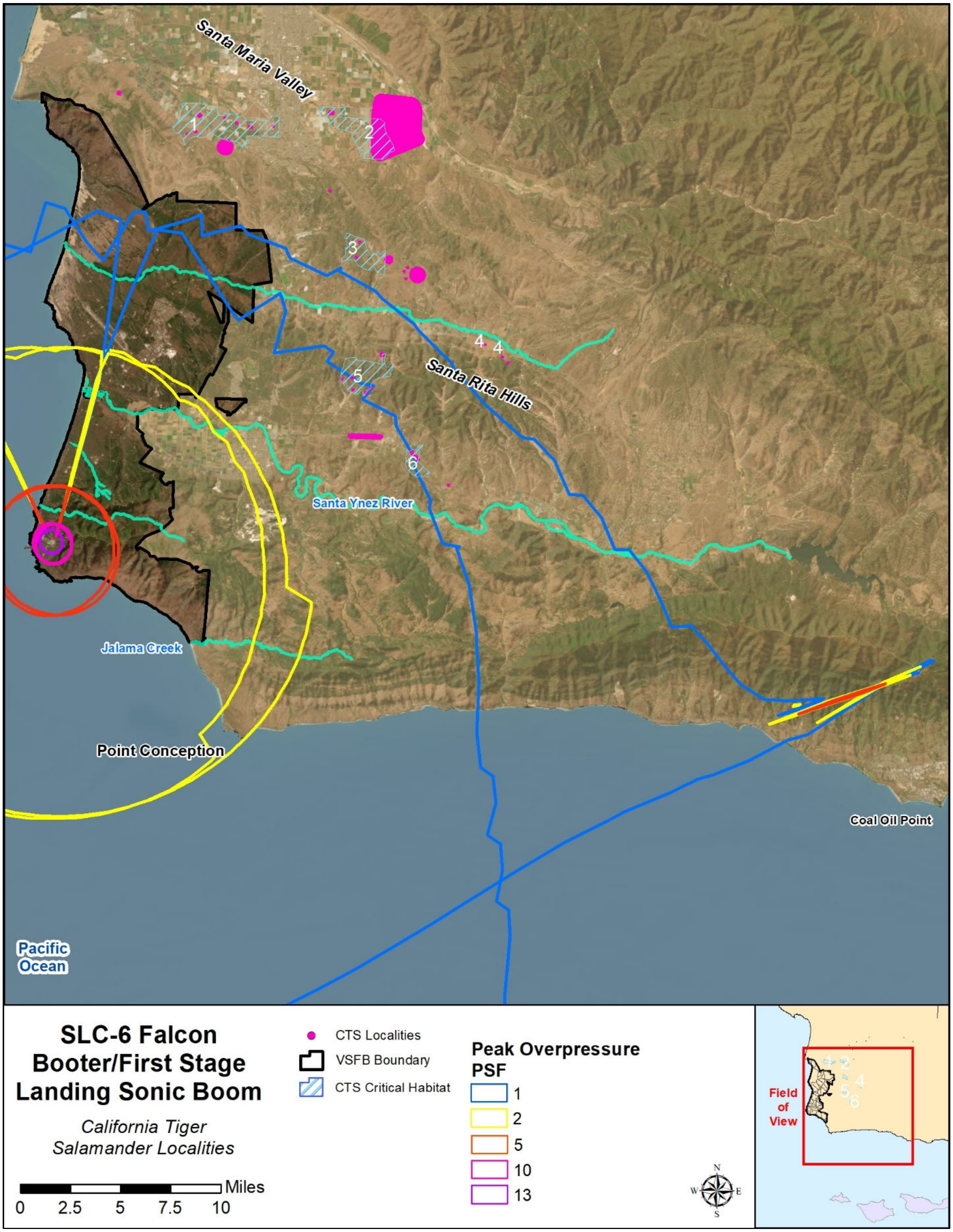

Figure 4.3-5. California tiger salamander localities, Critical Habitat, and two sample sonic boom model results for SLC-6 booster/first stage landing events.

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

4.4.1 Status

The UFSWS listed the CRLF as threatened on 23 May 1996 (61 FR 25813-25833). In 2002, USFWS issued a Recovery Plan for the CRLF (USFWS 2002b).

4.4.2 Life History

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

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

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

4.4.3 Occurrence within the Action Area

The DAF has been conducting baseline studies of CRLF populations on VSFB since the late 2000's. These survey data, collected during periods of time with very low launch cadence provide the most appropriate baseline. CRLF have been documented in nearly all permanent streams and ponds on VSFB as well as most seasonally inundated wetland and riparian sites (Figure 4.4-1 through Figure 4.4-6; Christopher 2002). CRLF have been consistently documented in Honda Creek (Christopher 2002; MSRS 2009a, 2016a, 2018a, 2021a) and during SpaceX launch monitoring activities in January 2022 (MSRS 2022b). The Santa Ynez River, San Antonio Creek, Shuman Creek, Bear Creek, Canada del Jolloru, and Jalama Creek, have CRLF populations and suitable breeding habitat (Christopher 2002; MSRS 2009b, 2014a, 2018a). CRLF have also been documented in isolated natural wetlands on south VSFB (Christopher 2002; MSRS 2018a). CRLF were consistently found in 3 decommissioned wastewater treatment pools approximately 0.5 mi west of SLC-6 in the late 1990's up to 2001 (Figure 4.4-6; Christopher 2002); however, these pools have been almost completely dry for the past 20 years (A. Abela, M. Ball, and J. LaBonte, pers.

obs.). These ponds were assessed in February 2024 and the northern pond was completely dry; the southern pond had shallow standing water that would not support anything more than temporary transitory habitat (Figure 4.4-6; A. Abela, pers. obs.). One adult CLRF was observed in 2001 at the Industrial Wastewater Treatment Ponds, approximately 0.4 mi southwest of SLC-6 (Figure 4.4-6); however, that was likely a transient as these two ponds rarely contain water, and when water is present it is shallow (less than 3 inches) and evaporates quickly. When they were assessed in February 2024, they had standing water that would not support anything more than temporary transitory habitat (Figure 4.4-6).

Two drainages border SLC-6, one to the north and one to the south (Figure 4.4-6). These drainages were assessed for CRLF habitat in February and March 2024. Although some surface water was observed, there was no deep pool habitat suitable for supporting breeding CRLF. Adjacent to SLC-6, they were determined to hold surface water flow inconsistently in response to seasonal storms that would only serve as temporary transitory habitat for CRLF. At the southwestern corner of SLC-6, the southern drainage transitions to potential aquatic, non-breeding habitat (Figure 4.4-6). Open water and flow were observed, which was determined to likely be long-lived during seasons with average to above average rainfall. Although open water, suitable aquatic and riparian vegetation, and refugia were observed, there was no deep pool habitat (> 0.7 meters) that could support CRLF breeding. Therefore, the drainage could likely serve as a suitable site for temporary occupation by CRLF. No visual or auditory evidence of CRLF presence was observed.

During the February and March 2024 CRLF habitat assessment, two areas within the SLC-6 fenceline were observed holding enough water to be potentially attractive habitat to CRLF: a “vault” structure and the “flame trench” (Figure 4.4-7 and Figure 4.4-8). Due to the lack of maintenance of the site since 2022, these structures have collected water during rainstorms and were determined to be “attractive nuisances.” The volume of water in both structures could be attractive to transiting frogs. The flame trench is sloped; thus animals can enter and exit. The vault presents an entrapment hazard since it has steep walls with no escape ladder. No visual or auditory evidence of CRLF presence was noted. Neither site has elements such as vegetation or shelter that would make them suitable for long-term occupancy, and no suitable breeding habitat was observed.

Spring Canyon is an ephemeral drainage located approximately 200 ft south of SLC-4. Spring Canyon has no definable channel through the majority of the drainage and minimal evidence of potential pooling or flow of surface water (MSRS 2014b). In July 2017, after an above-average rain year, a USFWS-permitted biologist reassessed the drainage in support of the 2017 Falcon 9 BA (MSRS 2017a) and found no significant changes from the habitat assessment conducted in 2013, which had less than average rainfall levels. Both the 2013 and 2017 assessments showed there was no suitable breeding habitat within the vegetation removal area or downstream. Since 2017, 11 survey efforts were undertaken associated with the 2017 BO, and no suitable habitat has been found. The nearest suitable habitat for CRLF is Bear Creek, approximately 1.2 mi north of Spring Canyon.

Approximately 2 mi south of SLC-4, suitable CRLF breeding habitat is found in Honda Creek, along with scattered CRLF localities in minor wetlands and drainages, across south VSFB, including Bear

Creek located 1.0 mi northeast of SLC-4 (Christopher 2002; MSRS 2009b, 2014a). Suitable upland dispersal habitat exists throughout VSFB between the various riparian zones and ponds on Base but, as noted above, dispersal into these upland habitats on VSFB is limited. CRLF also occur throughout San Antonio Creek on VSFB from Barka Slough to the estuary (MSRS 2009a, 2009b, 2016a).

CRLF on the south coast of Santa Barbara County, including Gaviota Creek, Arroyo Honda, Arroyo Quemado, and other nearby creeks and tributaries are also within the Action Area due to noise impacts associated with the Falcon Heavy launch and landing activities at SLC-6 (Figure 4.4-4). Additionally, within the areas potentially impacted by ascent sonic boom from missions with easterly trajectories, the CNDDB lists observations of CRLF from San Antonio Creek in Ojai, Las Virgenes Creek near Calabasas, and the Ventura River near Casitas Springs, from 2000 to 2016 (Figure 4.4-9; CDFW 2024).

4.4.4 Critical Habitat

The USFWS issued a final rule revising the CRLF's Critical Habitat on 16 March 2010 (75 FR 12816–12959). The USFWS excluded VSFB from CRLF Critical Habitat designation pursuant to Section 4(b)(2) of the ESA. Off-base, the Action Area includes STB-2, STB-4, STB-5, and STB-6 as a result of noise impact areas from Falcon 9 and Falcon Heavy launch and landing activities at SLC-4 and SLC-6 (Figure 4.4-1 through Figure 4.4-5). The potential ascent sonic boom footprint from missions with easterly trajectories overlaps STB-7, VEN-1, VEN-2, VEN-3, and LOS-1 (Figure 4.4-9).

The PCE for CRLF Critical Habitat include the following:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, or rearing (or development) of offspring; and

(5) Habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of a species.

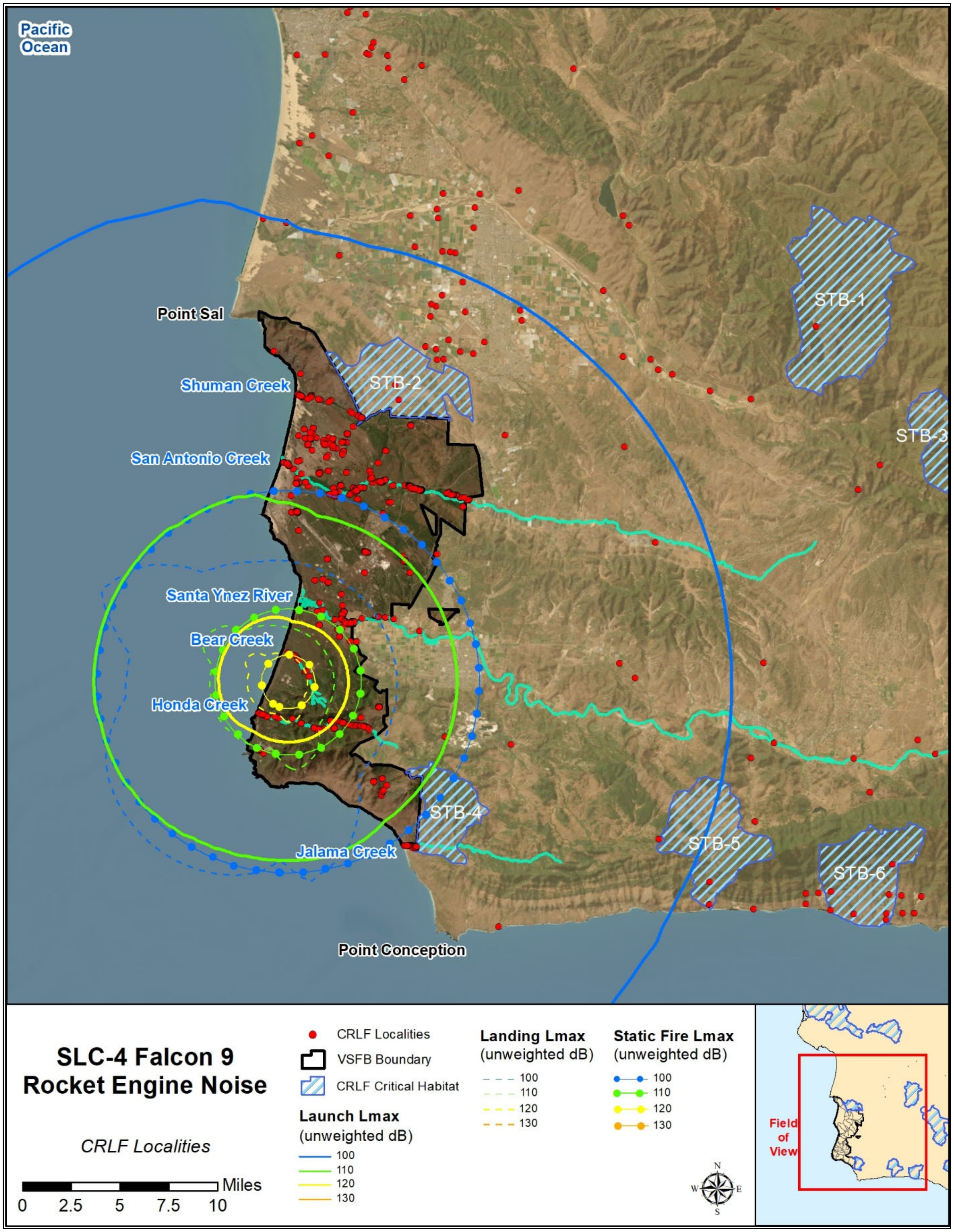

Figure 4.4-1. California red-legged frog localities, Critical Habitat, and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

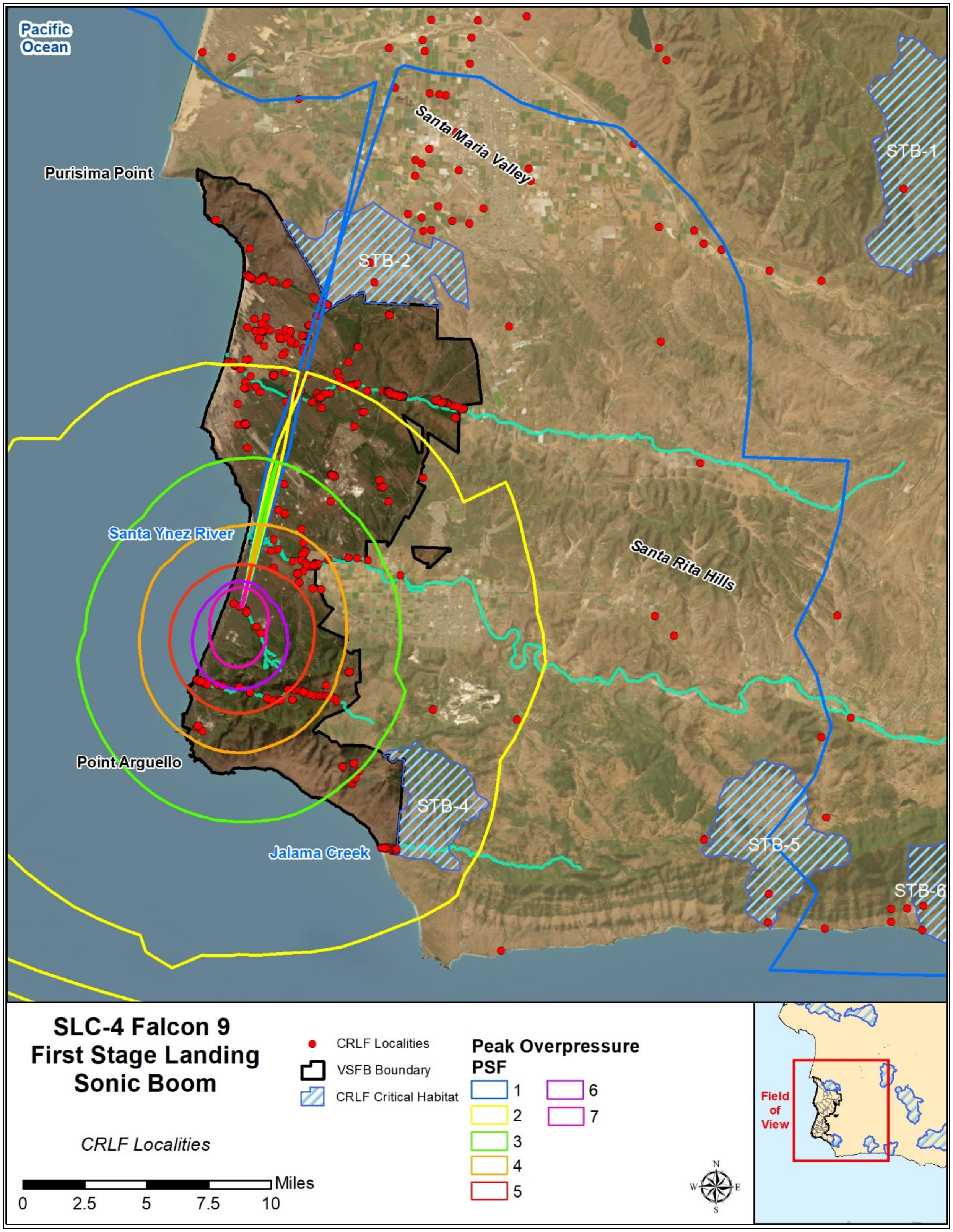

Figure 4.4-2. California red-legged frog localities, Critical Habitat, and sample SLC-4 landing sonic boom model results.

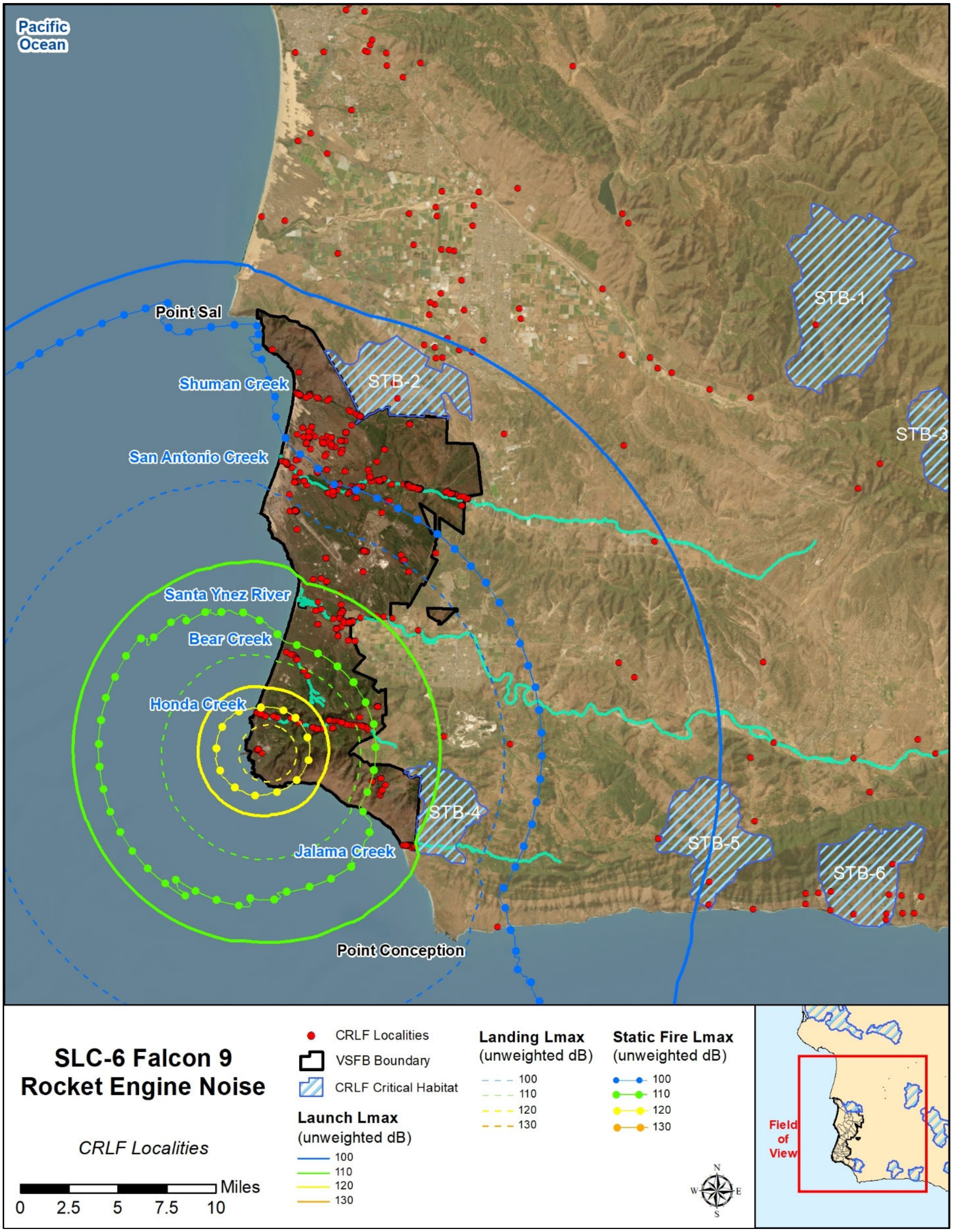

Figure 4.4-3. California red-legged frog localities, Critical Habitat, and modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

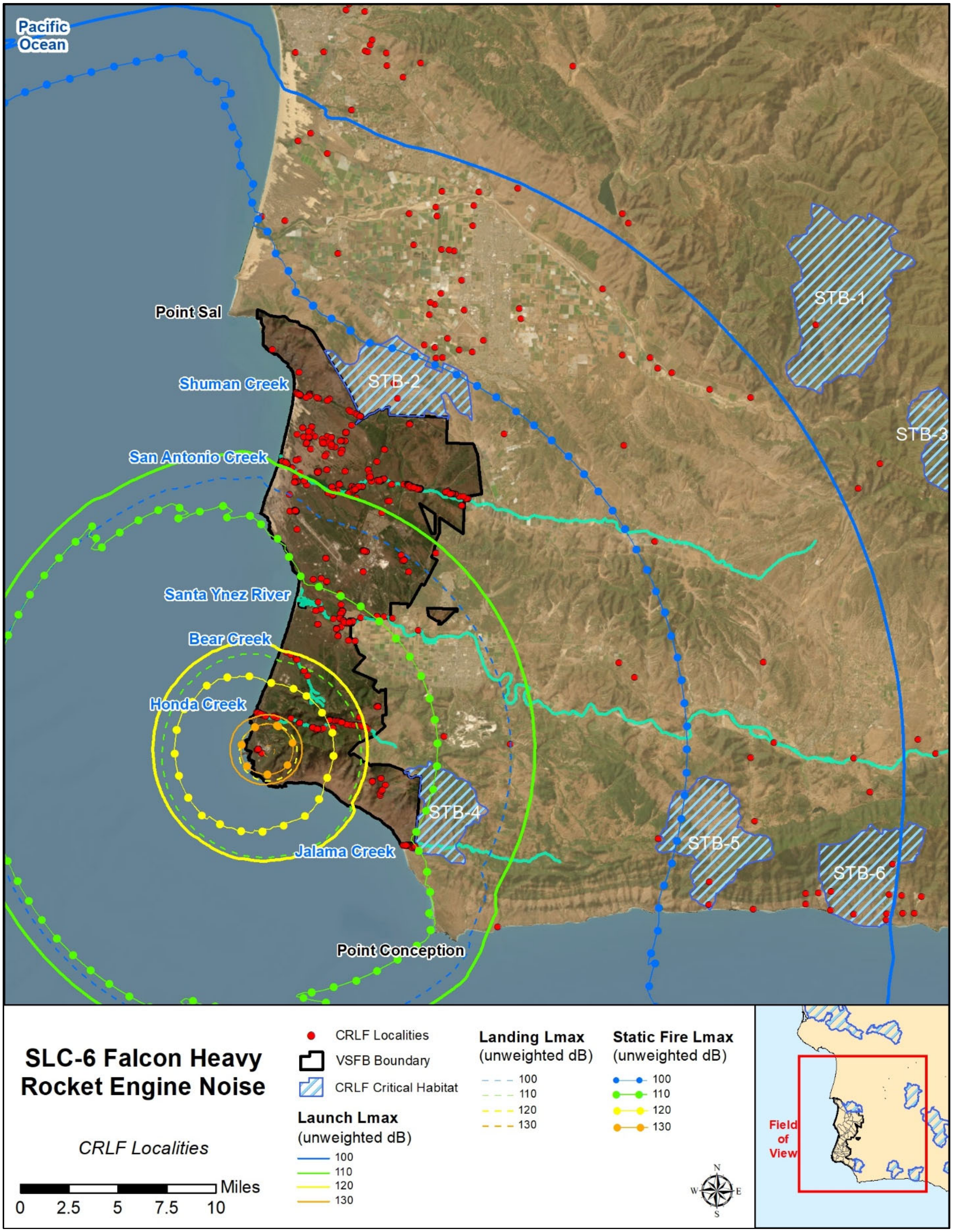

Figure 4.4-4. California red-legged frog localities, Critical Habitat, and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

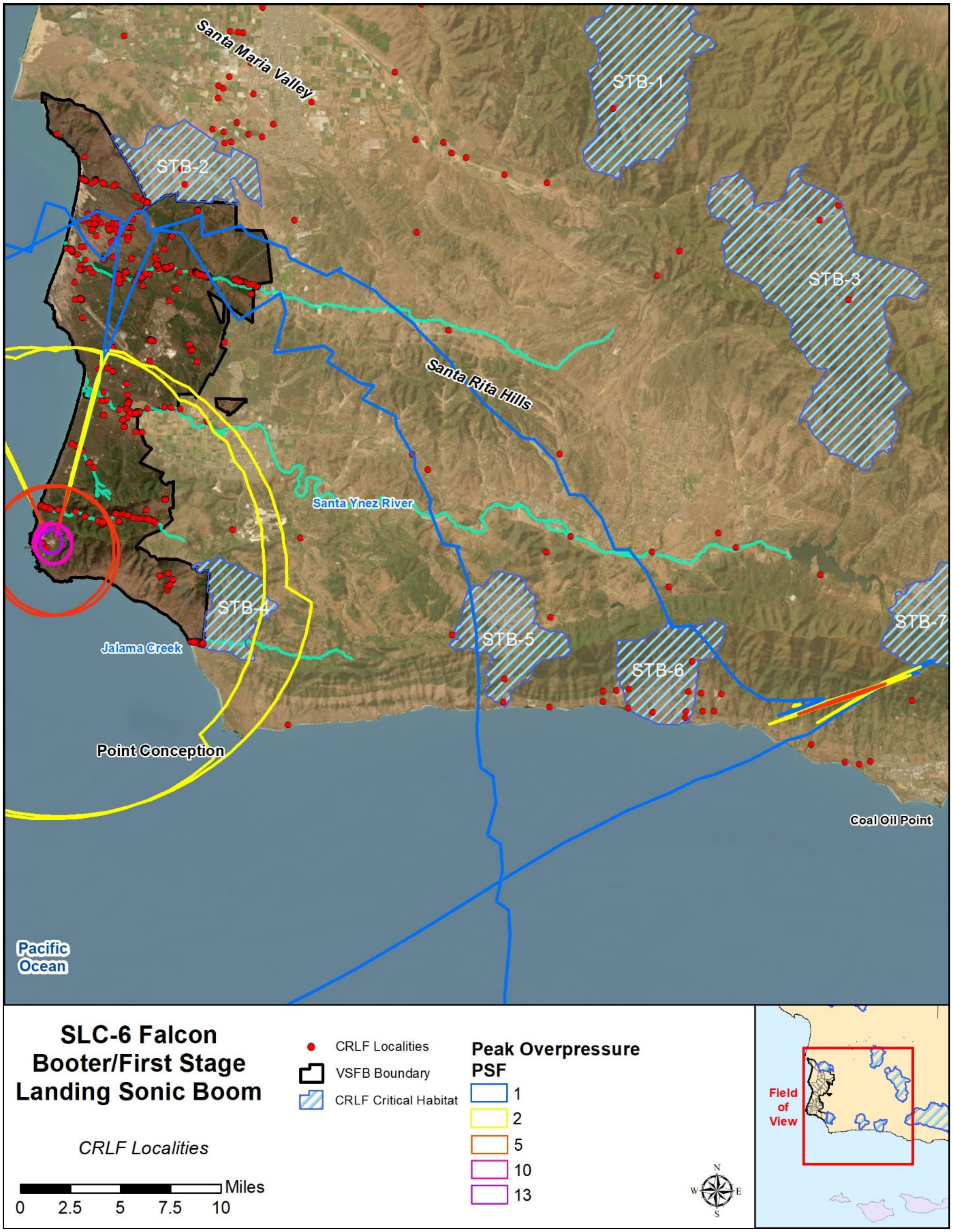

Figure 4.4-5. California red-legged frog localities, Critical Habitat, and two sample SLC-6 booster/first stage landing sonic boom model result.

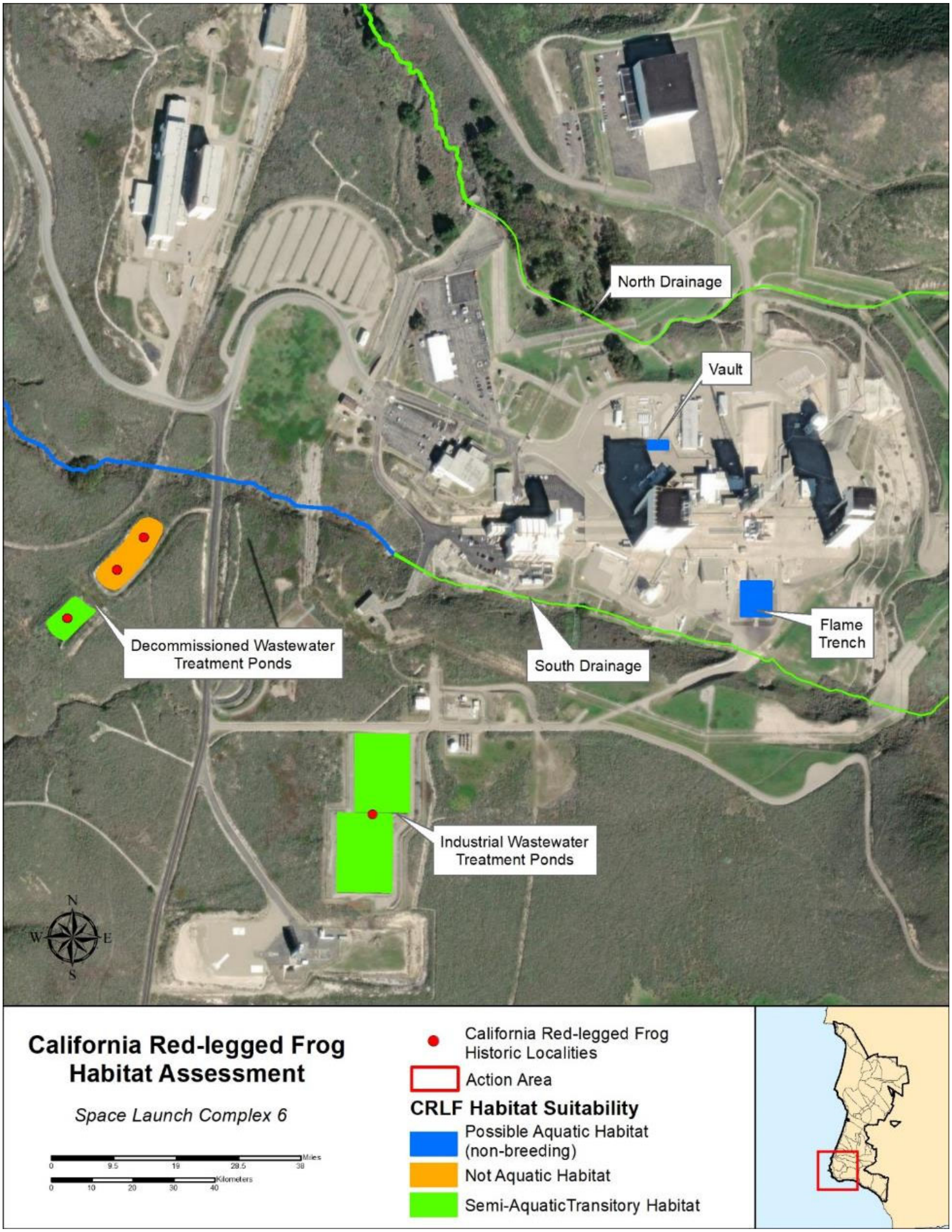

Figure 4.4-6. California red-legged frog habitat assessment of SLC-6.

Figure 4.4-7. Vault structure at SLC-6.

Figure 4.4-8. Flame trench at SLC-6.

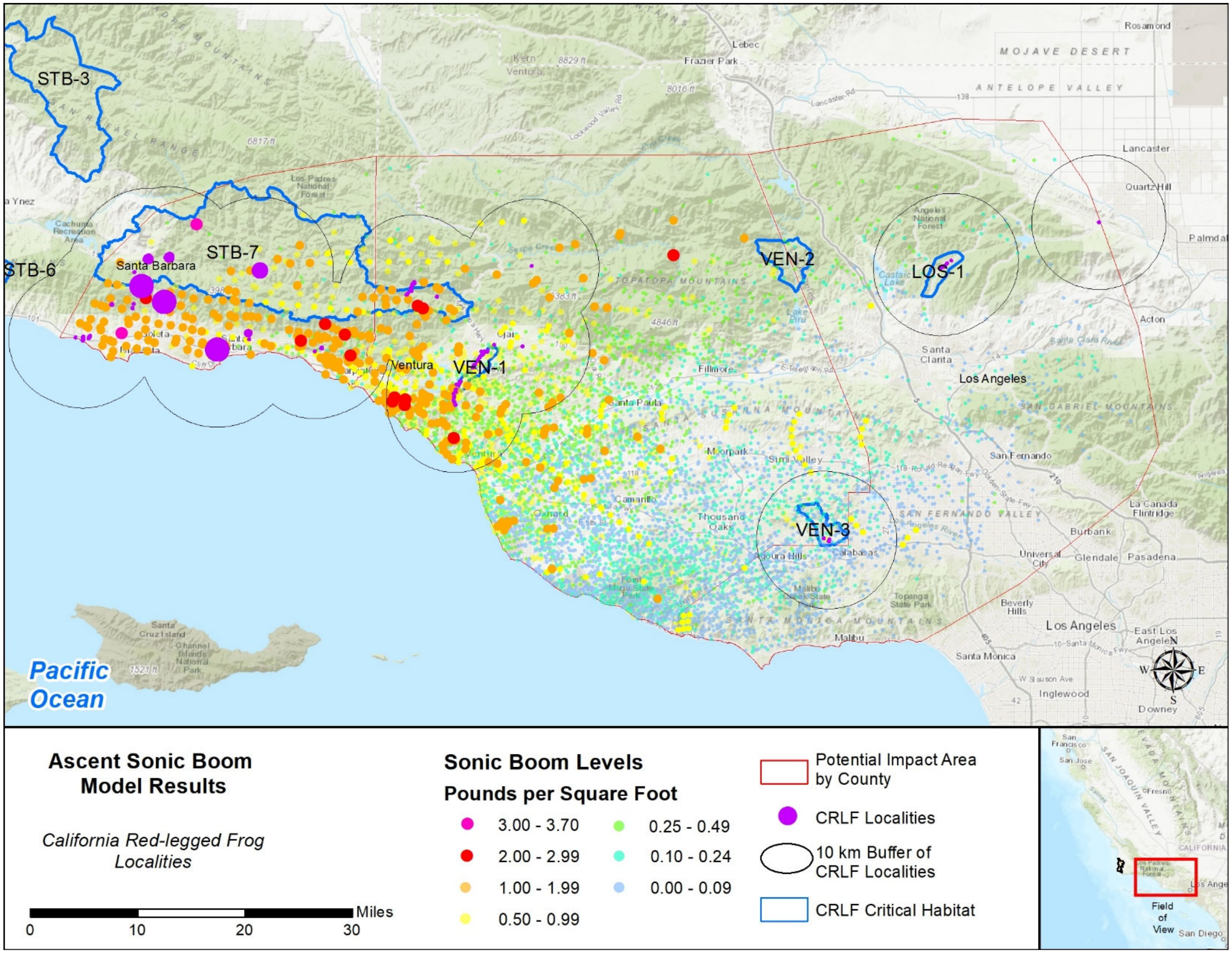

Figure 4.4-9. CRLF localities, Critical Habitat, and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.6).

4.5 Arroyo Toad (Federally Listed Endangered Species)

4.5.1 Status

The UFSWS listed the ARTO as endangered on 16 December 1994 (59 FR 64859-64867). The USFWS published a recovery plan for the ARTO in 1999 (USFWS 1999).

4.5.2 Life History

ARTO are relatively small toads that are typically found in shallow pools and sandy or gravely streams and creeks with sandy terraces with oaks, cottonwoods, or willows. Breeding occurs from February through July at open stretches with gravel or sandy substrates. Eggs hatch within four to six days and larvae require up to 85 days to develop into toads. Juveniles and adults burrow and overwinter on sandy terraces. ARTO's primary prey are native ant species, but may forage on a variety of invertebrates. Key threats to ARTO conservation include development of dams and water diversions; agriculture; off-road vehicles; invasive species that prey on ARTO; drought; and wildfires.

4.5.3 Occurrence within the Action Area

ARTO does not occur on VSFB but does occur within the region potentially impacted by ascent sonic booms during missions with easterly trajectories (Figure 4.5-1). Specifically, these areas include the upper Santa Ynez River, Sespe Creek, Piru Creek, and the upper Santa Clara River (Figure 4.5-1).

4.5.4 Critical Habitat

The USFWS issued a revised designation of Critical Habitat for the ARTO in 2011 (76 FR 7245-7467. In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, the Action Area overlaps Critical Habitat within inland Santa Barbara, Ventura, and Los Angeles Counties (Figure 4.5-2). The PCE for ARTO Critical Habitat include the following:

> (1) Rivers or streams with hydrologic regimes that supply water to provide space, food, and cover needed to sustain eggs, tadpoles, metamorphosing juveniles, and adult breeding toads. Breeding pools must persist a minimum of 2 months for the completion of larval development. However, due to the dynamic nature of southern California riparian systems and flood regimes, the location of suitable breeding pools may vary from year to year.
>
> - Breeding pools that are less than 6 inches deep;
> - Areas of flowing water with current velocities less than 1.3 ft per second; and
> - Surface water that lasts for a minimum of 2 months during the breeding season (a sufficient wet period in the spring months to allow arroyo toad larvae to hatch, mature, and metamorphose).
>
> (2) Riparian and adjacent upland habitats, particularly low-gradient (typically less than 6%) stream segments and alluvial streamside terraces with sandy or fine gravel substrates that support the formation of shallow pools and sparsely vegetated sand and gravel bars for breeding and rearing of tadpoles and juveniles; and adjacent valley bottomlands that

include areas of loose soil where toads can burrow underground, to provide foraging and living areas for juvenile and adult arroyo toads.

(3) A natural flooding regime, or one sufficiently corresponding to natural, that: (A) Is characterized by intermittent or near-perennial flow that contributes to the persistence of shallow pools into at least mid-summer; (B) Maintains areas of open, sparsely vegetated, sandy stream channels and terraces by periodically scouring riparian vegetation; and (C) Also modifies stream channels and terraces and redistributes sand and sediment, such that breeding pools and terrace habitats with scattered vegetation are maintained.

(4) Stream channels and adjacent upland habitats that allow for movement to breeding pools, foraging areas, overwintering sites, upstream and downstream dispersal, and connectivity to areas that contain suitable habitat.

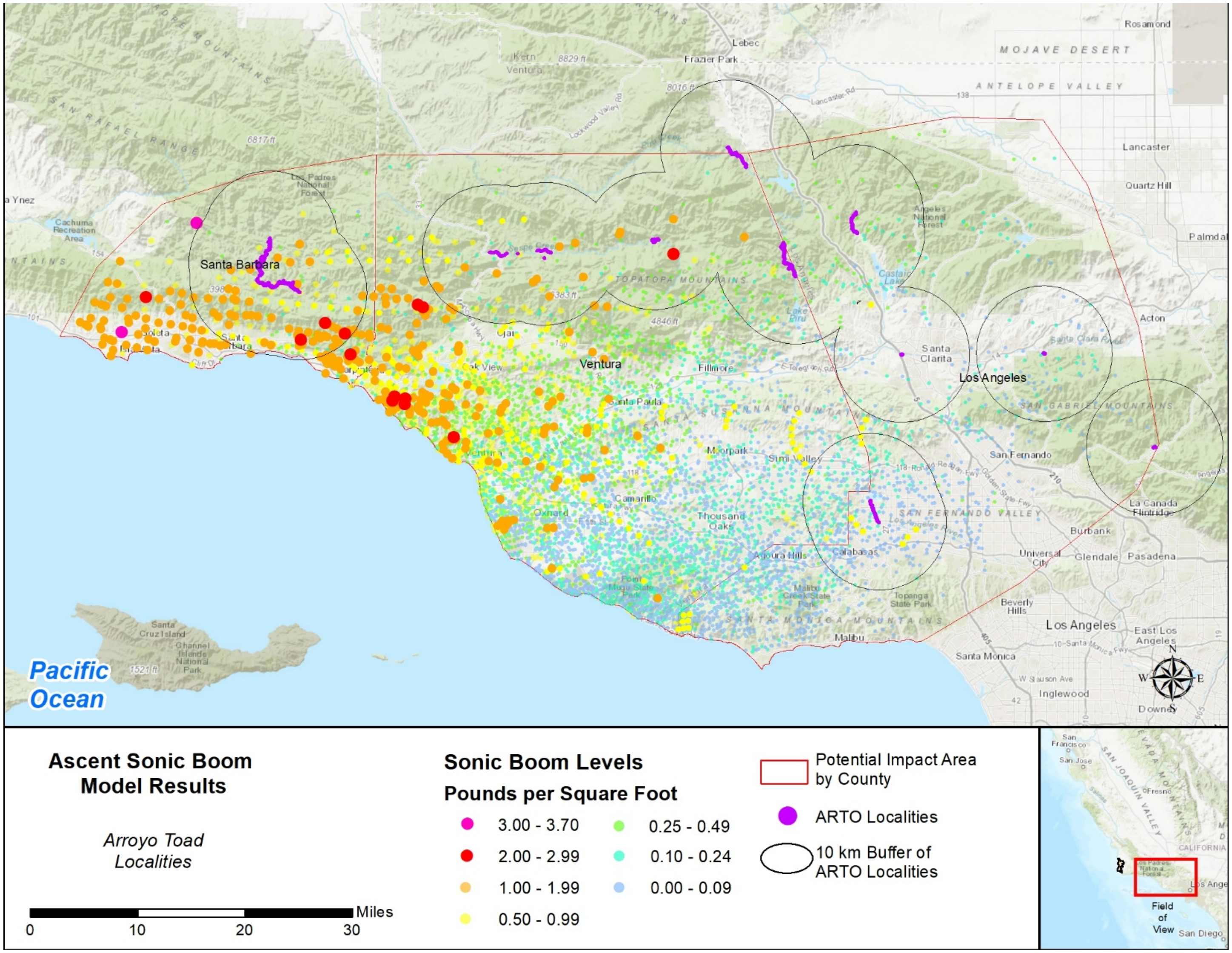

Figure 4.5-1. ARTO localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

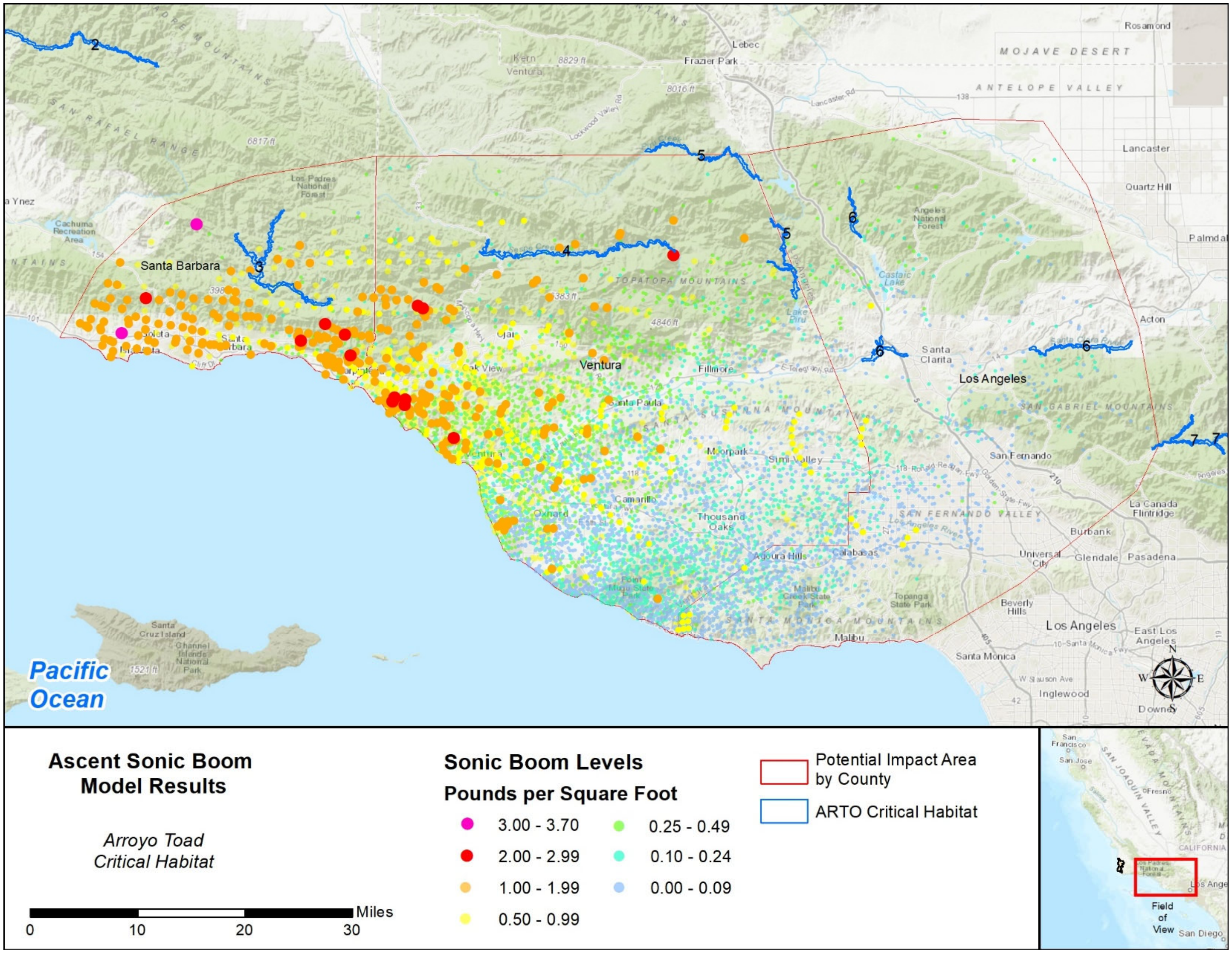

Figure 4.5-2. ARTO Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.6 Marbled Murrelet (Federally Listed Threatened Species)

4.6.1 Status

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

4.6.2 Life History

The MAMU is a small seabird that breeds along the Pacific coast. It forages in nearshore marine waters on small fish and invertebrates, and flies inland to breed. The species requires abundant prey within foraging habitat. Among alcids, the species is unique because it uses old-growth coniferous forests and mature trees for nesting (USFWS 1997). MAMU are wing-pursuit divers.

Although little was historically known about the MAMU movement and home range, more information is becoming available. The first MAMU nest was not documented until 1974. Since then, the MAMU's home range has been determined to be 253 square miles (mi^2) for non-nesters and 93 mi^2 for nesters within California. In addition, at-sea resting areas have also been observed an average of 3.2 mi from the mouths of drainages. MAMU spend nighttime hours resting in the ocean in these at-sea resting areas and commute to foraging areas during the day. Nests have been observed from sea level to 5,020 ft (USFWS 2009). The primary threats to MAMU conservation include habitat loss due to urbanization and logging; oil spills; climate change; and entanglement hazards in the ocean.

4.6.3 Occurrence Within the Action Area

MAMU range from Alaska to California and may occur as far south as Baja California. The species is considered rare to very rare much of the year in Santa Barbara County. However, the species may be present north of VSFB in the late summer and would be considered casual in the spring (Lehman 2020; eBird 2024). There is no known or suitable breeding habitat for MAMU on VSFB. As such, only non-breeding individuals would occur within portions of the Action Area subject to noise impacts (Figure 4.6-1 through Figure 4.6-5; eBird 2024).

MAMU have been observed semi-regularly off the coast in nearshore waters between the Santa Maria River and offshore of VSFB from on-land observation sites (Figure 4.6-1 through Figure 4.6-5; eBird 2024). Specifically, one individual was observed at an unreported distance offshore from an observation site located approximately 0.5 mi west of SLC-4 in 2011 (Figure 4.6-1 through Figure 4.6-5; eBird 2024). Two separate sightings were also documented in 1995 offshore of Purisima Point (Figure 4.6-1 through Figure 4.6-3; eBird 2024). MAMU has never been documented breeding on VSFB, nor is any old-growth coniferous forest present on VSFB or in the Action Area.

4.6.4 Critical Habitat

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

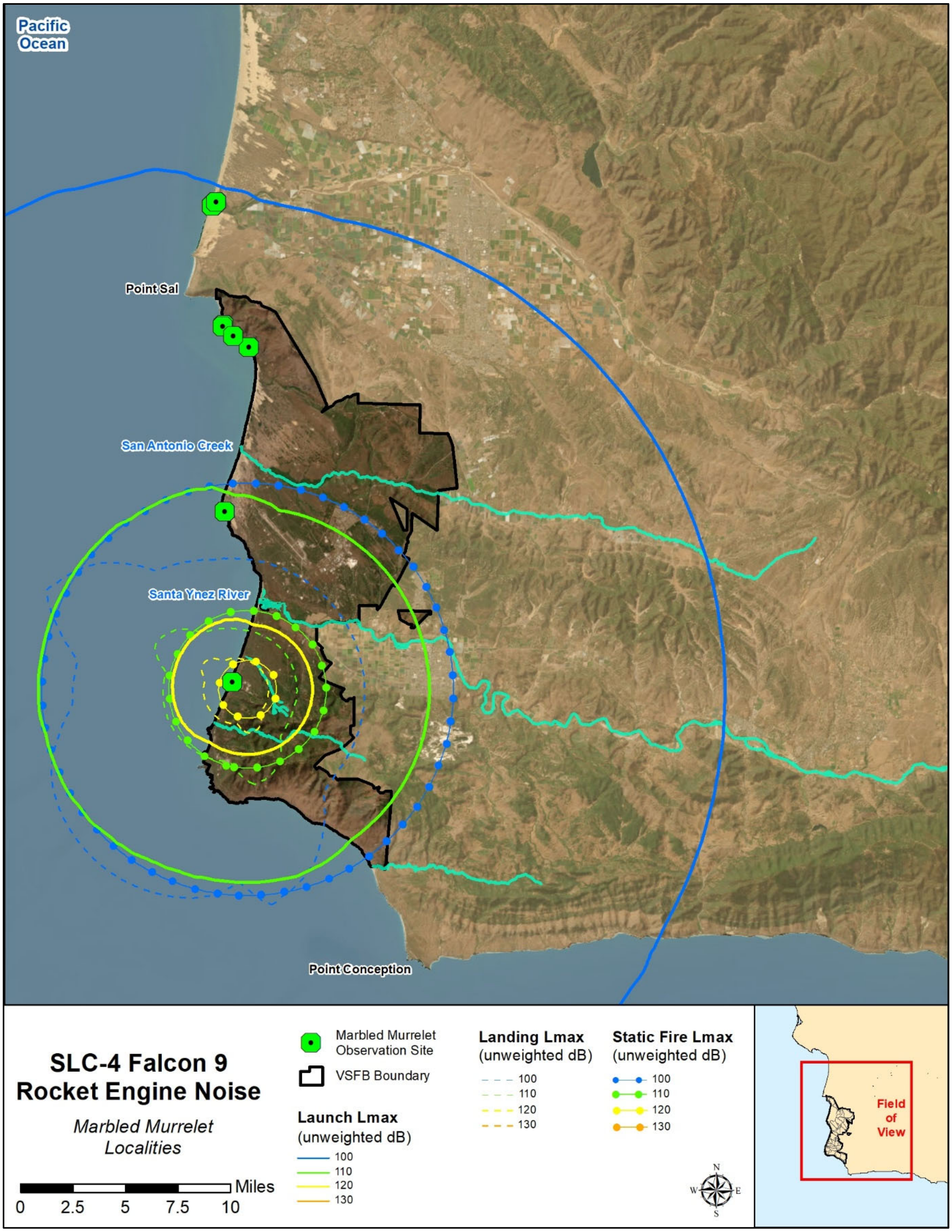

Figure 4.6-1. Marbled murrelet observation sites and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise (Note: birds were observed at an unrecorded distance offshore of these observation sites).

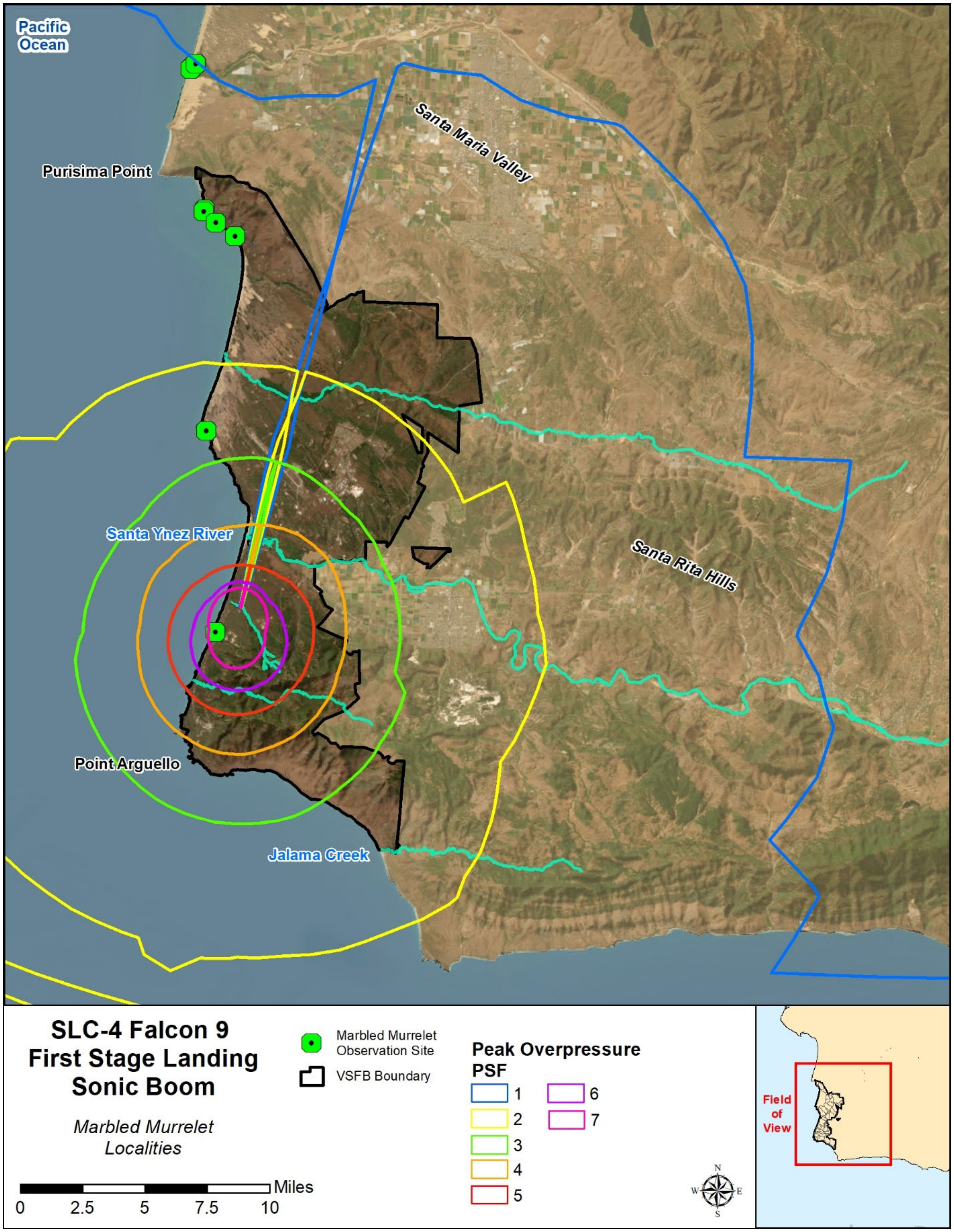

Figure 4.6-2. Marbled murrelet observation sites and sample sonic boom model results for SLC-4 landing events (Note: birds were observed at an unrecorded distance offshore of these observation sites).

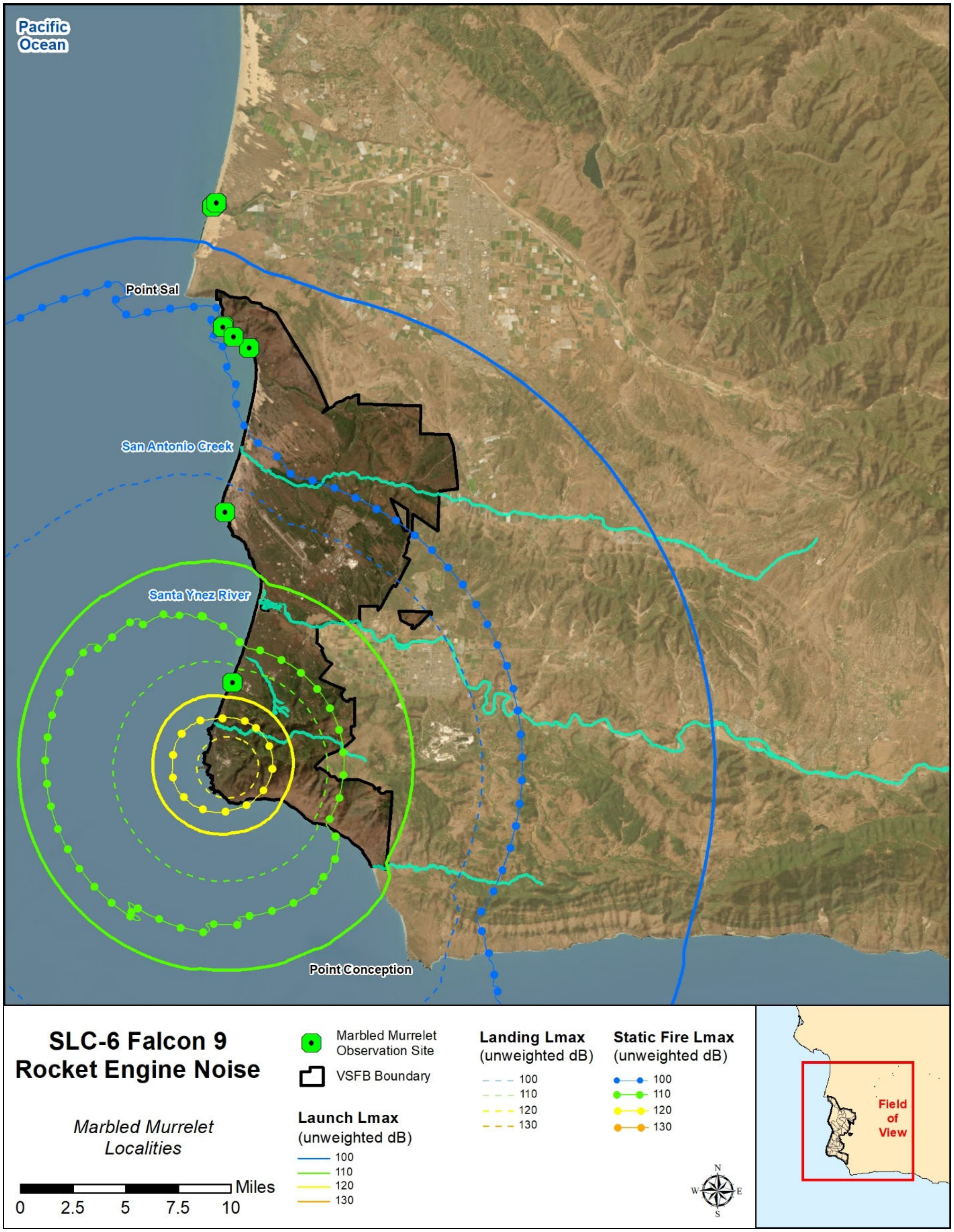

Figure 4.6-3. Marbled murrelet observation sites and modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise (Note: birds were observed at an unrecorded distance offshore of these observation sites).

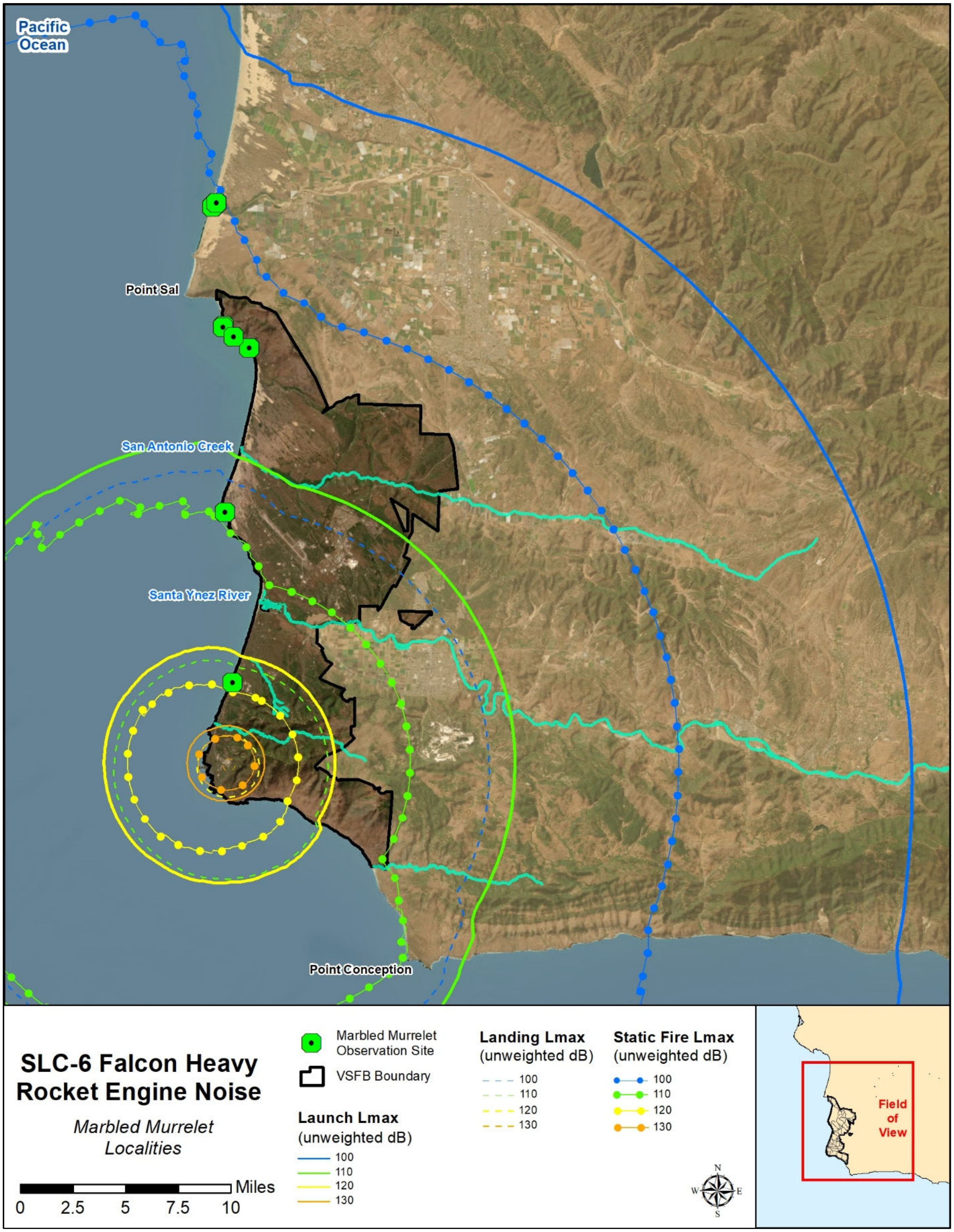

Figure 4.6-4. Marbled murrelet observation sites and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise (Note: birds were observed at an unrecorded distance offshore of these observation sites).

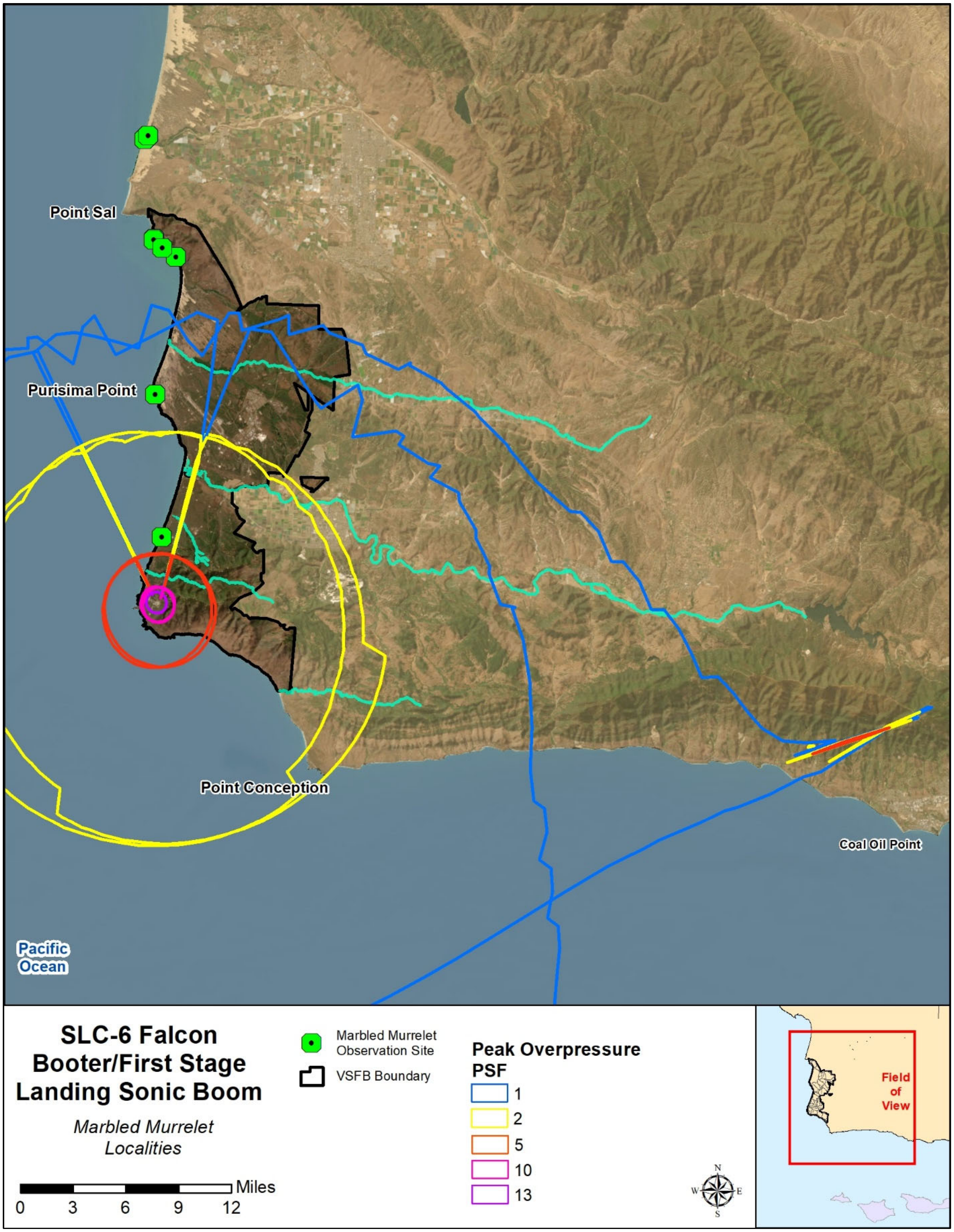

Figure 4.6-5. Marbled murrelet observation sites and two sample sonic boom model results for SLC-6 booster/first stage landing events (Note: birds were observed at an unrecorded distance offshore of these observation sites).

4.7 Southwestern Willow Flycatcher (Federally Listed Endangered Species)

4.7.1 Status

The UFSWS listed the SWFL as endangered on 27 February 1995 (60 FR 10695-10715). In 2002, USFWS issued a Final Recovery Plan to stabilize and restore SWFL populations (USFWS 2002b).

4.7.2 Life History

SWFL in California, are spring and summer residents of willow thickets in riparian habitats. SWFLs typically arrive at breeding grounds in early May and depart in August after breeding has been completed. SWFL are closely tied to dynamic riparian habitats featuring an overlapping mosaic of dense willows, wetlands, and open water. SWFL historically bred along the Santa Ynez River on VSFB west of the 13th Street Bridge, but progressive changes to habitat in this area has largely eliminated favored SWFL breeding habitat on VSFB. The key threats to SWFL conservation include habitat loss due to water impoundments, groundwater pumping, and altered streamflow; habitat alteration by invasive plants; urban development; fire; and nest parasitism by brown-headed cowbirds (*Molothrus ater*).

4.7.3 Occurrence in the Action Area

The first documented SWFL breeding territory on the Santa Ynez River on VSFB was found at the Miguelito Wetland in 1992 (Figure 4.7-1 through **Error! Reference source not found.**; Ball et al. 2012). This site is approximately 3.9 mi north of SLC-4, but it has not been occupied since 1994 (Ball et al. 2012). A small population of between one and six SWFL was consistently found from 1995 to 2003 further east along the Santa Ynez River at two sites: an area immediately west of the 13th Street Bridge and the Wildlife Natural Resources Area (Figure 4.7-1 through Figure 4.7-5). The 13th Street Bridge territory included a nest site near the 13th Street Bridge (Holmgren & Collins 1999) where breeding was documented in 1998 (Farmer et al. 2003). SWFL were last seen at this site in 2000, which was subsequently destroyed by high water flow events during the winter storms of 2000-2001 (Farmer et al. 2003). SWFL were last documented at the Wildlife Natural Resources Area in 2003 (Farmer et al. 2003) and have not been re-documented during subsequent surveys.

Riparian point count surveys conducted on the Santa Ynez River on VSFB from 2004 to 2011 did not detect SWFL in the vicinity of the 13th Street Bridge (Seavy et al. 2012). SWFL were also not detected during targeted surveys of the Santa Ynez River for SWFL in 2003, 2004, 2012, and 2017 (SRS Technologies, Inc. 2004; Ball et al. 2012; Southern Sierra Research Station 2017). In addition, four surveys in the riparian forest on VSFB along the Santa Ynez River during the 2011 breeding season did not detect the species (DiGaudio et al. 2011). If SWFL were to be present on VSFB during a launch event, they would likely be migrating or foraging and present for a short period of time.

Historic modifications to the Santa Ynez River, including the installation of the former 35th Street Bridge and the bridges at 13th Street and Floredale Avenue have resulted in increased straightening and channelization of flow. The historic impacts contributed to the progressive downcutting of the Santa Ynez River and lead to a gradual separation of the river elevation from riparian habitat (ESA PWA 2010). As the level of the channel dropped, much of the riparian habitat on the upper terrace of the floodplain was cut off from regular inundation (ESA PWA 2010). Consequently, aging riparian trees were not being replaced and interstitial wetlands have disappeared, rendering this habitat unsuitable for SWFL occupancy. The riparian habitat along the incised channel is largely confined to narrow banks and lacks complexity. This progressive deterioration of the floodplain has likely contributed to the absence of SWFL from the Santa Ynez River on VSFB in recent years, and future SWFL breeding on VSFB is unlikely. Both the 13th Street Bridge and Floredale Bridges have been re-designed and replaced in recent years to allow more river movement, but effects on downstream habitats have yet to be determined.

One territorial male SWFL was incidentally detected at the Santa Ynez River adjacent to Buellton, approximately 24.5 mi east of SLC-6, in 2022; pairing was suspected but not confirmed (Griffith Wildlife Biology 2022). This area was historically occupied, with the most recent prior documented detections in 2017 (Southern Sierra Research Station 2017).

In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, SWFL occur in the upper Santa Ynez River and the Santa Clara River drainage in Ventura and Los Angeles Counties (Figure 4.7-6; CDFW 2024).

4.7.4 Critical Habitat

The USFWS issued a final rule on SWFL Critical Habitat on 3 January 2013 (78 FR 344-534). The USFWS excluded VSFB from SWFL Critical Habitat designation pursuant to Section 4(a)(3) of the ESA, based on the implementation of an INRMP (U.S. Air Force 2021). Off-base, Critical Habitat has been designated along the Santa Ynez River from Lompoc to Buellton (Figure 4.7-1 through Figure 4.7-5). In the region potentially impacted by ascent sonic booms during missions with easterly trajectories SWFL occur in the upper Santa Ynez River, the Ventura River, and the Santa Clara River drainage in Ventura and Los Angeles Counties (Figure 4.7-6). Critical habitat has been designated in these areas (Figure 4.7-7).

The PCEs for SWFL Critical Habitat include the following:

> (1) Riparian vegetation. Riparian habitat along a dynamic river or lakeside, in a natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs and some combination of:
>
> > (a) Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 6 to 98 ft. Lower-stature thickets (6 to 13 ft tall) are found at higher elevation riparian forests and tall-stature thickets are found at middle and lower-elevation riparian forests;
> >
> > (b) Areas of dense riparian foliage at least from the ground level up to approximately 13 ft above ground or dense foliage only at the shrub or tree level as a low, dense canopy;
> >
> > (c) Sites for nesting that contain a dense (about 50 to 100%) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground);
> >
> > (d) Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a

variety of habitat that is not uniformly dense. Patch size may be as small as 0.25 ac or as large as 175 ac.

(2) Insect prey populations. A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs Homoptera).

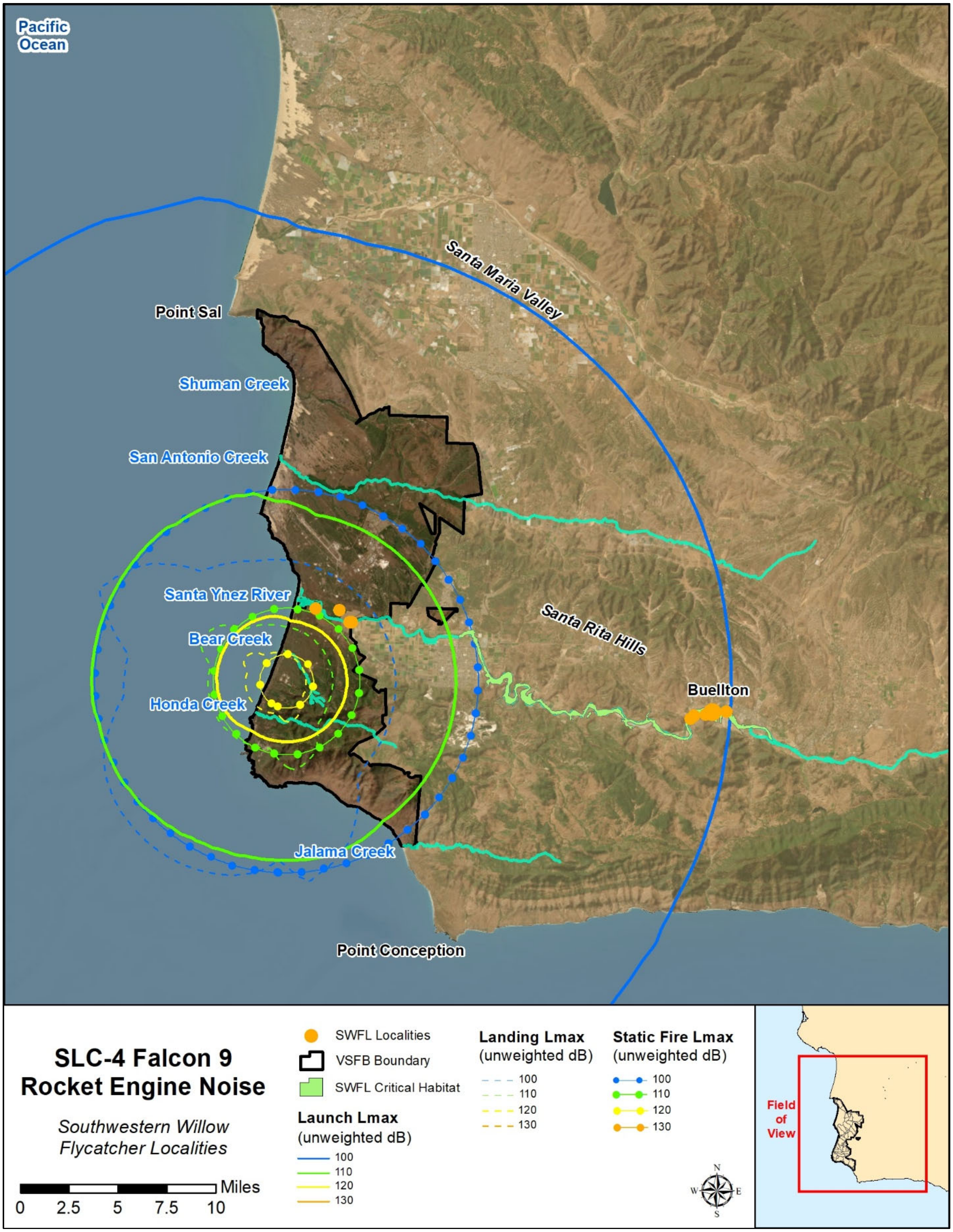

Figure 4.7-1. Southwestern willow flycatcher localities and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

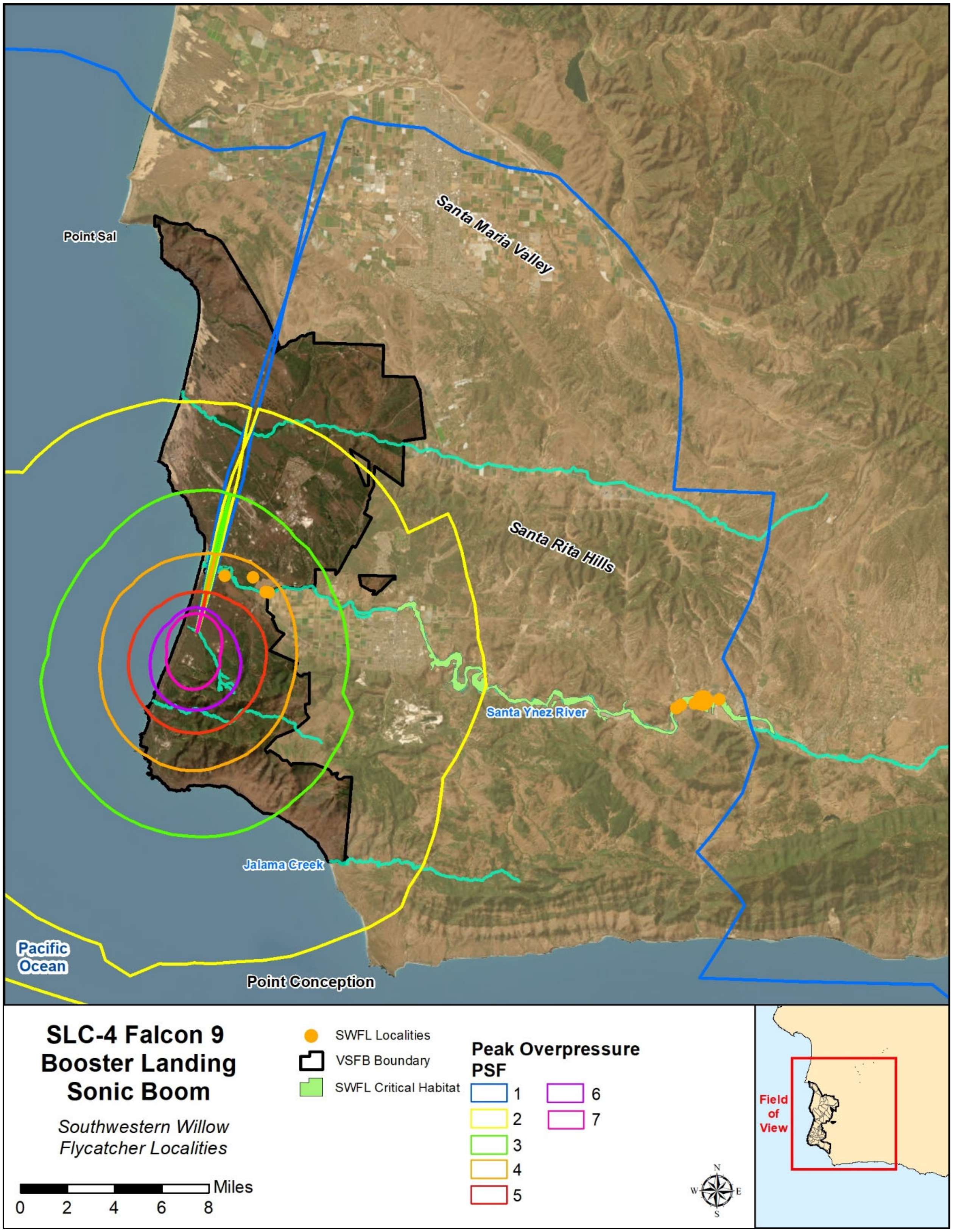

Figure 4.7-2. Southwestern willow flycatcher localities and sample SLC-4 landing sonic boom model results.

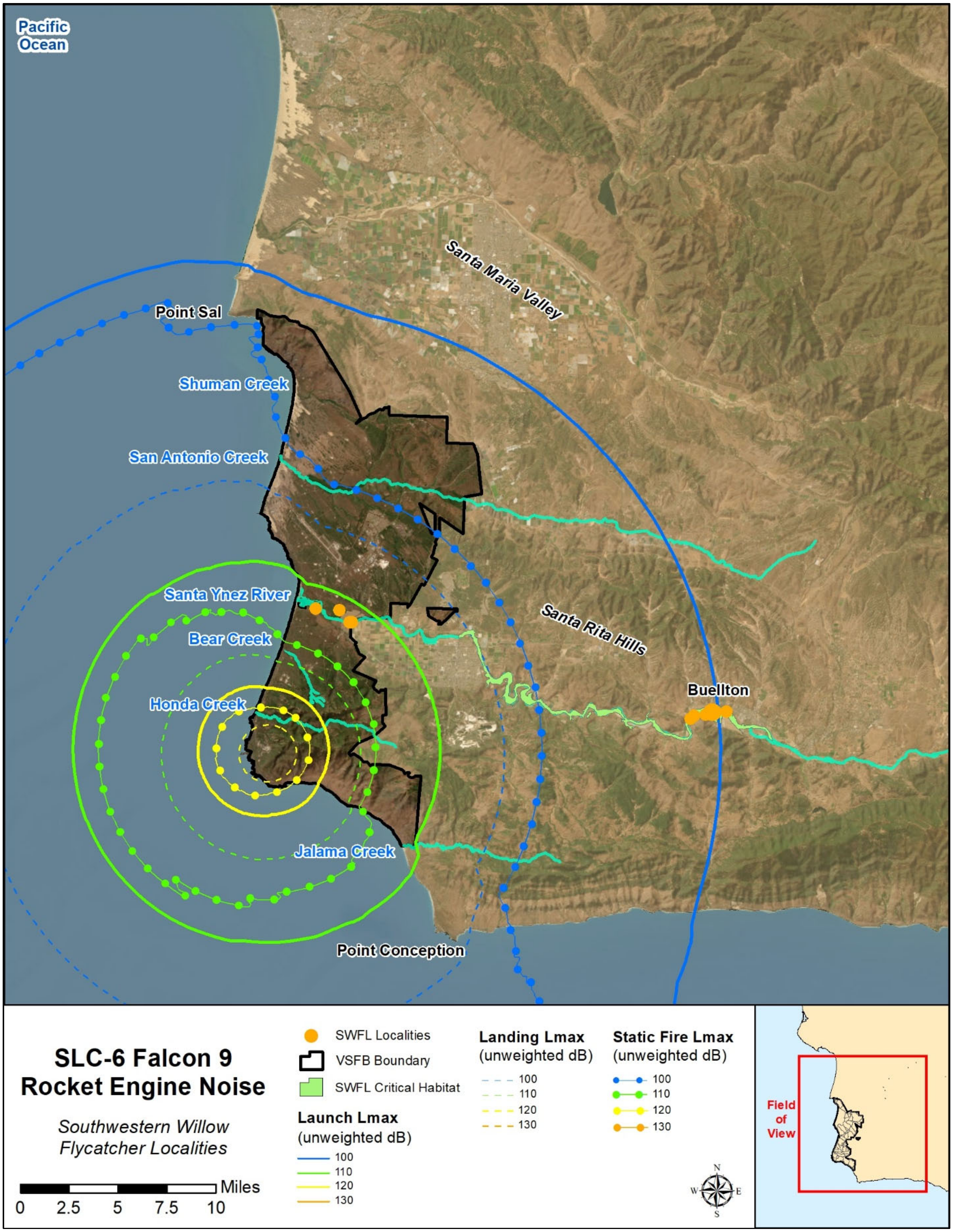

Figure 4.7-3. Southwestern willow flycatcher localities modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

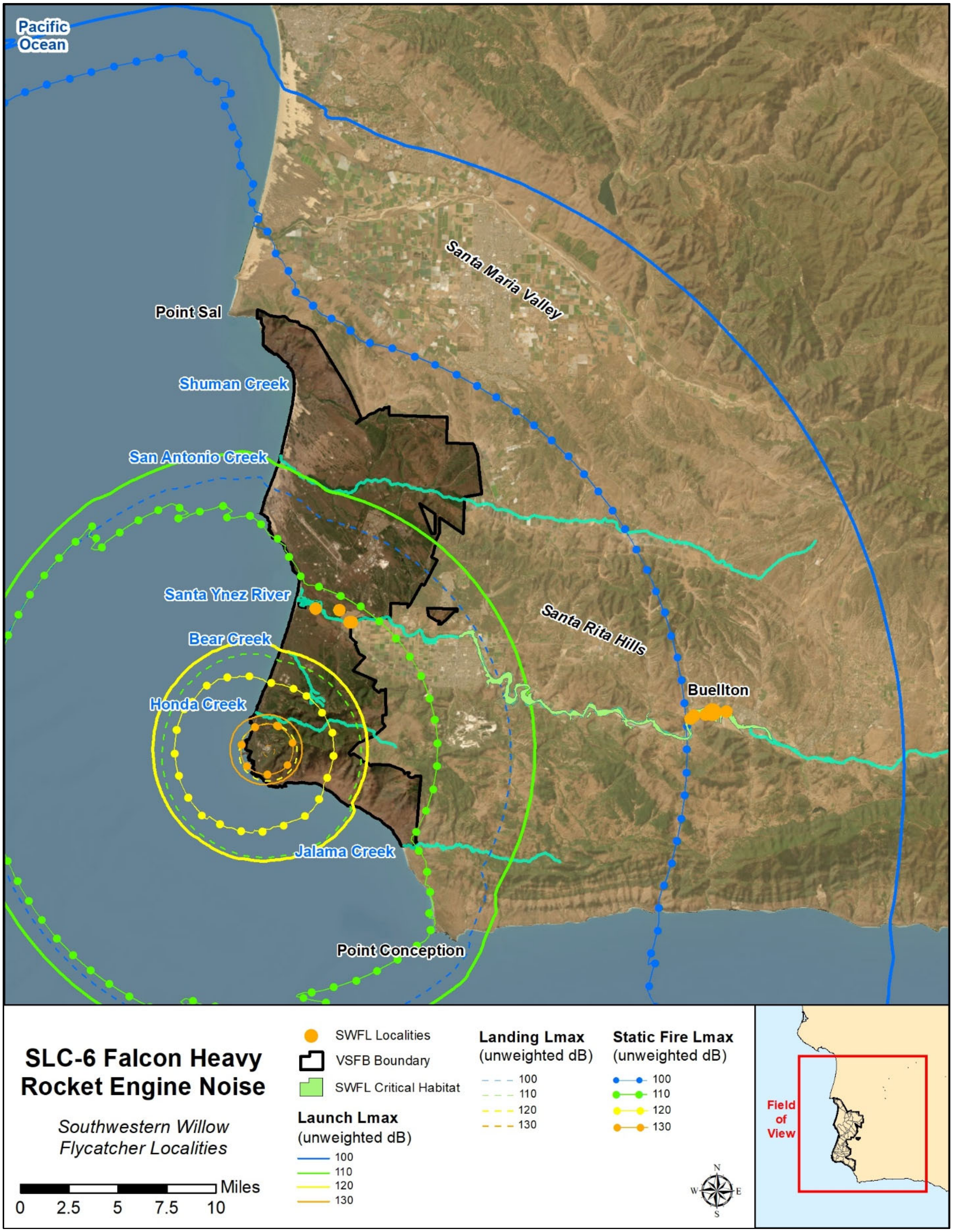

Figure 4.7-4. Southwestern willow flycatcher localities and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

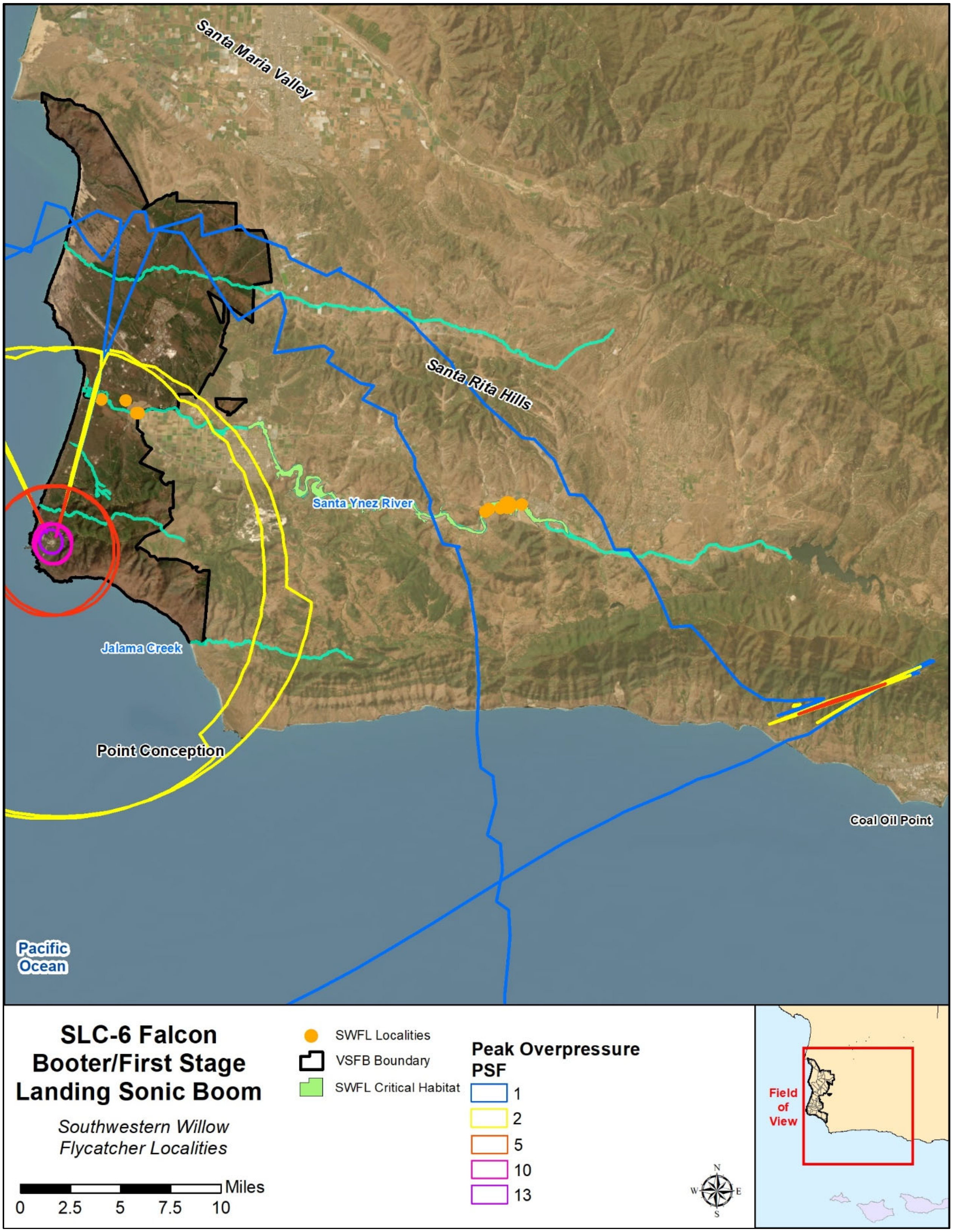

Figure 4.7-5. Southwestern willow flycatcher localities and two sample SLC-6 booster/first stage landing sonic boom model results.

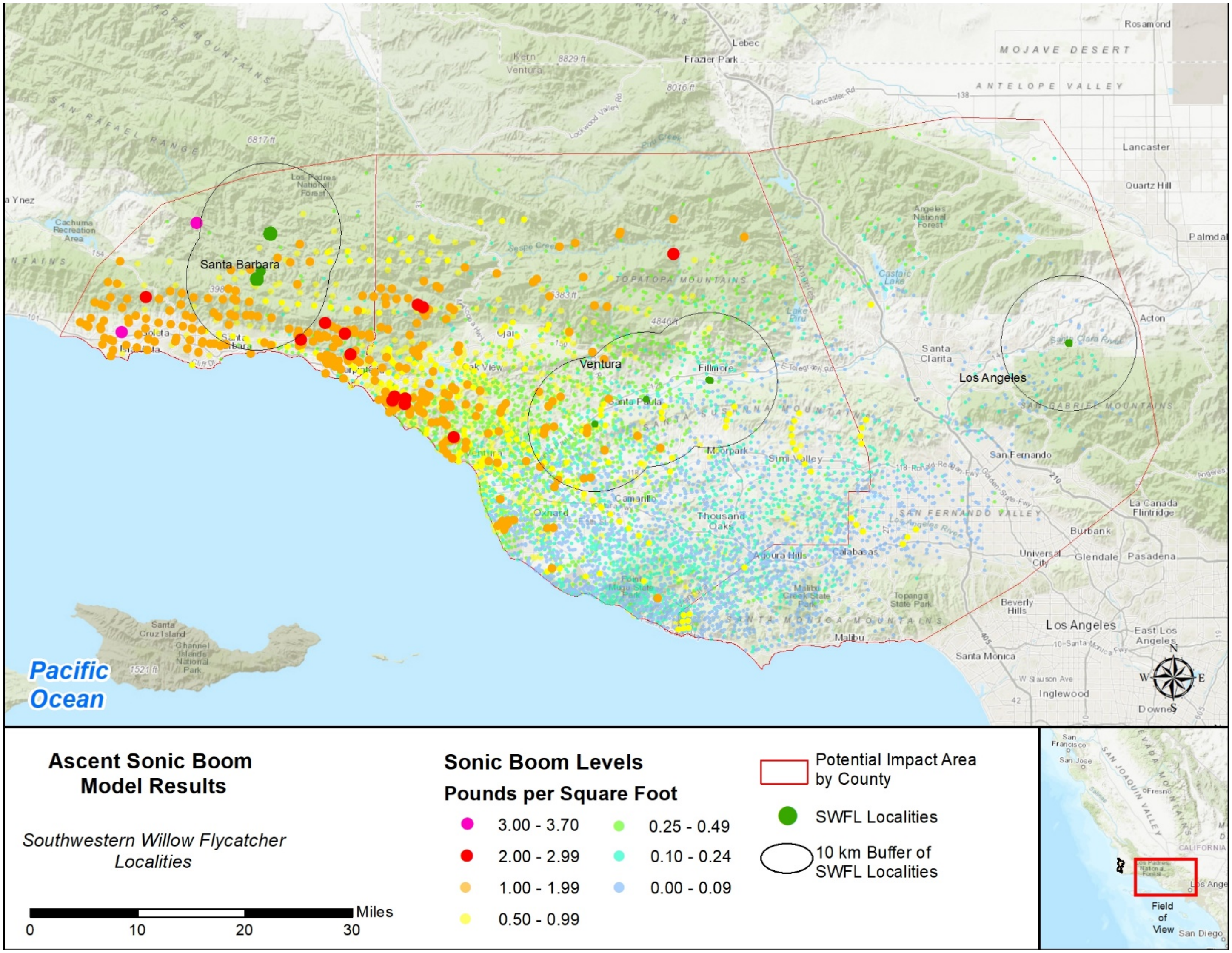

Figure 4.7-6. SWFL localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

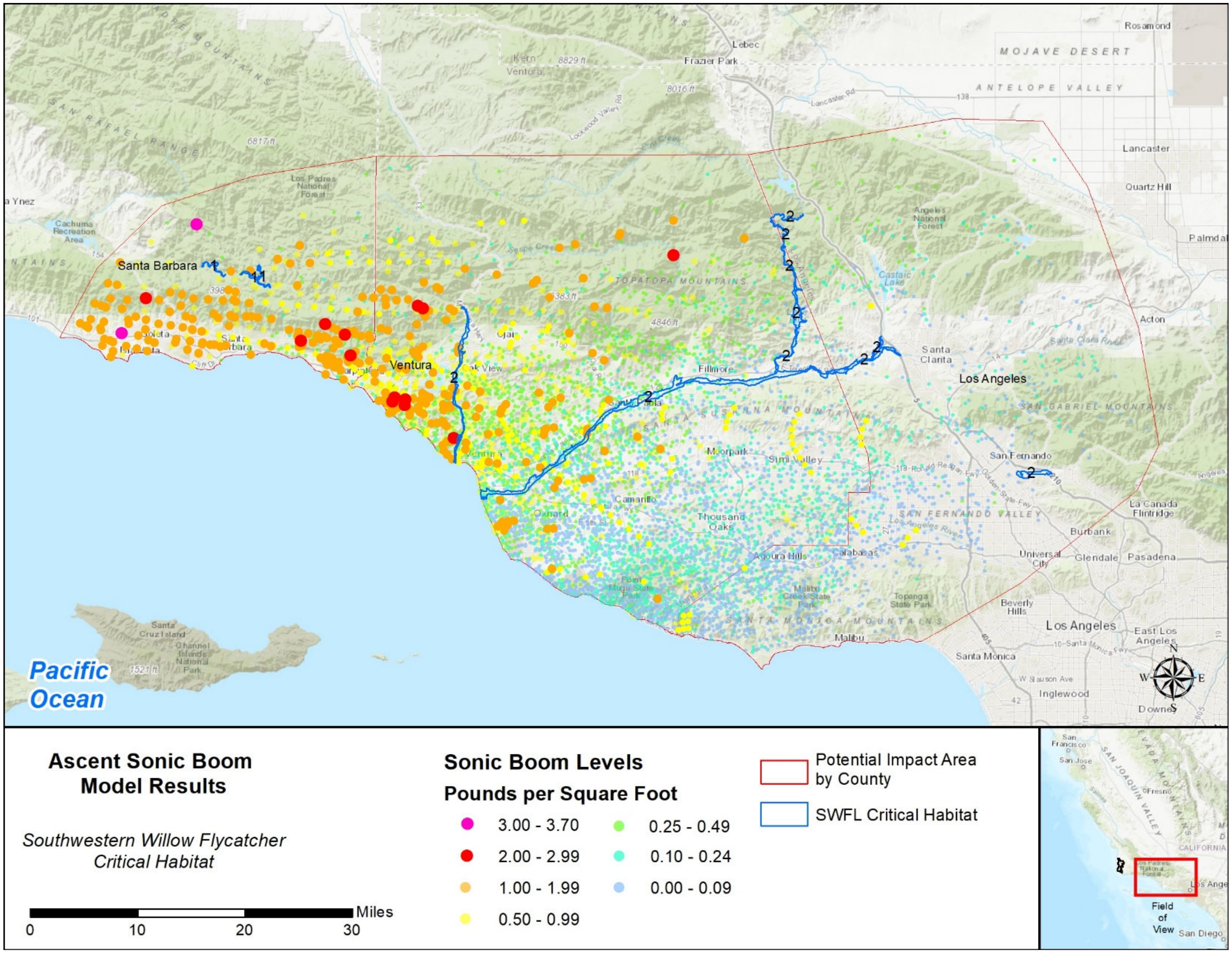

Figure 4.7-7. SWFL Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.8 Least Bell's Vireo (Federally Listed Endangered Species)

4.8.1 Status

The USFWS listed the LBVI as federally endangered in May 1986 (51 FR 16474-16482). A draft recovery plan was published in 1998 (USFWS 1998).

4.8.2 Life History

The LBVI is a small bird that is approximately 4.5 to 5 inches in length. This species has short, rounded wings, a short straight bill, and a faint white eye ring. Feathers are mostly gray above and pale below. LBVI forage in bushes and shrubs, preying on spiders and insects (USFWS 1998). LBVI overwinter in southern Baja California, Mexico (Kus 2002) and migrate north to nest from mid-March to April (USFWS 1998). Breeding habitat in coastal California is primarily willow-riparian woodlands (USFWS 1998). The primary threats to LBVI conservation include habitat loss due to development and agriculture; nest parasitism by brown-headed cowbirds; habitat alteration as a result of invasive plants; and habitat degradation due to fires, groundwater extraction, and changes in streamflow regimes; and drought.

4.8.3 Occurrence within the Action Area

Currently, most LBVI occur in eight counties south of Santa Barbara, with approximately half of all birds occurring on drainages within Marine Corps Base Camp Pendleton in San Diego County. LBVI, however, occurs as far north as Gilroy (Santa Clara County), and nesting birds have been documented at the Santa Clara River (Ventura County) and the Mojave River (San Bernardino County) as well. LBVI generally winter in southern Baja California, Mexico (Kus 2002).

Potential habitat for LBVI exists on VSFB and off-base in Santa Barbara County. There are no breeding records for LBVI on VSFB, and, until 2023, there were only 2 documented records of occurrence, both of which are east of the 13th Street Bridge and Santa Ynez River crossing approximately 7.6 mi northeast of SLC-6 (Figure 4.8-1 through Figure 4.8-5; CDFW 2024). Both of these records are more than 20 years old (Holmgren and Collins 1999). LBVI was not detected in riparian point count surveys conducted on VSFB in 1998, annually from 2000 to 2005, 2008, and 2010 (Seavy et al. 2012). However, in 2023, one lone male was detected in June at the Santa Ynez River near 13th Street Bridge (VSFB, unpublished data; Figure 4.8-1 through Figure 4.8-5). The individual was not detected on follow-up surveys and presumed to be a transient unpaired male.

In the off-Base project area, LBVI has been recorded at the Santa Ynez River adjacent to Buellton, approximately 24.5 mi east of SLC-6. In 2016, one territorial male was detected. This male was, however, presumed to be unpaired based on behavior (CDFW 2024; Figure 4.8-1 through Figure 4.8-5). A single male was again detected at this location in 2020, a transient male in 2021, and a territorial male in 2022 (Griffith Wildlife Biology 2022). The territorial male was not detected during multiple subsequent surveys conducted later in 2022 (Griffith Wildlife Biology 2022). At the Santa Maria River/Sisquoc River 4 paired males were detected in 2022, at locations approximately 28.0 to 30.1 mi northeast of SLC-6. Three of these pairs successfully raised young (Griffith Wildlife Biology 2022). In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, LBVI occur across eastern Santa Barbara, Ventura, and western Los Angeles Counties (Figure 4.8-6; CDFW 2024).

4.8.4 Critical Habitat

The USFWS designated Critical Habitat for this species in February 1994 (59 FR 4845-4867). In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, Critical Habitat has been designated in the upper Santa Ynez River in eastern Santa Barbara County and the Santa Clara River drainage in Ventura and Los Angeles Counties (Figure 4.8-7). The essential physical and biological features identified in the designation that support feeding, nesting, roosting, and sheltering are described as: "riparian woodland vegetation that generally contains both canopy and shrub layers, and includes some associated upland habitats" (59 FR 4845-4867).

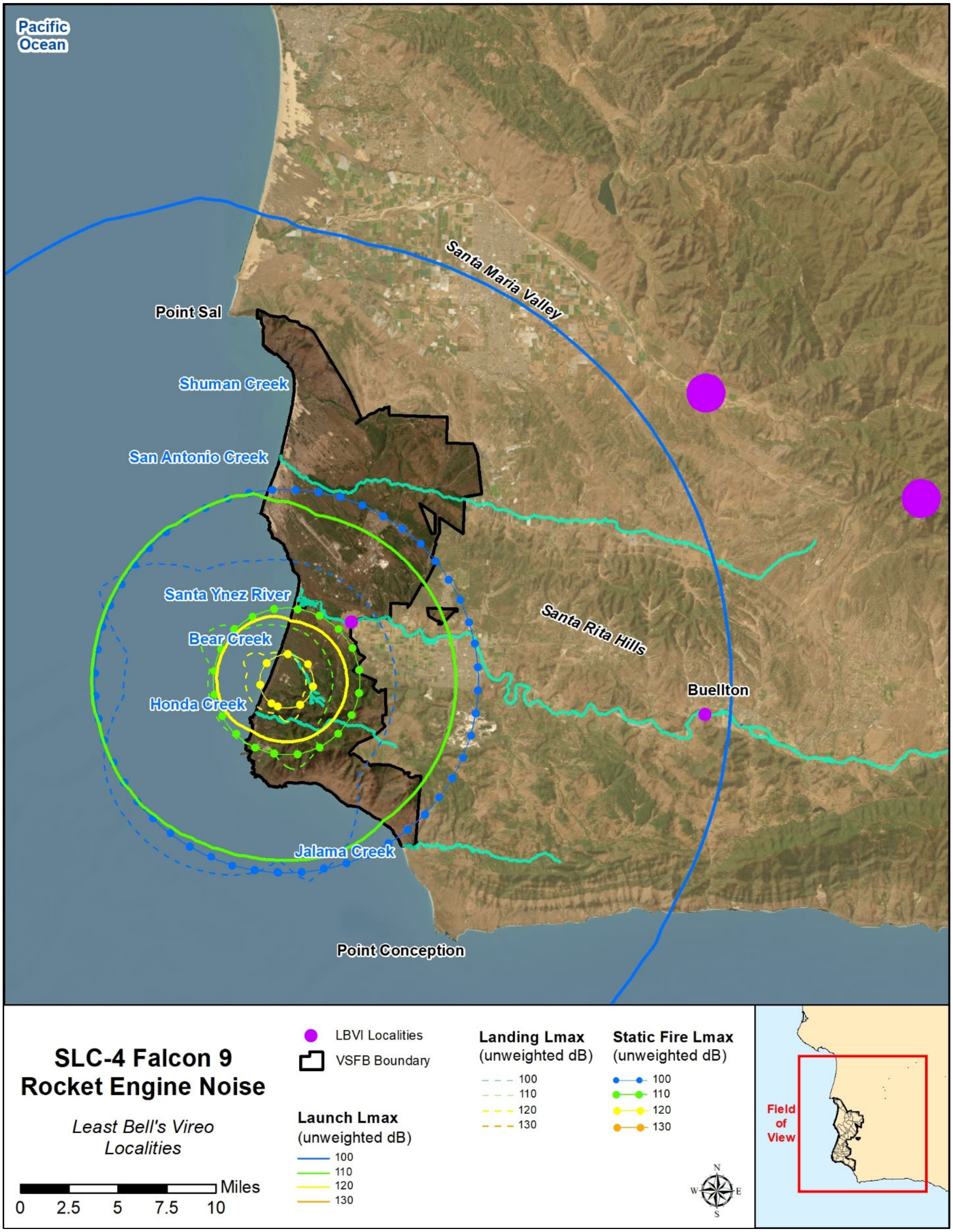

Figure 4.8-1. Least Bell's vireo localities and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

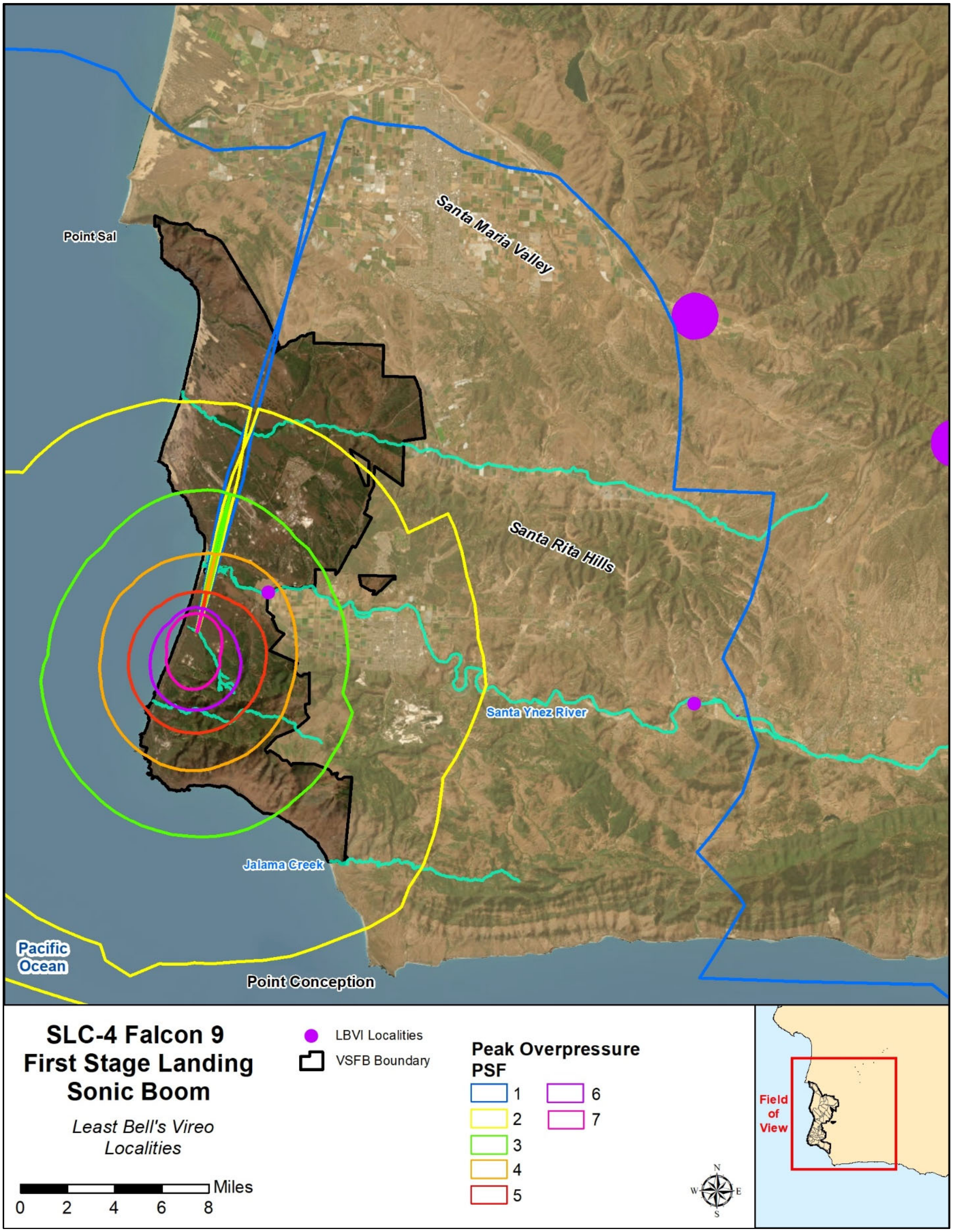

Figure 4.8-2. Least Bell's vireo localities and sample SLC-4 landing sonic boom model results.

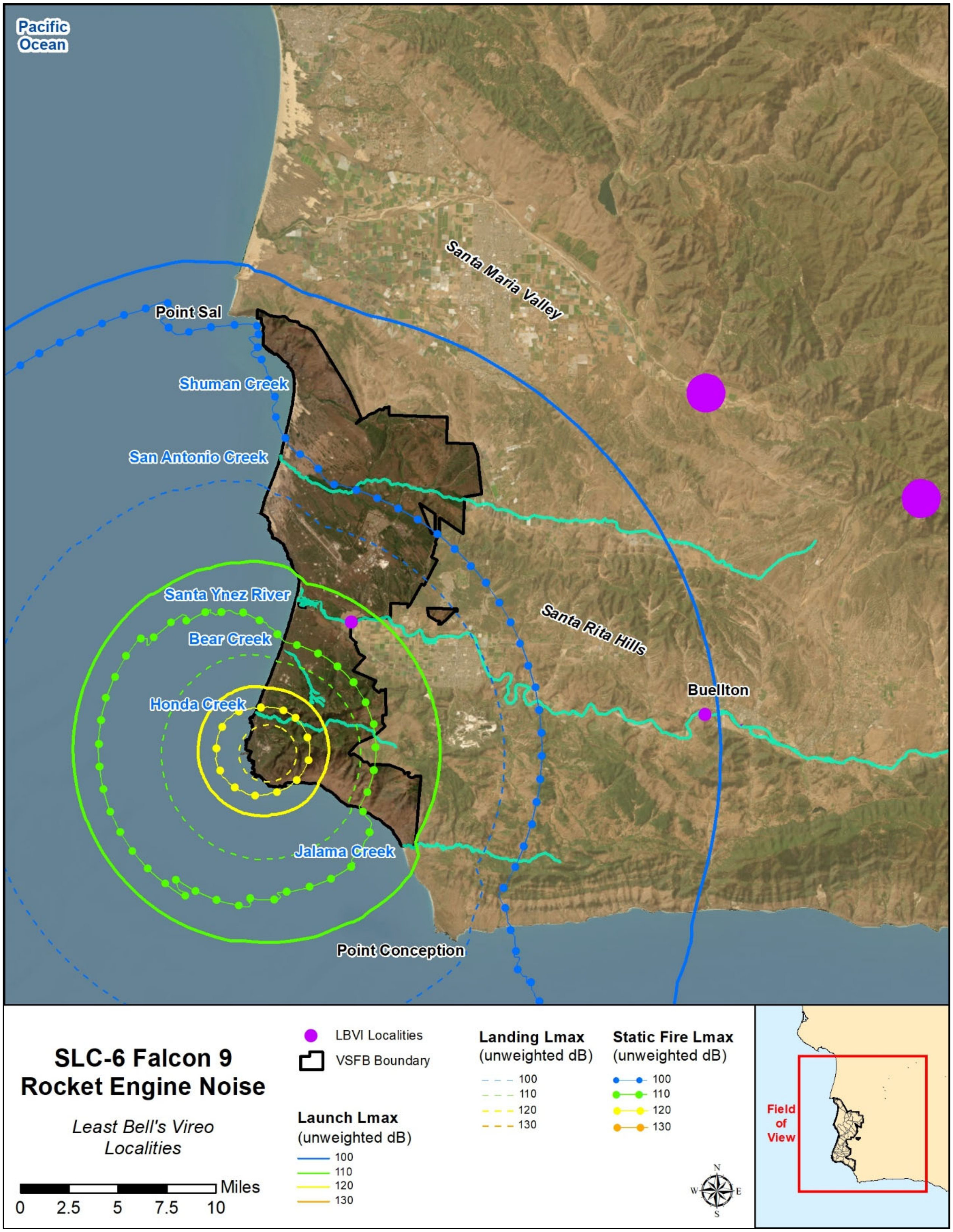

Figure 4.8-3. Least Bell's vireo localities modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

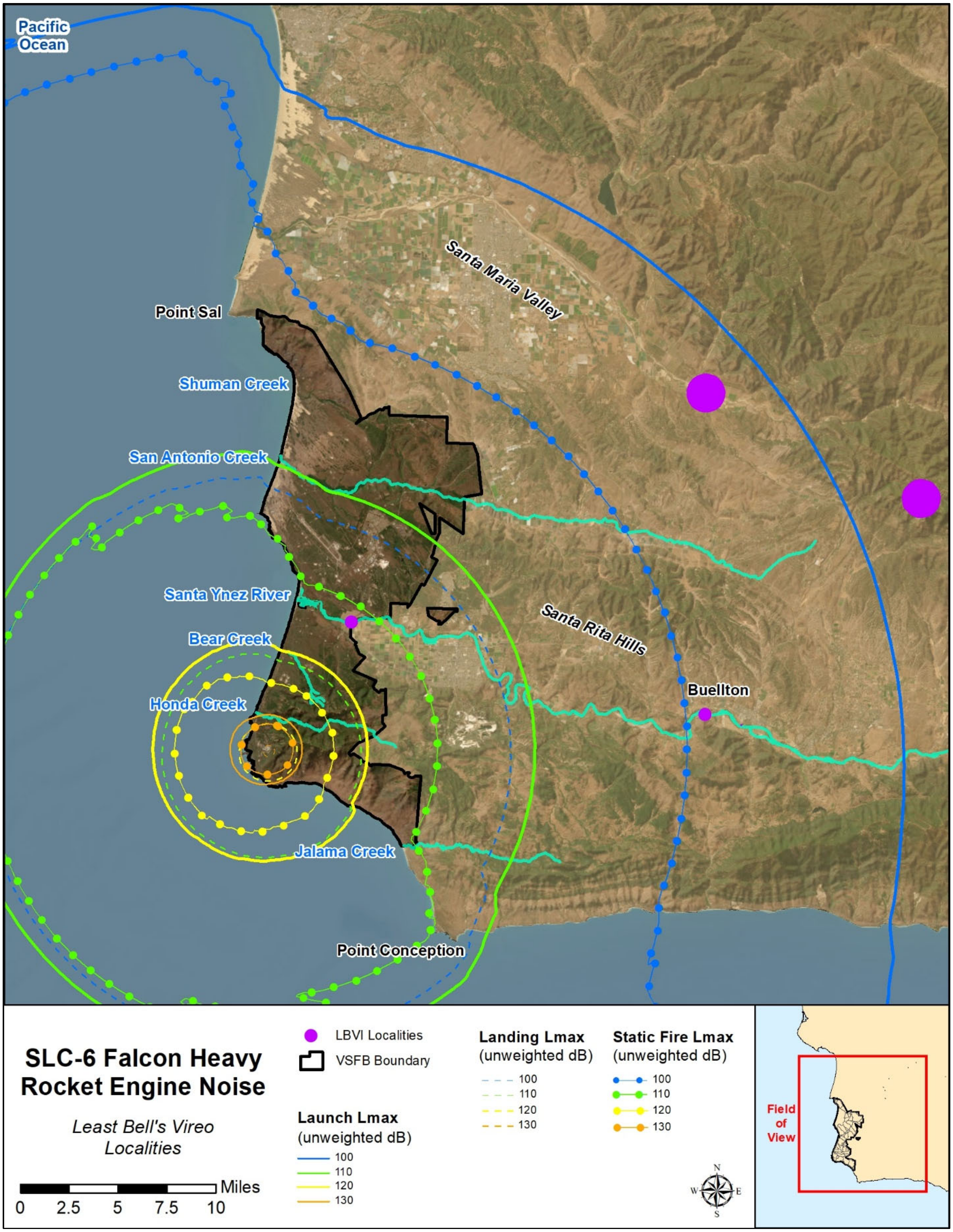

Figure 4.8-4. Least Bell's vireo localities and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

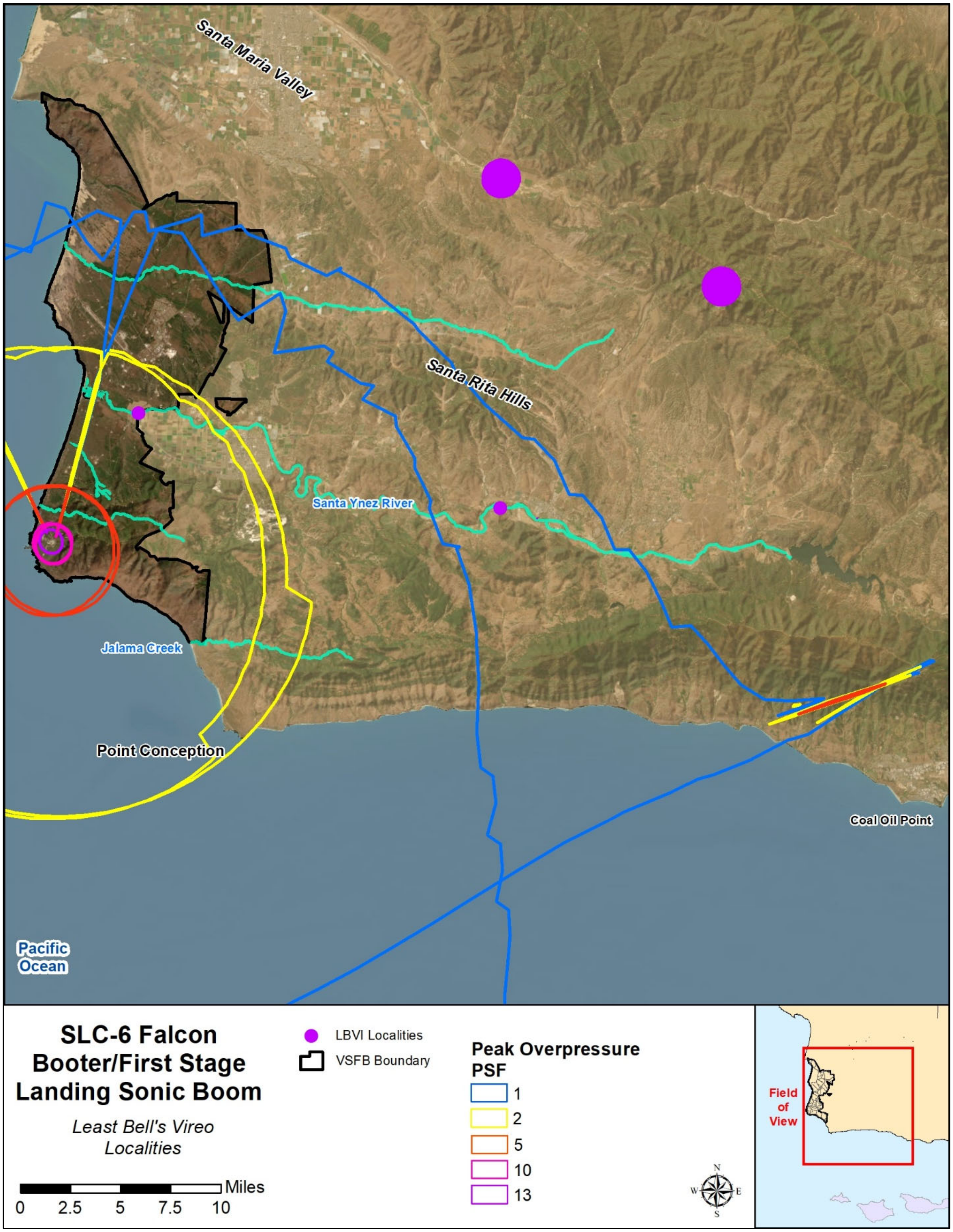

Figure 4.8-5. Least Bell's vireo localities and two sample SLC-6 landing sonic boom model results.

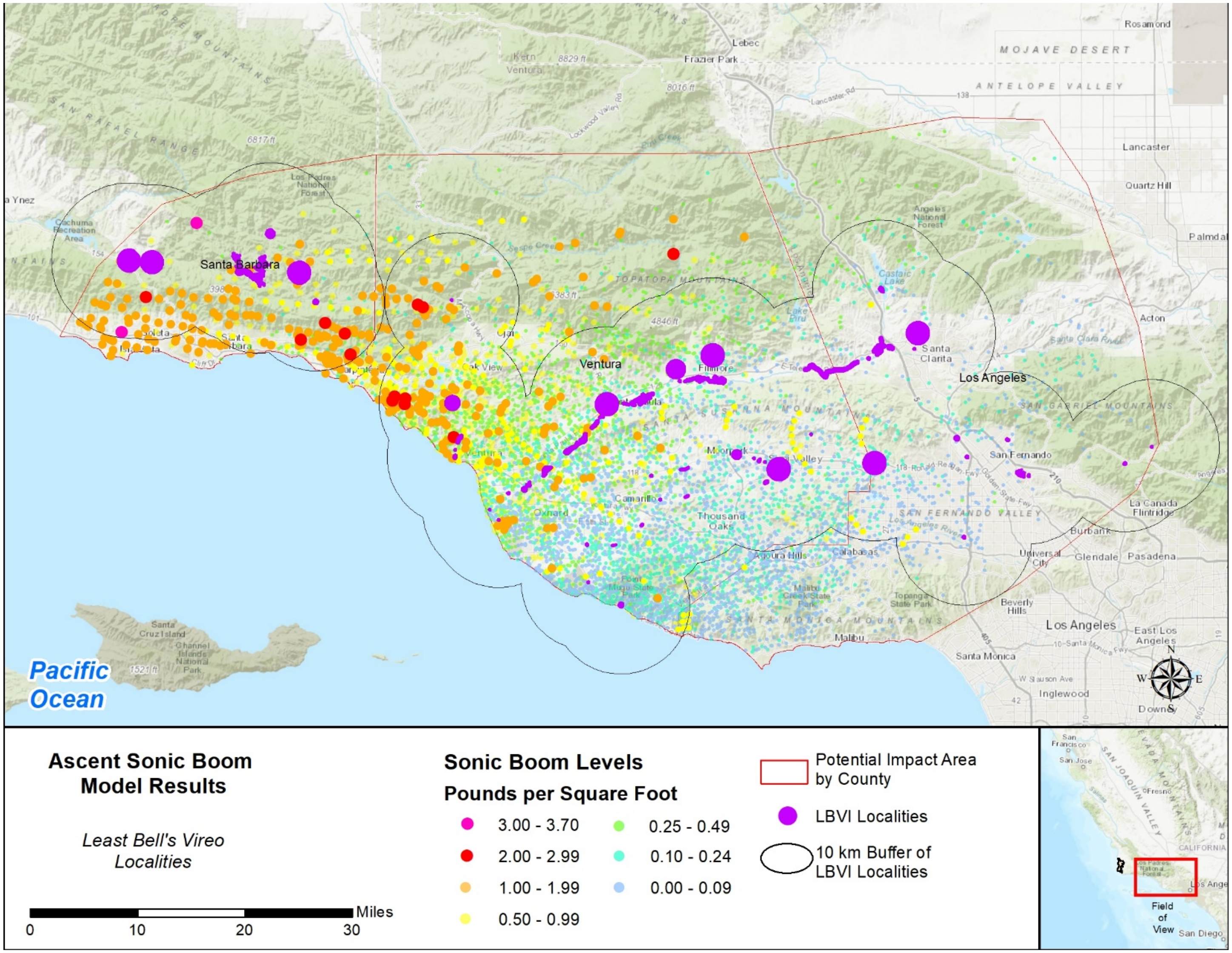

Figure 4.8-6. LBVI localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.6).

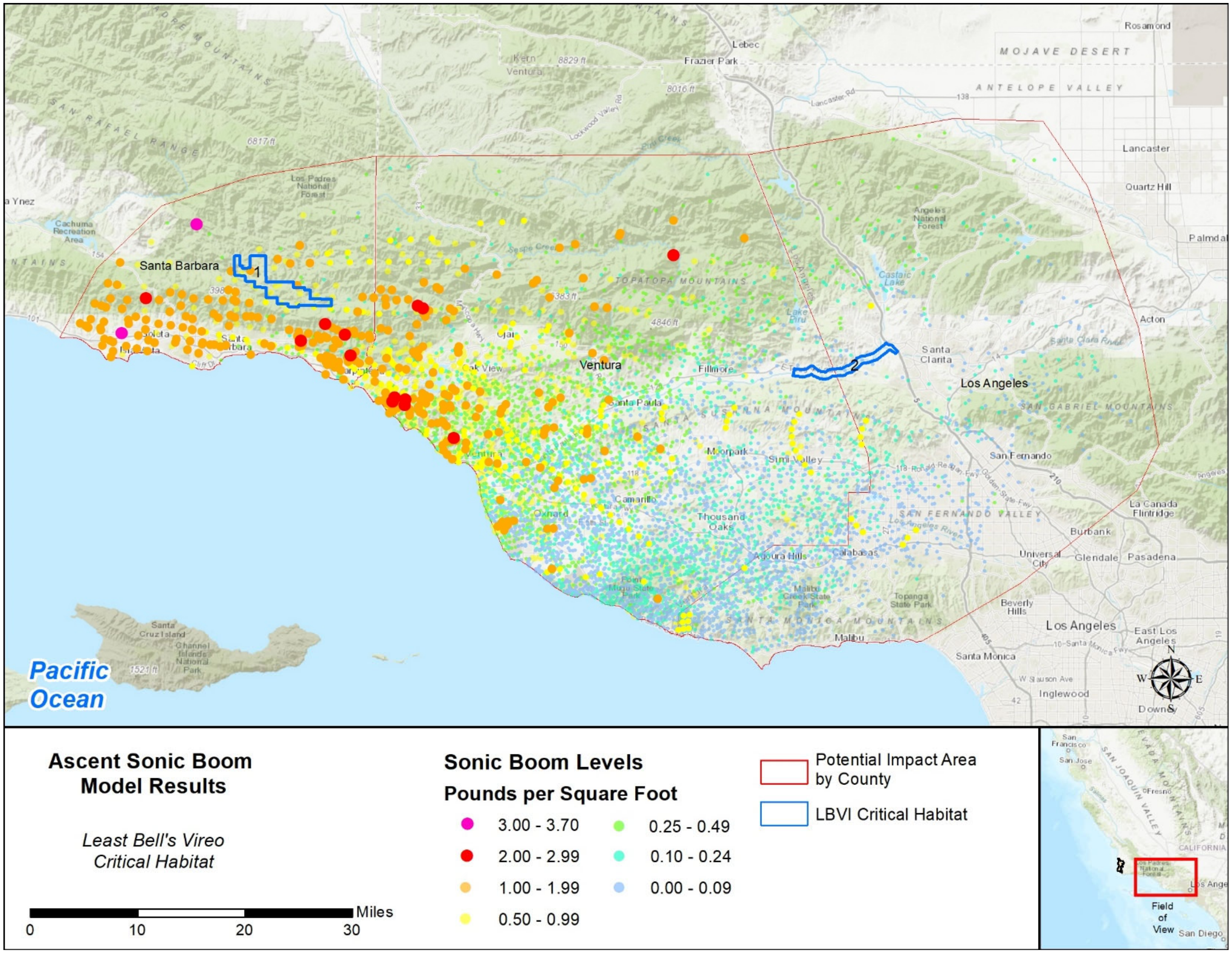

Figure 4.8-7. LBVI Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.6).

4.9 Western Snowy Plover (Federally Listed Threatened Species)

4.9.1 Status

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

4.9.2 Life History

The SNPL is a small shorebird with a pale tan back, white underparts, and dark patches on the sides of the neck reaching around to the top of the chest. The Pacific coast population of snowy plovers is limited to individuals that nest adjacent to tidal waters. The population's range extends from Southern Washington to Baja California, Mexico. The nesting season is typically from March through September. Key threats to SNPL conservation include habitat loss and degradation due to coastal development, off-road vehicle use, and invasive species; human activities including recreation; predation by ravens, crows, coyotes, dogs, cats, racoons, and other species; and sea level rise.

4.9.3 Occurrence within the Action Area

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

VSFB has consistently supported one of the largest populations of breeding SNPL along the west coast of the United States (Robinette et al. 2016), resulting in a large dataset on the effects of VSFB-related activity on the SNPL. The DAF has performed annual monitoring of SNPL since 1993 (Robinette et al. 2021). The breeding population of SNPL on VSFB has been relatively stable since 2007, with 235 adults in 2021 (Robinette et al. 2021) and 309 adults in 2024 (Robinette et al. 2024d). The nearest SNPL nesting area to SLC-4 and SLC-6 is on South Surf Beach, approximately 0.7 mi northwest of SLC-4 and 4.1 mi northwest of SLC-6 (Figure 4.9-1 through Figure 4.9-3).

The SNPL is considered a permanent resident of Santa Rosa Island. On San Miguel Island, a high count of 61 SNPL was documented during the 2016–2017 winter window survey (USFWS 2017c); however, counts at San Miguel Island typically document very few to no individuals, as evident by no SNPL detected on San Miguel Island during the 2024 winter window surveys (USFWS 2024d).

In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, SNPL occur at various open sandy beaches along the coastline (Figure 4.9-8; CDFW 2024).

4.9.4 Critical Habitat

The USFWS designated Critical Habitat for the SNPL in 1999 and revised this designation on 29 September 2005 (70 FR 56969–57119) and on 19 June 2012 (77 FR 36727). VSFB was exempted from Critical Habitat designation under Section 4(a)(3) of the ESA. The nearest Critical Habitat is approximately 8 mi south of VSFB on Santa Rosa Island (Figure 4.9-6 and Figure 4.9-7). In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, Critical Habitat has been designated at various sandy beaches along the coast of eastern Santa Barbara, Ventura, and Los Angeles Counties (Figure 4.9-9). The USFWS listed the following PCEs:

> Sandy beaches, dune systems immediately inland of an active beach face, salt flats, mud flats, seasonally exposed gravel bars, artificial salt ponds and adjoining levees, and dredge spoil sites, with:
>
> 1) Areas that are below heavily vegetated areas or developed areas and above the daily high tides;
> 2) Shoreline habitat areas for feeding, with no or very sparse vegetation, that are between the annual low tide or low-water flow and annual high tide or high-water flow, subject to inundation but not constantly under water, that support small invertebrates, such as crabs, worms, flies, beetles, spiders, sand hoppers, clams, and ostracods, that are essential food sources;
> 3) Surf or water-deposited organic debris, such as seaweed (including kelp and eelgrass) or driftwood located on open substrates that supports and attracts small invertebrates described in PCE 2 for food, and provides cover or shelter from predators and weather, and assists in avoidance of detection (crypsis) for nests, chicks, and incubating adults; and.
> 4) Minimal disturbance from the presence of humans, pets, vehicles, or human-attracted predators, which provide relatively undisturbed areas for individual and population growth and for normal behavior.

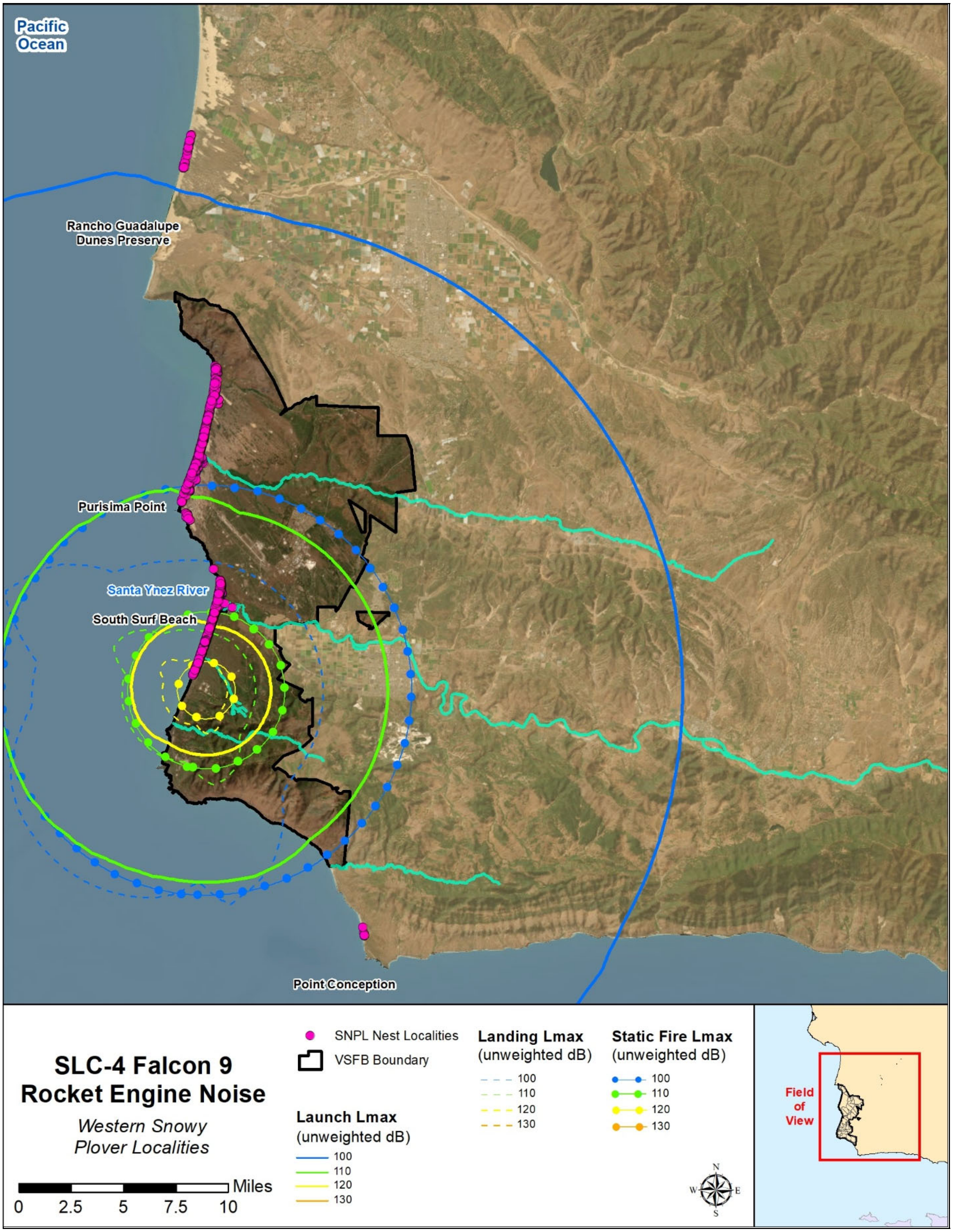

Figure 4.9-1. Western snowy plover nesting localities and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

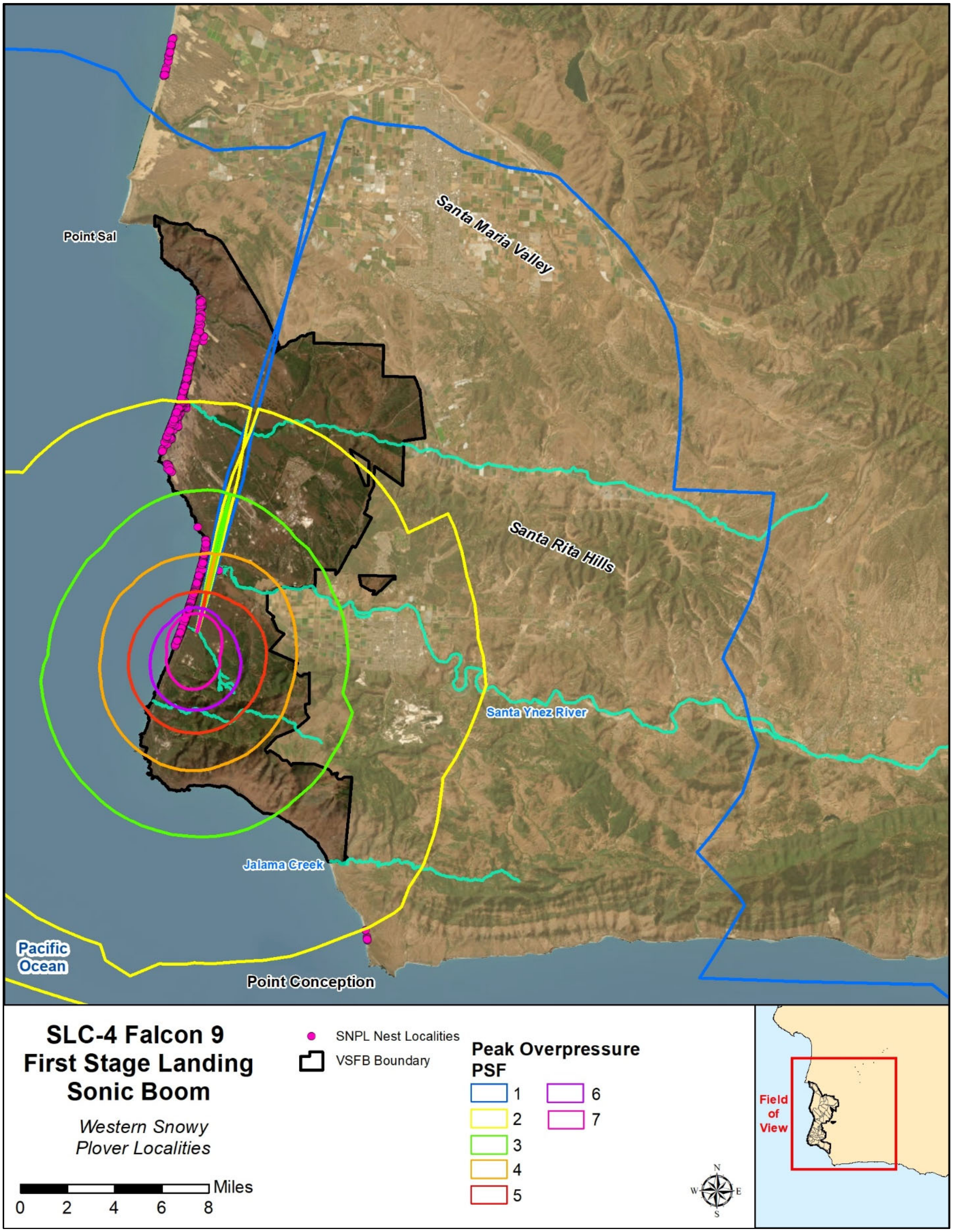

Figure 4.9-2. Western snowy plover nesting records and sample SLC-4 landing sonic boom model results.

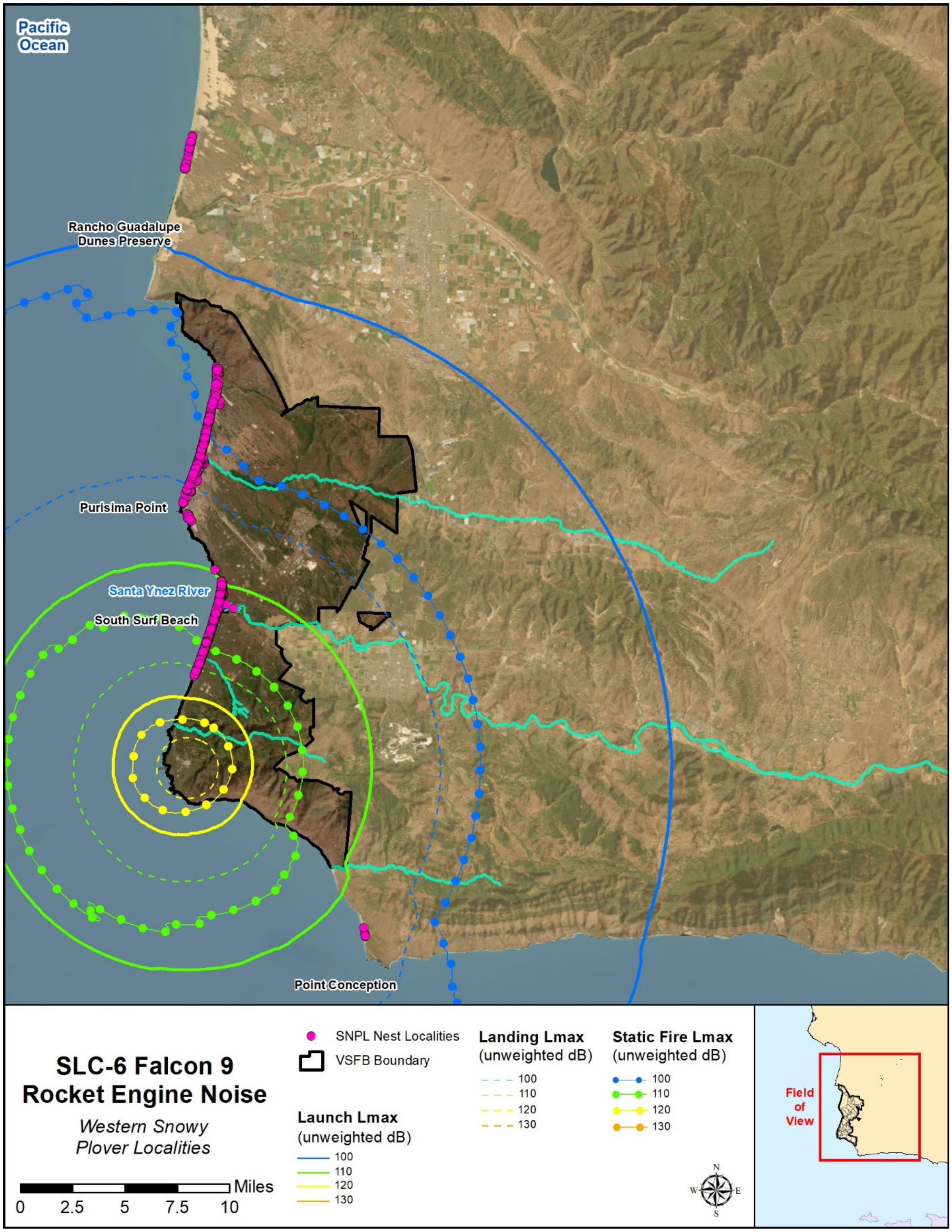

Figure 4.9-3. Western snowy plover nesting localities and modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

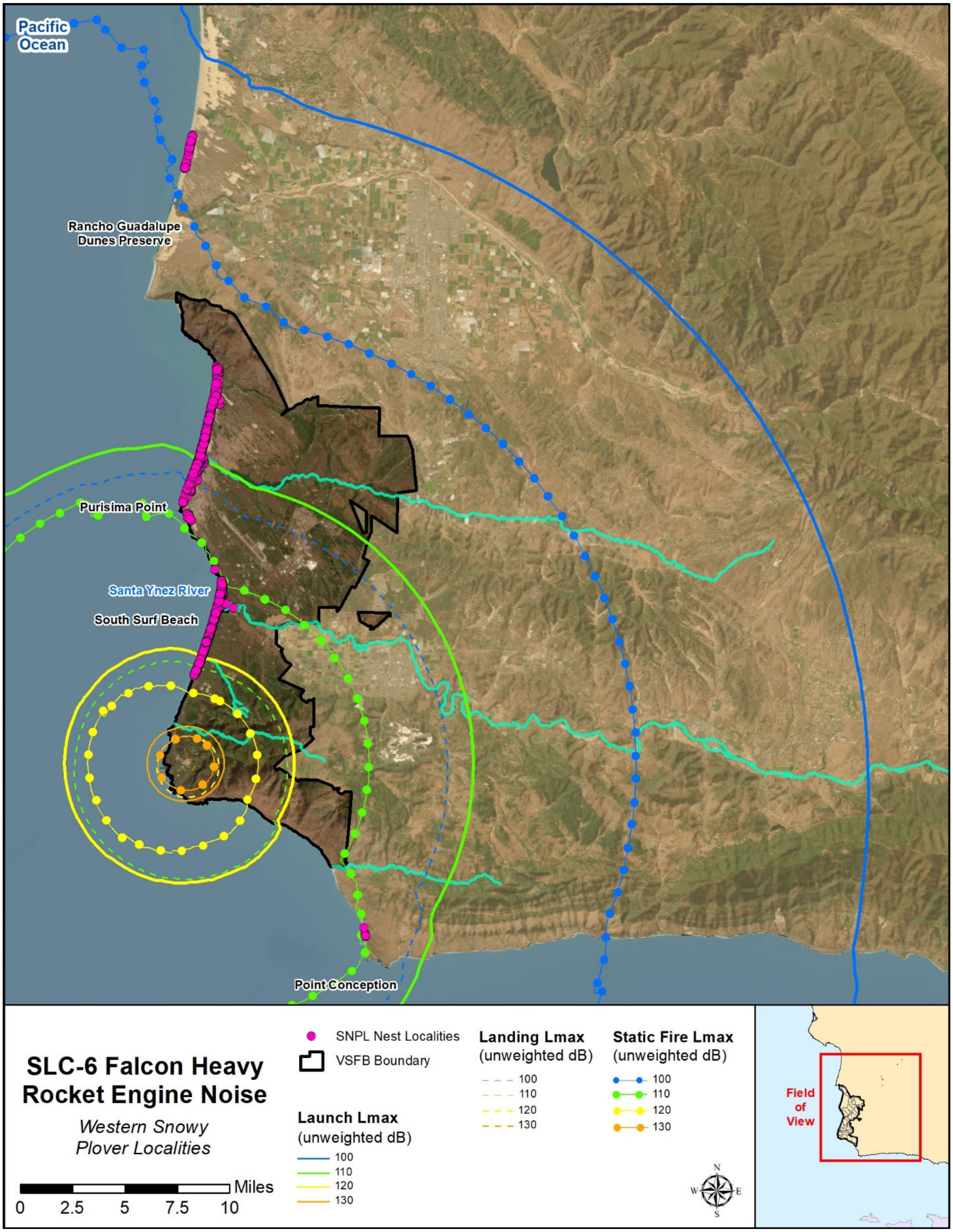

Figure 4.9-4. Western snowy plover nesting localities and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

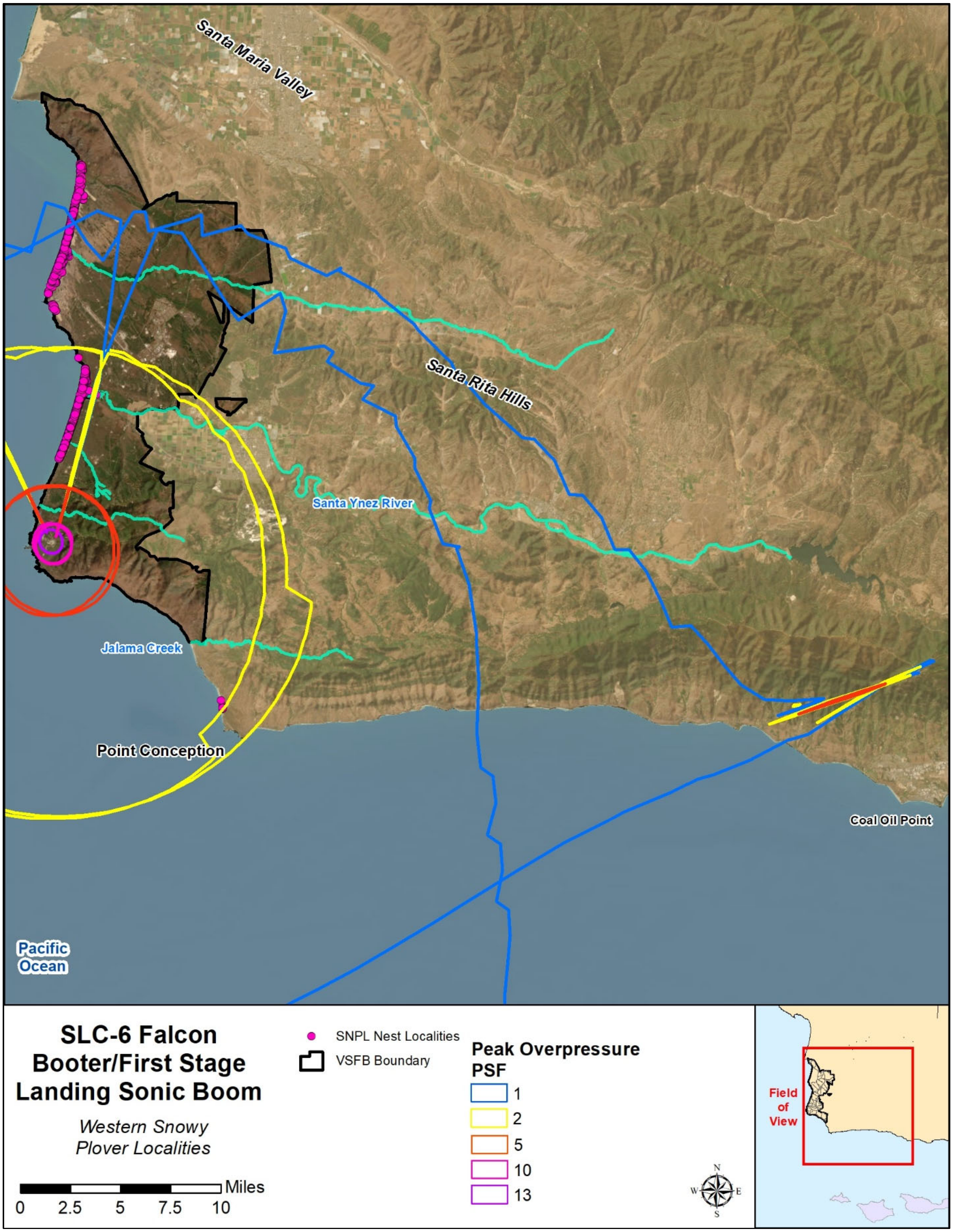

Figure 4.9-5. Western snowy plover nesting records and two sample sonic boom model results for SLC-6 booster/first stage landing events.

Figure 4.9-6. Critical Habitat for the western snowy plover and sample SLC-4 Falcon 9 launch sonic boom model results (Note: variation in model results for a variety of potential trajectories shows a sonic boom of 1 psf or greater may impact any of the critical habitat units on Santa Rosa Islands).

Figure 4.9-7. Critical Habitat for the western snowy plover and two samples of SLC-6 Falcon 9 and Falcon Heavy launch sonic boom model results.

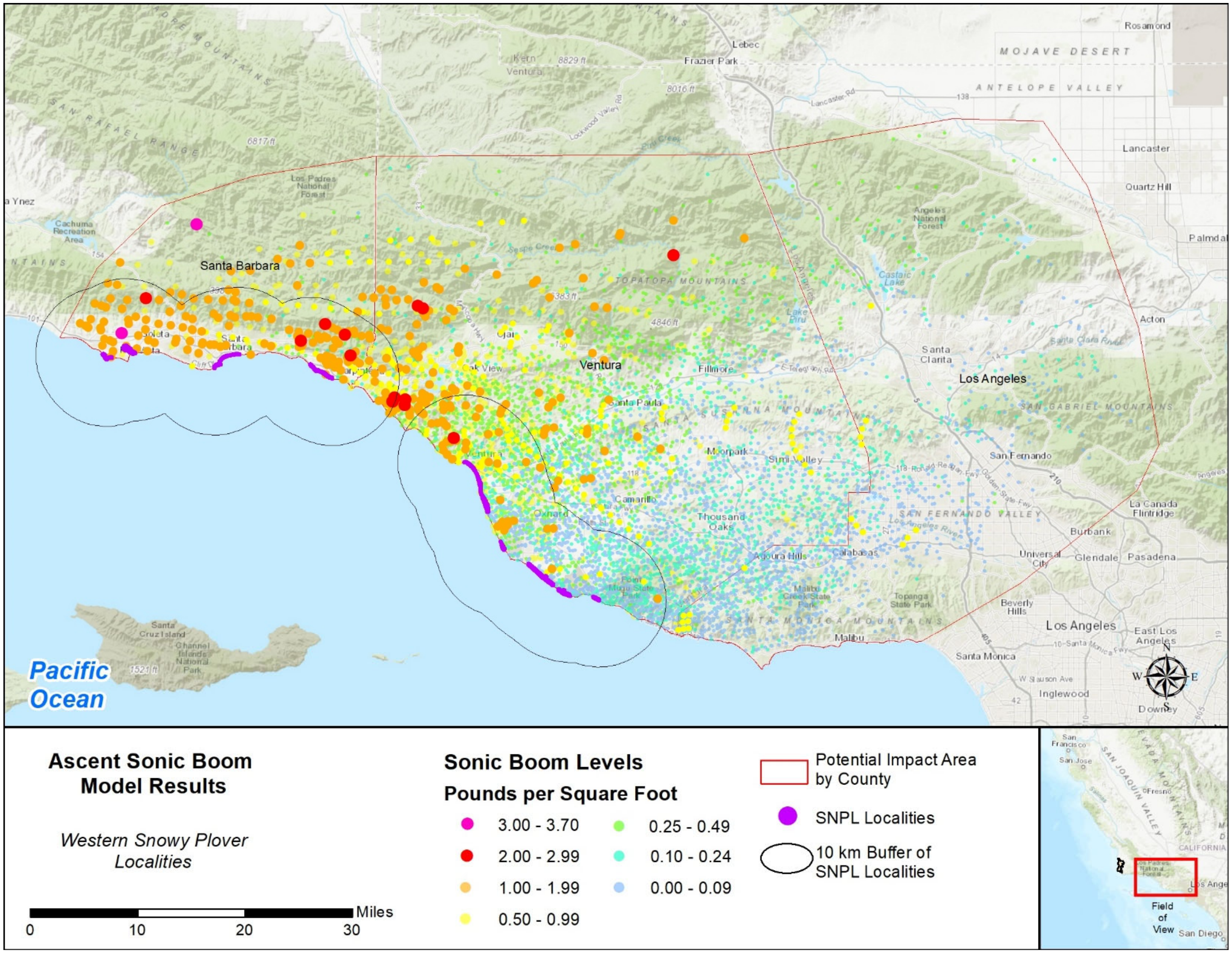

Figure 4.9-8. SNPL localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

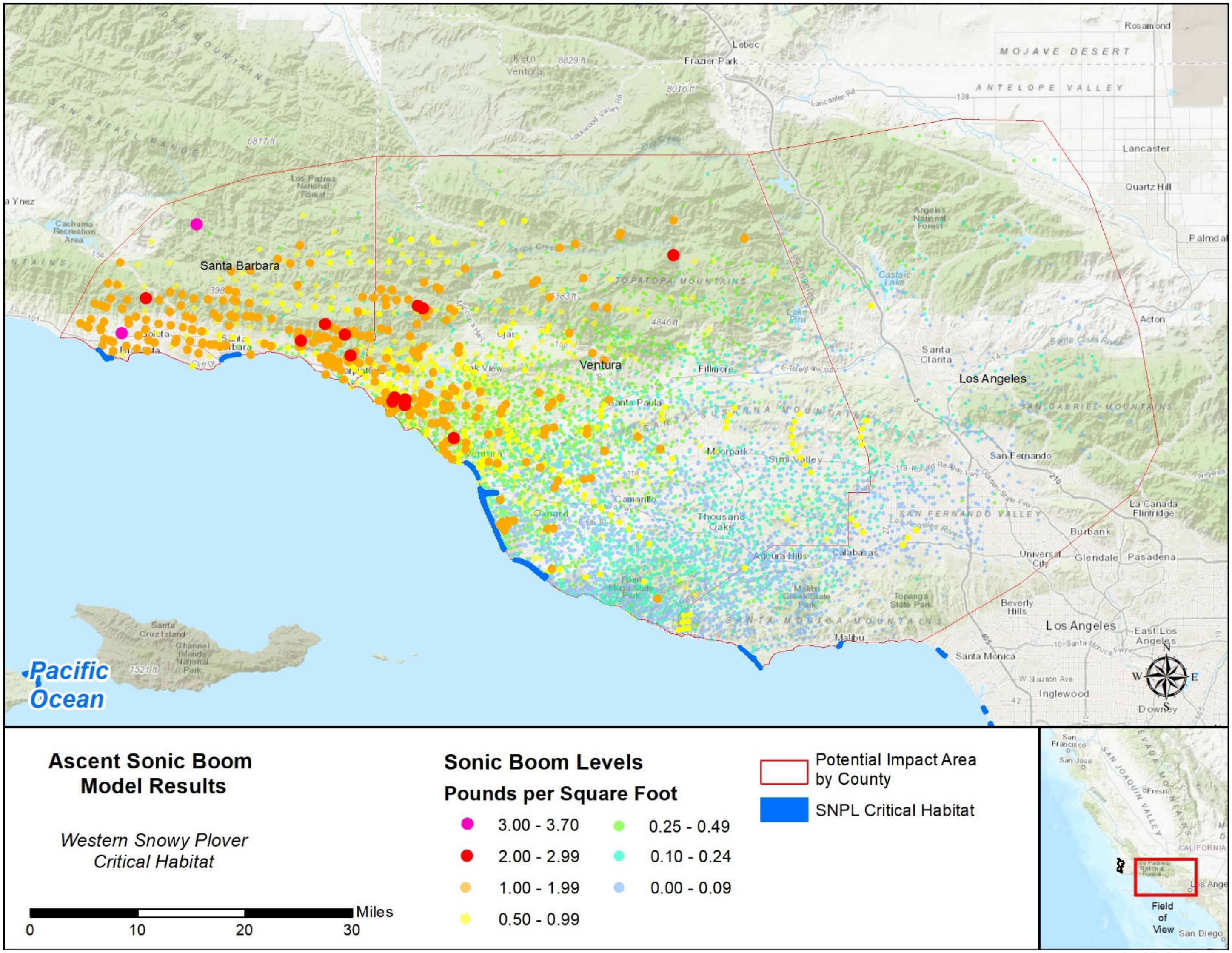

Figure 4.9-9. SNPL Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.10 California Least Tern (Federally Listed Endangered Species)

4.10.1 Status

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

4.10.2 Life History

The LETE is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. The upper parts are gray and the underparts are white. The California populations are localized and increasingly fragmented due to coastal development resulting in habitat loss. LETE are migratory and winter along the Pacific coast of Southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. This species nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal or wind action. The primary threats to LETE conservation include habitat loss due to coastal development; habitat degradation resulting from invasive plant species and off-road vehicle use; dredging and pollution which can reduce foraging grounds; predation by dogs, cats, raccoons, coyotes, ravens, and other wild animals; human disturbance including recreation; and food shortages which can be caused by unfavorable ocean conditions.

4.10.3 Occurrence in the Action Area

Historically, LETE nested in colonies in several locations along the coastal strand of the north VSFB coastline. Since 1998, except for two nests established south of San Antonio Creek in 2002, LETE have nested only at the primary colony site, in relatively undisturbed blufftop open dune habitat at Purisima Point. The population of LETE at VSFB represents a small percentage of the known breeding colonies. Robinette et al. (2024d) observed a breeding population of 32 pairs of LETE on VSFB in 2024.

Although this population is small, VSFB is one of only three breeding colonies that nest between Monterey and Point Conception. This colony is approximately 8 mi north of SLC-4 (Figure 4.10-1 through Figure 4.10-5). Adult LETE forage in the Santa Ynez River lagoon and estuary, approximately 3.7 mi north of SLC-4. After young LETE have fledged in late summer, they will disperse to this location to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (Robinette & Howar 2010).

In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, LETE breeding occur at several open sandy beaches in eastern Santa Barbara and Ventura Counties (Figure 4.10-6; CDFW 2024).

4.10.4 Critical Habitat

The USFWS has not designated Critical Habitat for the LETE.

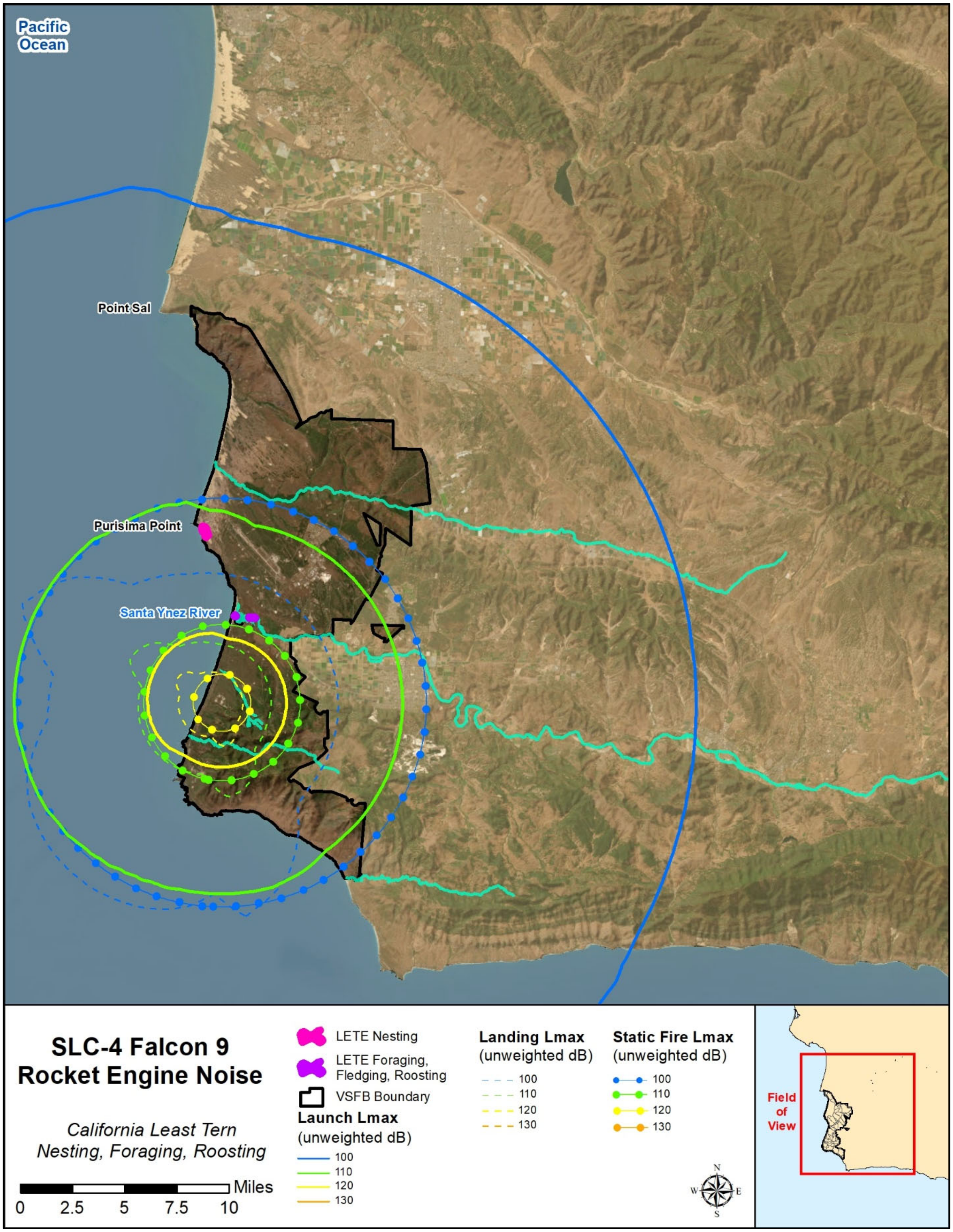

Figure 4.10-1. California least tern foraging, roosting, and nesting areas and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

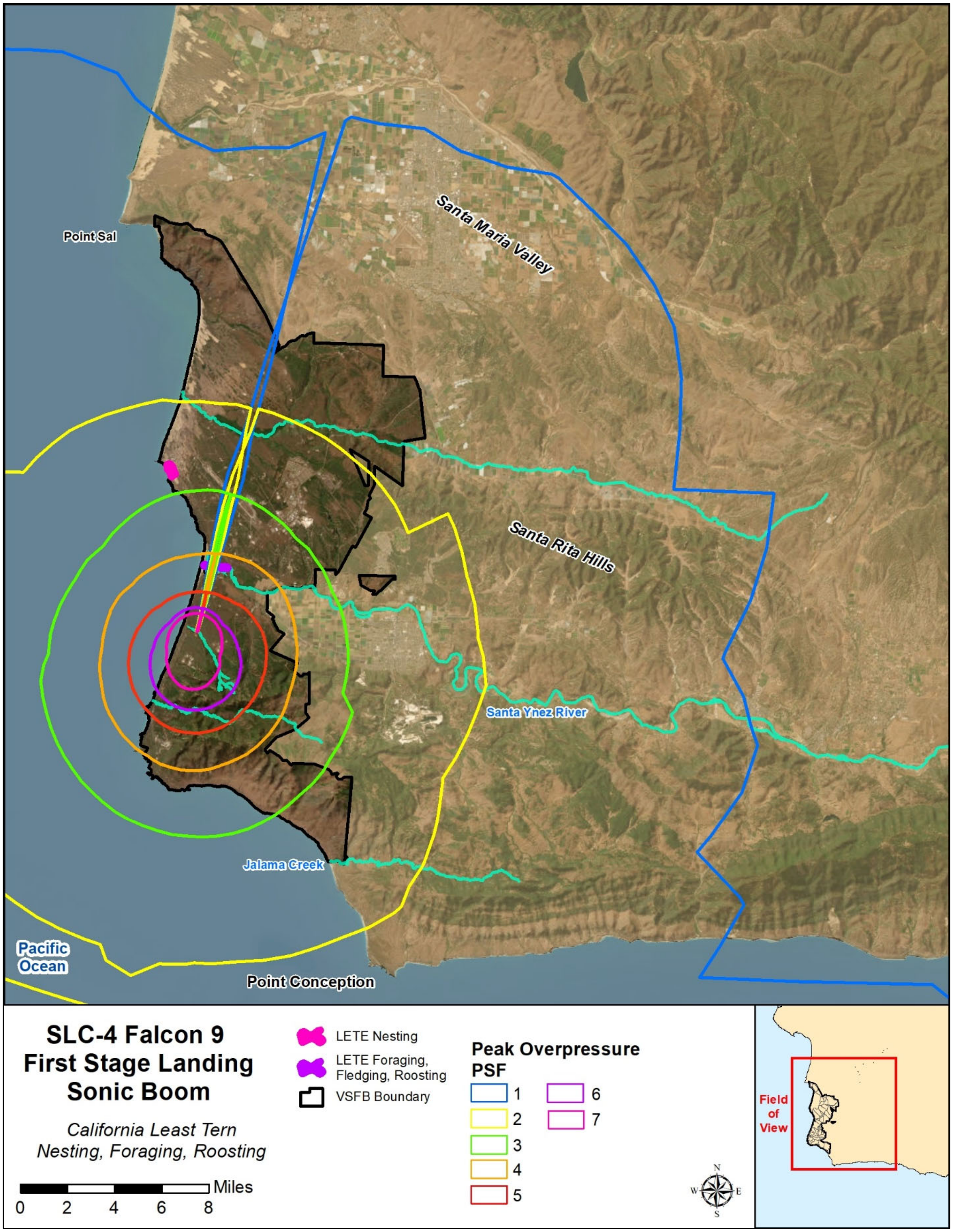

Figure 4.10-2. California least tern foraging, roosting, and sample SLC-4 landing sonic boom model results.

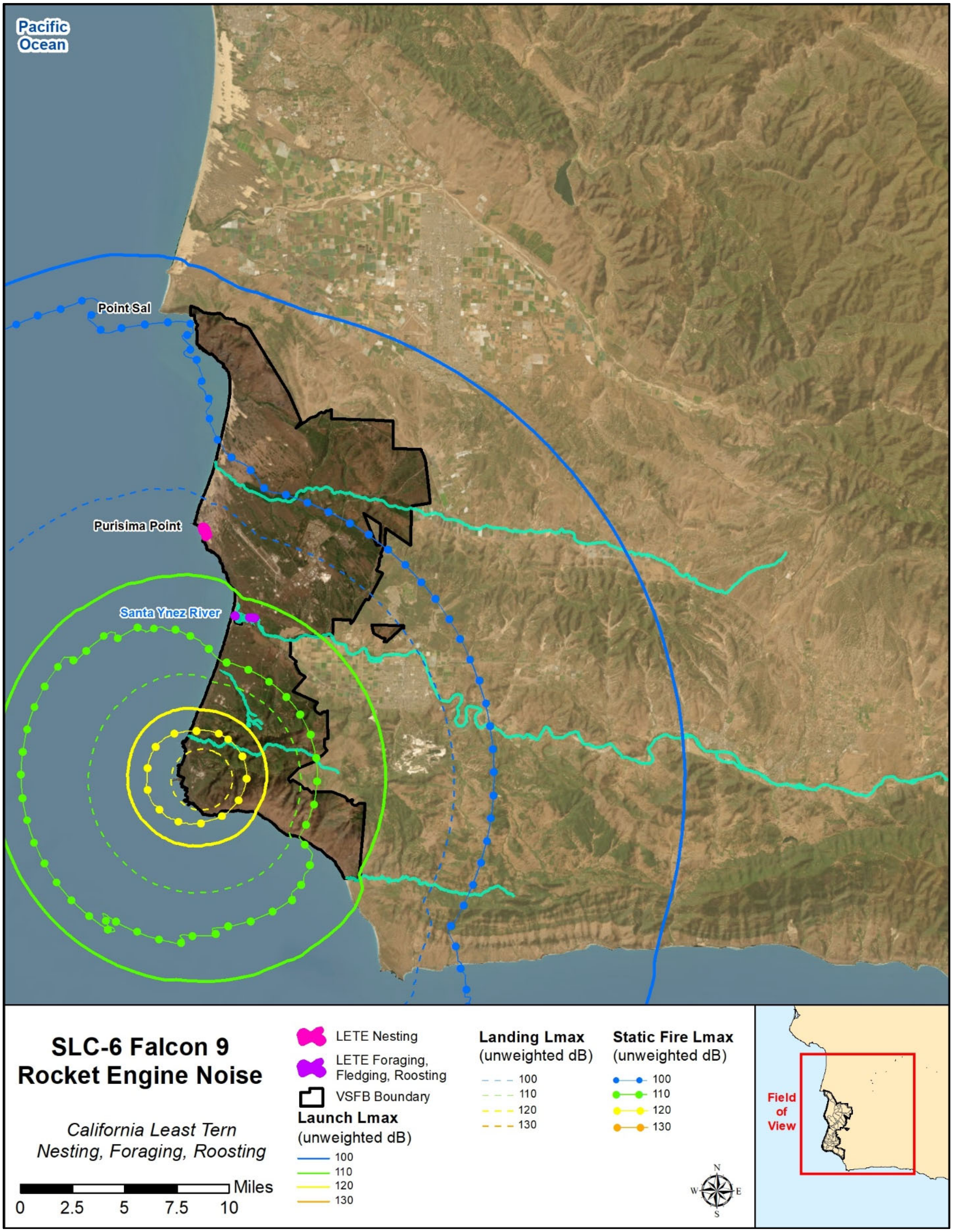

Figure 4.10-3. California least tern nesting, foraging, and roosting areas, and modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

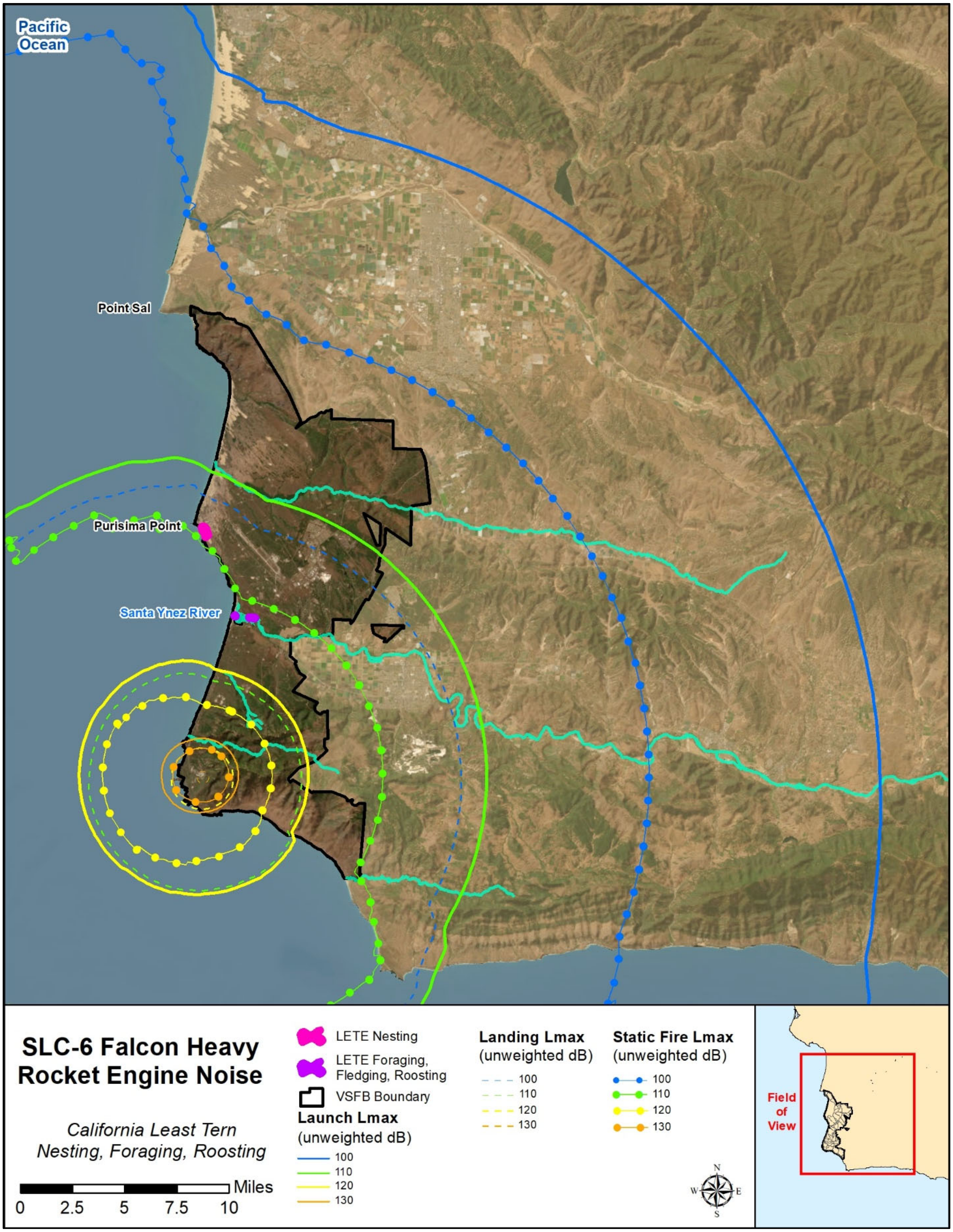

Figure 4.10-4. California least tern nesting, foraging, and roosting areas, and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

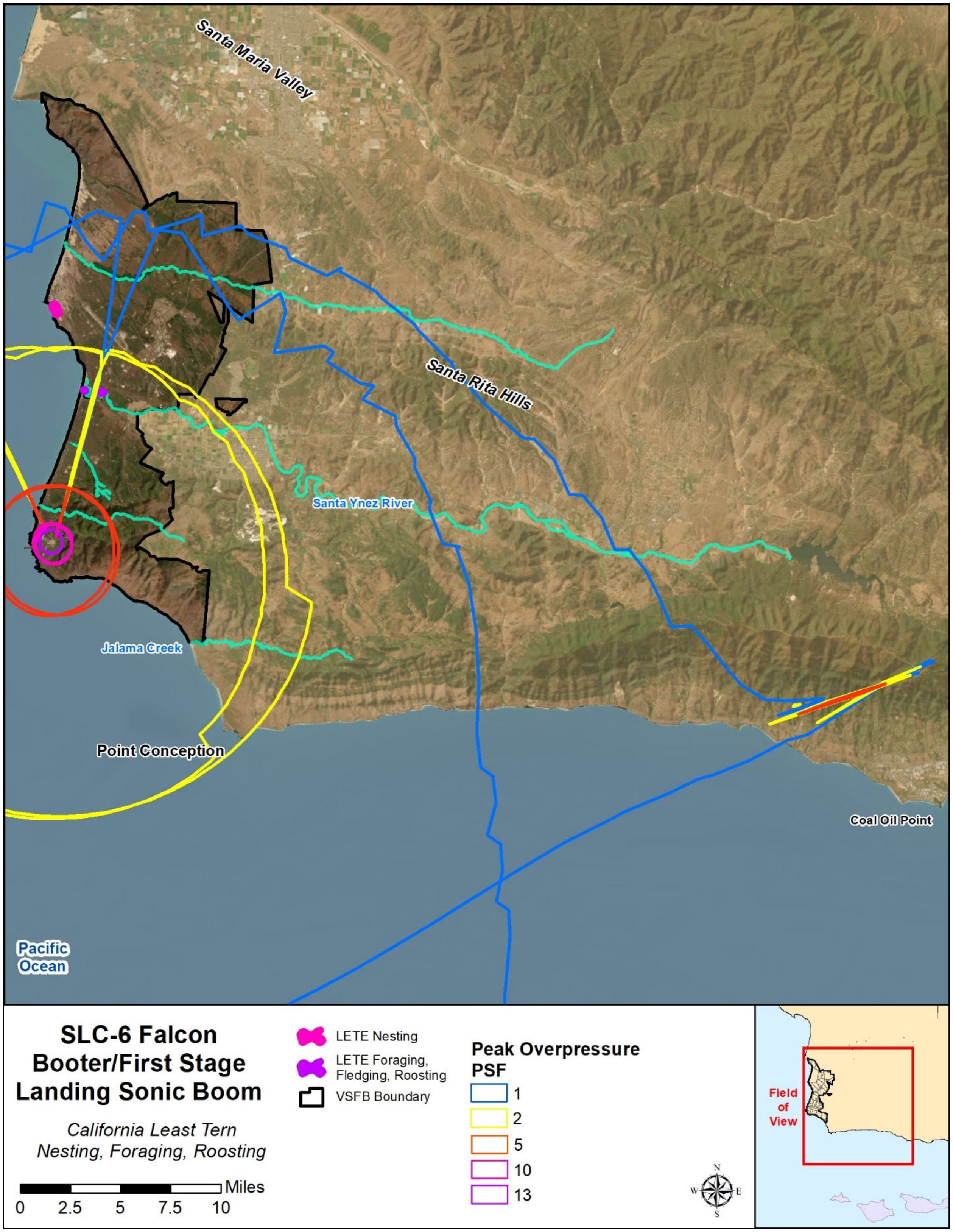

Figure 4.10-5. California least tern nesting, foraging, and roosting areas, and two sample sonic boom model results for SLC-6 booster/first stage landing events.

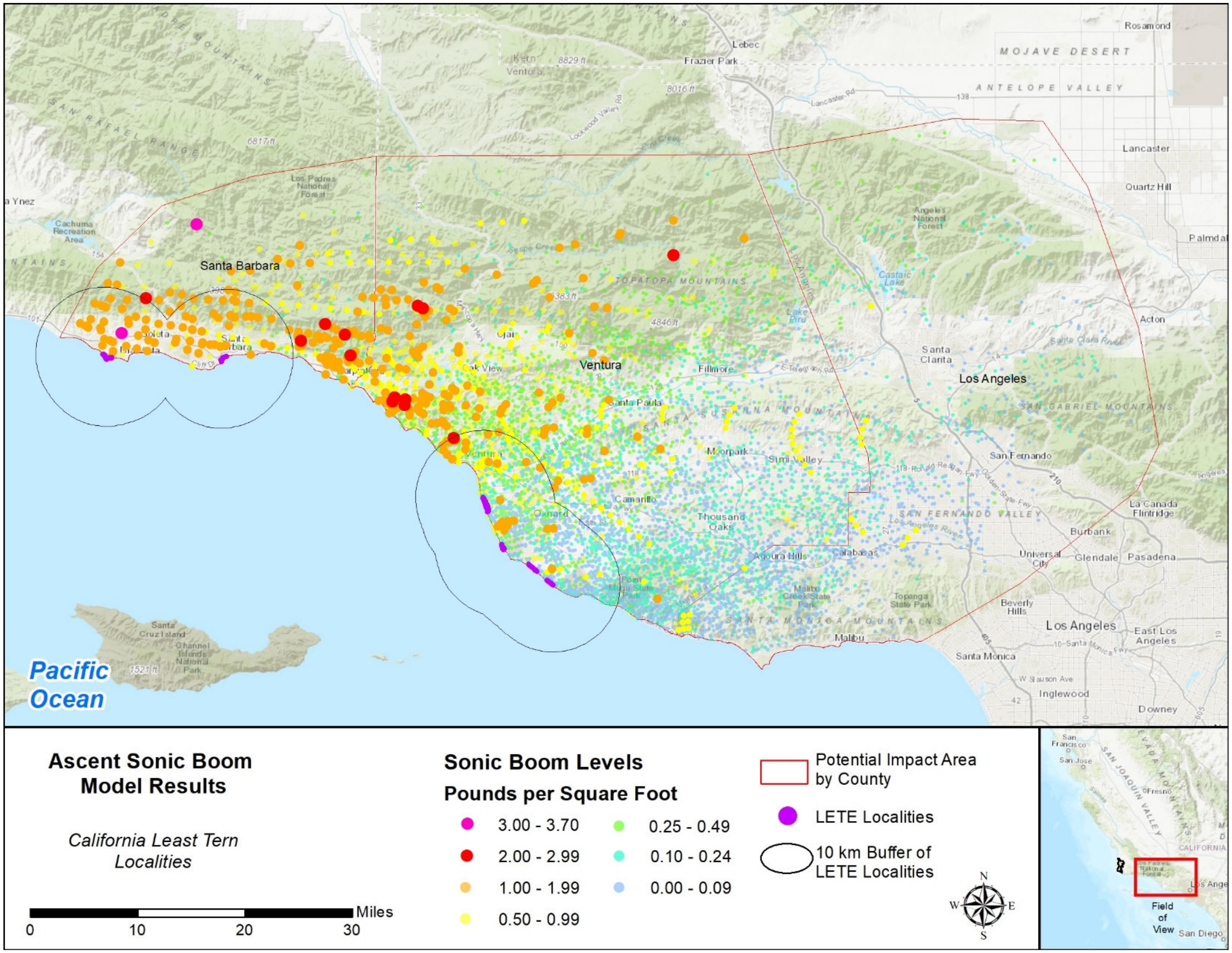

Figure 4.10-6. LETE localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.11 California Condor (Federally Listed Endangered Species)

4.11.1 Status

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

4.11.2 Life History

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

4.11.3 Occurrence within the Action Area

The California condor's current range does not include VSFB. However, in March 2017, the DAF learned that telemetry data from USFWS showed there was a California condor ranging within VSFB. This condor was SB 760 (“VooDoo”), an immature, non-reproductive female (USFWS, personal communication, 27 March 2017). SB 760 hatched in captivity on 22 May 2014. She was released at the Ventana Wilderness on 9 November 2016 (Ventana Wildlife Society 2017). SB 760 departed the VSFB area on or about 22 April 2017 and, several months later, SB 760 was found deceased as a result of drowning in an uncovered water tank in northern San Luis Obispo County.

VSFB natural resource managers maintain routine communications with the USFWS and the Ventana Wildlife Society for SpaceX launch monitoring requirements and condors have not been present since this event. However, given the wide-ranging nature of this species, it is possible individuals may occur on VSFB in the future.

In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, California condors occur year-round in the Sisquoc, Matilija, Sespe, and Piru areas (Figure 4.11-1; CDFW 2024).

4.11.4 Critical Habitat

The USFWS designated Critical Habitat for the California condor in 1976 and revised it in 1977 (42 FR 47840). The potential ascent sonic boom footprint from missions with easterly trajectories overlaps the Sisquoc-San Rafael, Matilija, and Sespe-Piru Critical Habitat units (Figure 4.11-2). The designation did not include a description of Critical Habitat Physical and Biological Features.

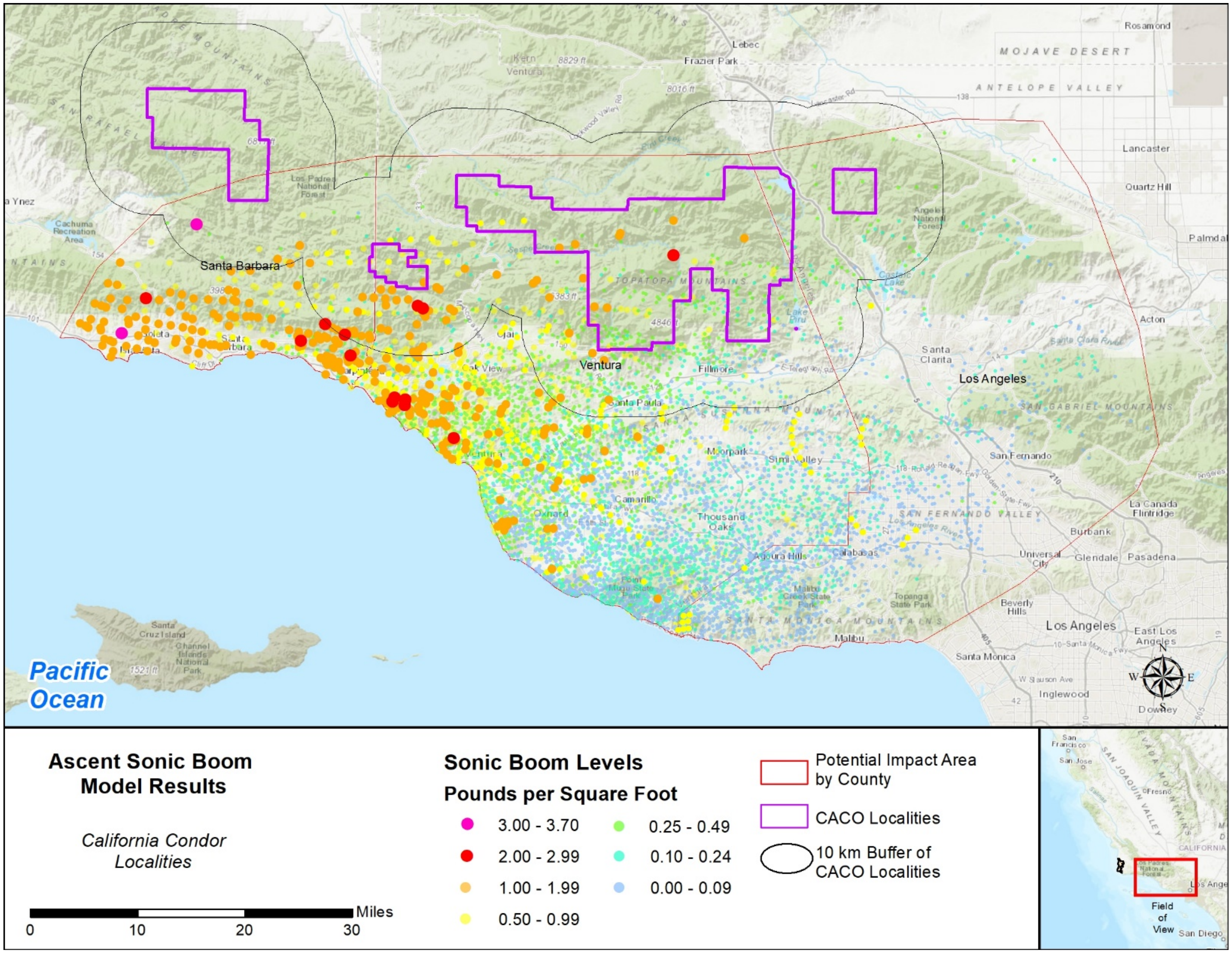

Figure 4.11-1. California condor localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: CACO = California condor; sonic boom model output is explained in Section 2.2.4).

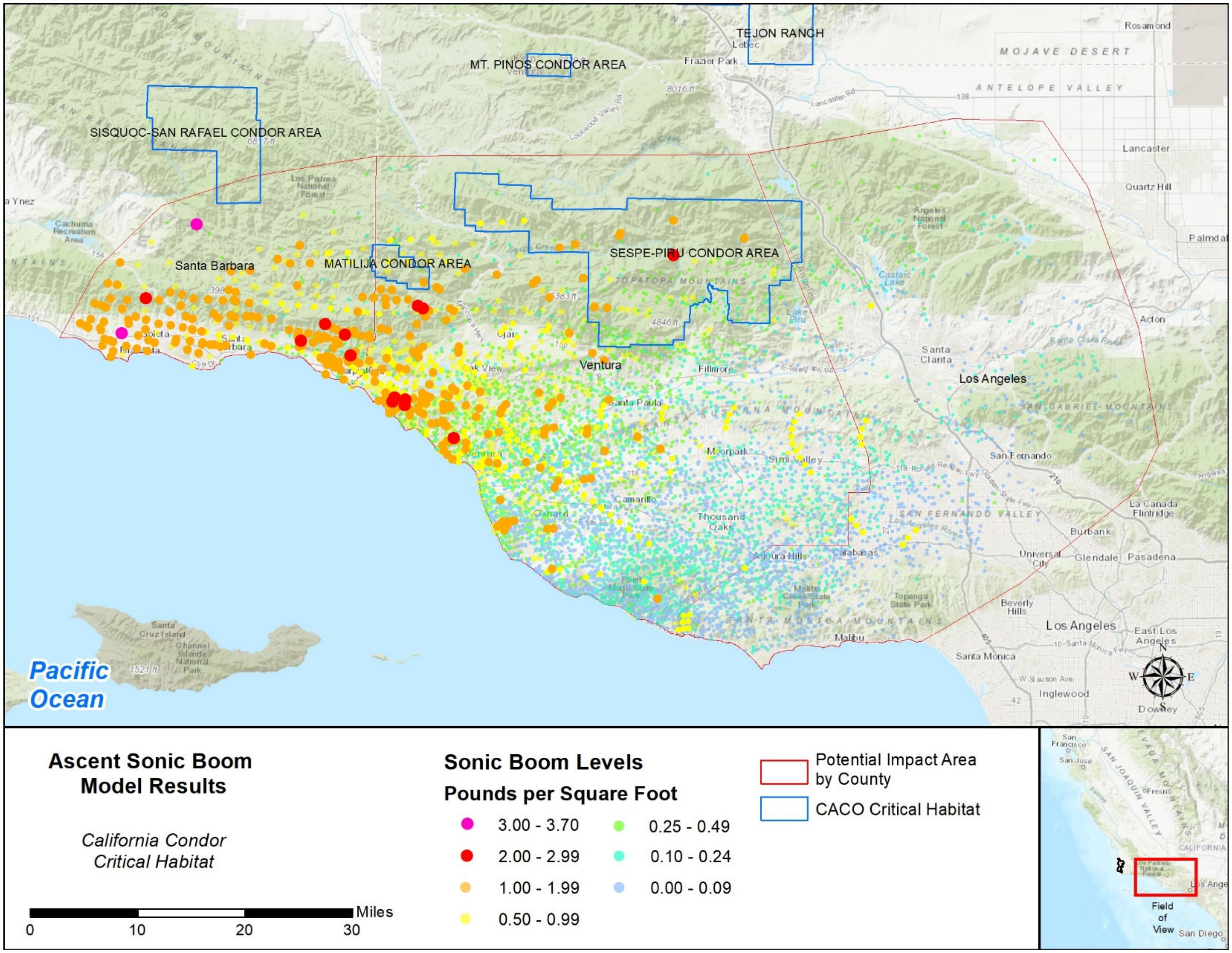

Figure 4.11-2. California condor Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.12 Coastal California Gnatcatcher (Federally Listed Threatened Species)

4.12.1 Status

The USFWS listed the CAGN as federally threatened on 30 March 1993 (58 FR 16742-16757). The USFWS has not published a Recovery Plan for this species.

4.12.2 Life History

The CAGN is a small, nonmigratory bird that nests from late February through July in coastal sage scrub habitat from coastal Baja California, Mexico, north to Ventura County in California. CAGN prey on insects and spiders. Because they are found exclusively in coastal sage scrub, this species has been heavily impacted by coastal development in California.

4.12.3 Occurrence within the Action Area

CAGN does not occur on VSFB. In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, CAGN occur across southern Ventura and western Los Angeles Counties (Figure 4.12-1; CDFW 2024).

4.12.4 Critical Habitat

The USFWS issued a revised designation of Critical Habitat for the CAGN in 2007 (72 FR 72010-72213). The potential ascent sonic boom footprint from missions with easterly trajectories overlaps Unit 13 in western Los Angeles and Ventura Counties (Figure 4.12-2). The PCEs for CAGN are:

> (i) Dynamic and successional sage scrub habitats: Venturan coastal sage scrub, Diegan coastal sage scrub, Riversidean sage scrub, maritime succulent scrub, Riversidean alluvial fan scrub, southern coastal bluff scrub, and coastal sage-chaparral scrub in Ventura, Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties that provide space for individual and population growth, normal behavior, breeding, reproduction, nesting, dispersal and foraging; and
>
> (ii) Non-sage scrub habitats such as chaparral, grassland, riparian areas, in proximity to sage scrub habitats as described above that provide space for dispersal, foraging, and nesting.

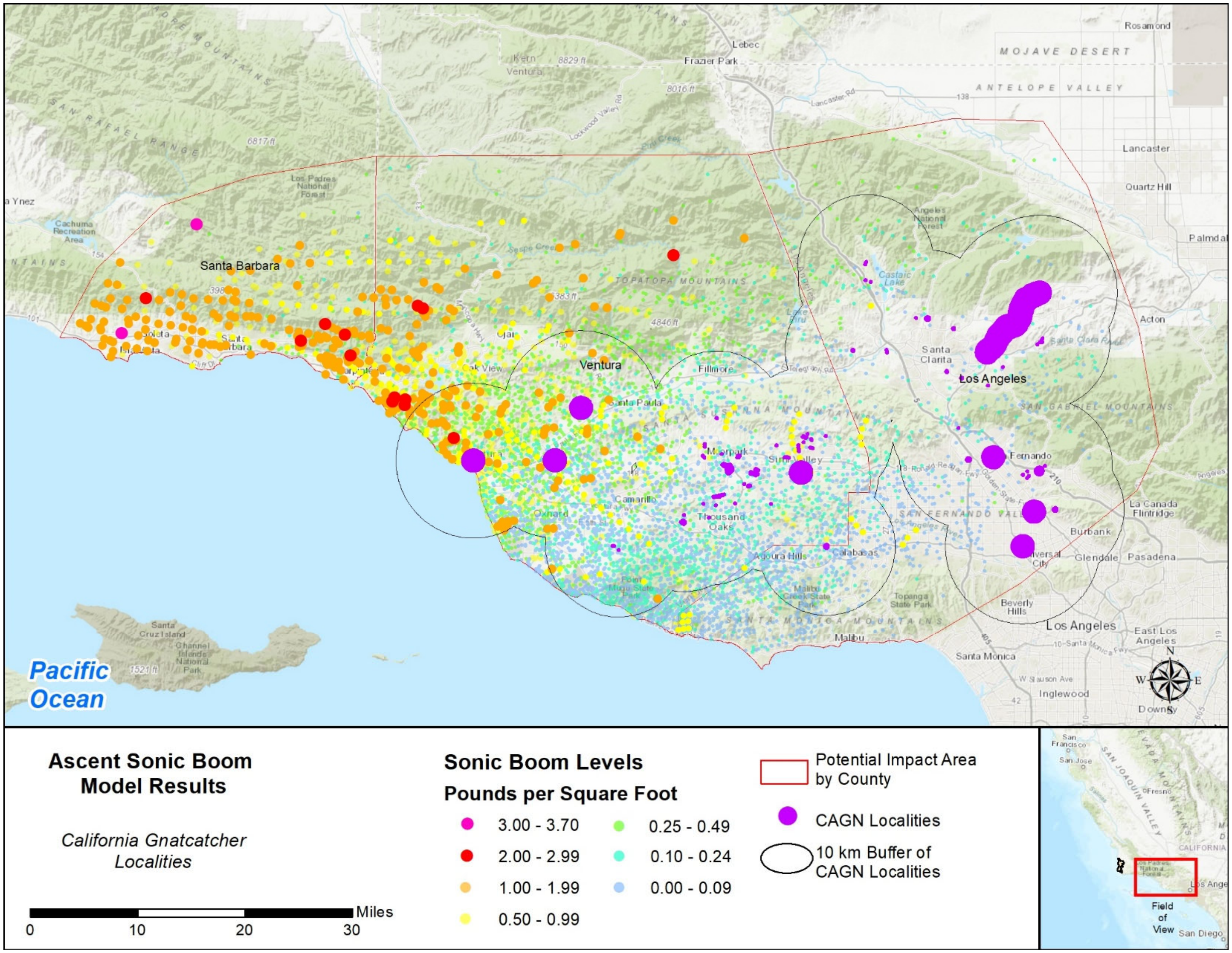

Figure 4.12-1. CAGN localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

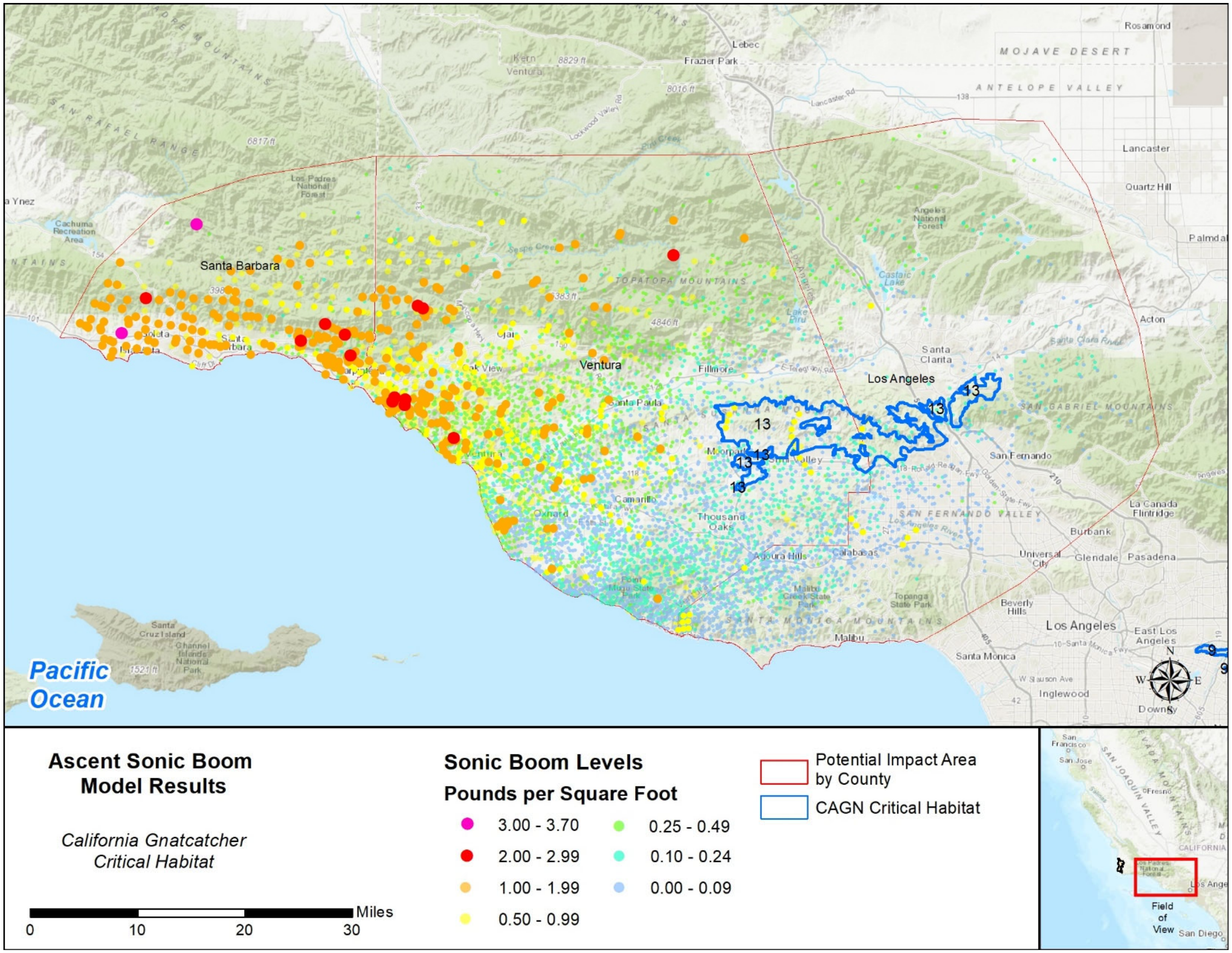

Figure 4.12-2. CAGN Critical Habitat and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.13 Light-footed Ridgeway's Rail (Federally Listed Endangered Species)

4.13.1 Status

The USFWS listed the RIRA as federally threatened on 13 October 1970 (35 FR 16047-16048). The USFWS published a Recovery Plan that included this species in 2014 (79 FR 10830-10831).

4.13.2 Life History

RIRA can be found in southern California coastal salt marshes. This species nests in cordgrass and construct their nests of dried cordgrass, which is intertwined at its edges with upright stems of living cordgrass so that it floats up and down on the tides, held in place by the living stems. The geographic range of the species is from their over-wintering habitat in Central America to Baja California and Southern California. RIRA depends entirely on salt marsh habitat for feeding, resting, and nesting. RIRA are generalists, foraging for invertebrates while utilizing the cover of tidal marsh vegetation. Key threats to RIRA conservation include loss of coastal wetlands; habitat degradation due to dredging, siltation, and pollution; predation by cats, dogs, raccoons, coyotes, and other wild predators; and sea level rise.

4.13.3 Occurrence within the Action Area

RIRA does not occur on VSFB. In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, RIRA occurs at the Carpinteria Salt Marsh and the marshes at Naval Base Ventura County Point Mugu (Figure 4.13-1; CDFW 2024).

4.13.4 Critical Habitat

The USFWS has not designated Critical Habitat for this species.

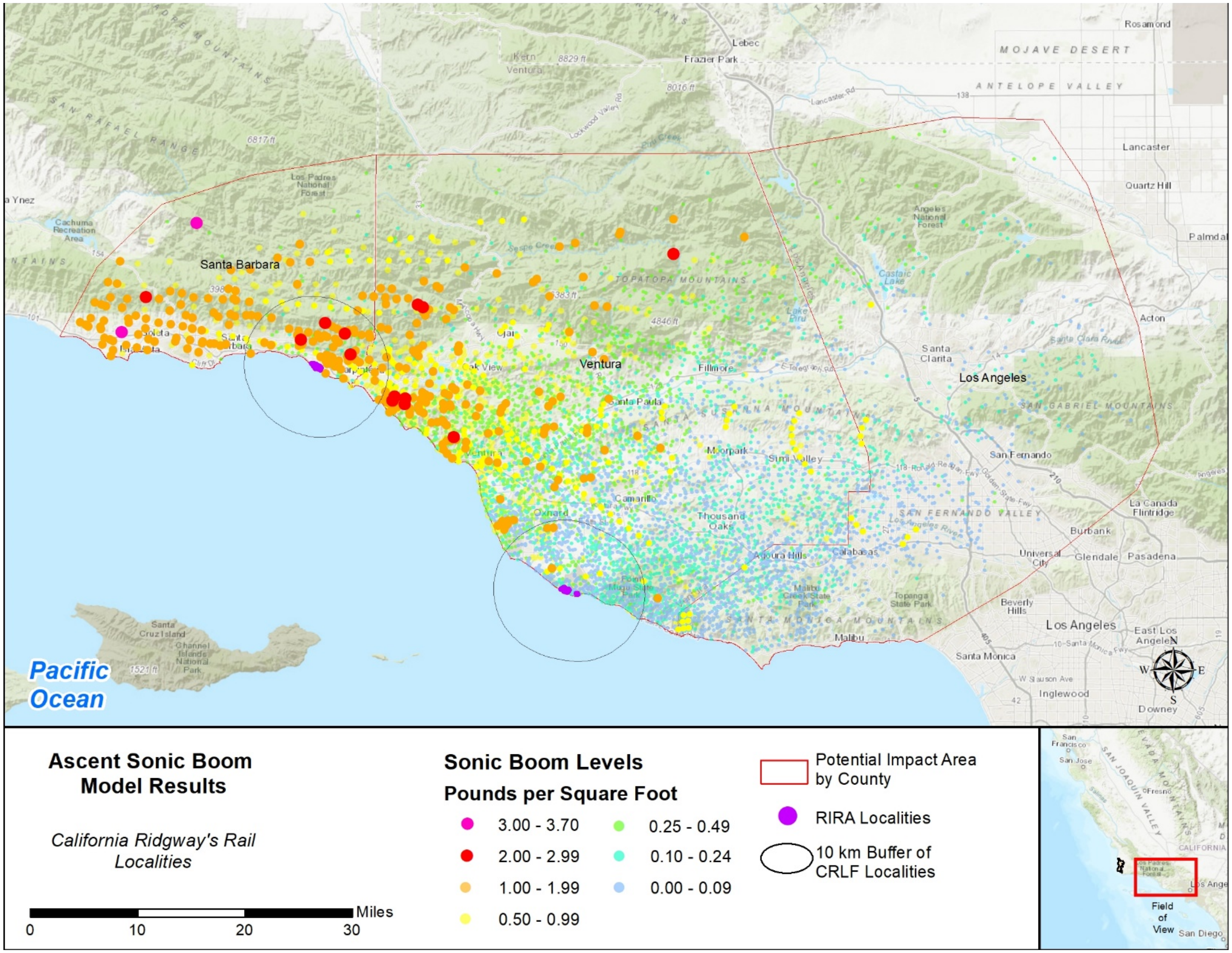

Figure 4.13-1. RIRA localities and potential ascent sonic boom impact areas in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: sonic boom model output is explained in Section 2.2.4).

4.14 Short-tailed Albatross (Federally Listed Endangered Species)

4.14.1 Status

The USFWS listed the short-tailed albatross as federally endangered on 31 July 2000 (65 FR 147) and published a Recovery Plan in 2008 (USFWS 2008). Most recently, the USWFS completed a 5-year review of the species in 2020 (USFWS 2020).

4.14.2 Life History

Short-tailed albatross primarily nest on Torishima Island in the Izu Islands of Japan (USFWS 2008). This species is monogamous and philopatric to nesting areas and breeds at 5 or 6 years of age. During the incubation and brooding cycle (October through June) adults forage in the coastal waters of Honshu Island, Japan (Suryan et al. 2008). Adults leave the nesting colony in Late May and early June, chicks fledge soon after, dispersing across the North Pacific Ocean (Austin 1949). The primary threats to short-tailed albatross conservation include injury and mortality due to fishing bycatch; oil spills; plastic pollution; invasive predators on nesting islands; and sea level rise which could affect nesting habitat.

4.14.3 Occurrence within the Action Area

There are approximately 7,365 individuals, primarily concentrated around the breeding islands of Torishima and the Senkaku Islands, making their density relatively high in those areas, but very low across the vast expanse of the Pacific Ocean. In the summer, short-tailed albatross forage throughout the North Pacific Ocean (Sanger 1972; Suryan et al. 2007) and therefore may be found in the offshore recovery area (Figure 2.2-6) in very low densities.

4.14.4 Critical Habitat

The USFWS has not designated Critical Habitat for this species.

4.15 Hawaiian Petrel (Federally Listed Endangered Species)

4.15.1 Status

The USFWS listed the Hawaiian petrel as federally endangered on 11 March 1967, pursuant to the ESA. The USFWS published a Recovery Plan in 1983 (USFWS 1983) and an amendement to the Recovery Plan in 2019 (USFWS 2019). The USWFS completed the most recent 5-year review of the species in 2022 (USFWS 2022b).

4.15.2 Life History

After fledging, Hawaiian petrels spend the first several years of their lives at sea and do not typically begin breeding until they are six years old. Individuals may not breed each year, but live greater than 30 years. This species primarily preys on squid but also feeds on fish, crustaceans, and plankton. Key threats to Hawaiian petrel conservation include injury and mortality due to fishing bycatch; introduced predators on nesting islands; feral ungulates that degrade nesting habitat; plastic pollution; and sea level rise which may affect nesting habitat.

4.15.3 Occurrence within the Action Area

Hawaiian petrel ranges in the central Pacific Ocean and breeds only in the main Hawaiian Islands, though there are specimen records from Japan, Philippines, and Moluccas at the western edge of the distribution. Most of the Hawaiian petrel global population breeds on the island of Maui within Haleakala National Park. The Hawaiian petrel typically feeds far offshore but tends to feed closer to shore during spring than in the fall. This species favors open ocean water conditions, with an average sea surface temperature of 80 degrees Fahrenheit, sea surface salinity of 34 parts per thousand, wind speed of 19 miles per hour, and a wave height of 5 ft.

The Hawaiian petrel occurs largely in equatorial waters of the eastern tropical Pacific, generally from 10 degrees South to 20 degrees North. The Hawaiian petrel may occur in open ocean waters throughout western and southern portions of the recovery area. But given the vast expanse of the ocean that these birds inhabit, their at-sea density is relatively low.

4.15.4 Critical Habitat

The USFWS has not designated Critical Habitat for this species.

4.16 Southern Sea Otter (Federally Listed Threatened Species)

4.16.1 Status

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

4.16.2 Life History

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

This species breeds and gives birth year-round and pups are dependent for 120 to 280 days (average 166 days; Riedman & Estes 1990). SSO are opportunistic foragers known to eat mostly abalones, sea urchins, crabs, and clams. They play a key ecological role in kelp bed communities by controlling sea urchin grazing. The primary threats to SSO conservation include oil spills; loss of kelp forests along the California coast; overfishing which has depleted some food sources; pathogens that cause disease from pets and livestock; entanglement with fishing gear; and direct conflict with humans, including shootings and boat strikes.

4.16.3 Occurrence within the Action Area

SSOs occur regularly off the coast of VSFB, with animals typically concentrated in the kelp beds between the Boat House and Jalama Creek on south VSFB (Figure 4.16-1 through Figure 4.16-5). Annual spring surveys performed by United States Geological Survey (USGS) document persistent populations in nearshore waters in this area (USGS Western Ecological Resource Center 2017, 2018, 2020). As many as 55 adult SSO have been documented in the Sudden Flats area at one time (SRS Technologies, Inc. 2006a). More recently, a high of 49 adults and 4 pups were observed in March 2023 in the Sudden Flats area during monitoring for a Falcon 9 launch (MSRS, unpubl. data).

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

4.16.4 Critical Habitat

The USFWS has not designated Critical Habitat for this species.

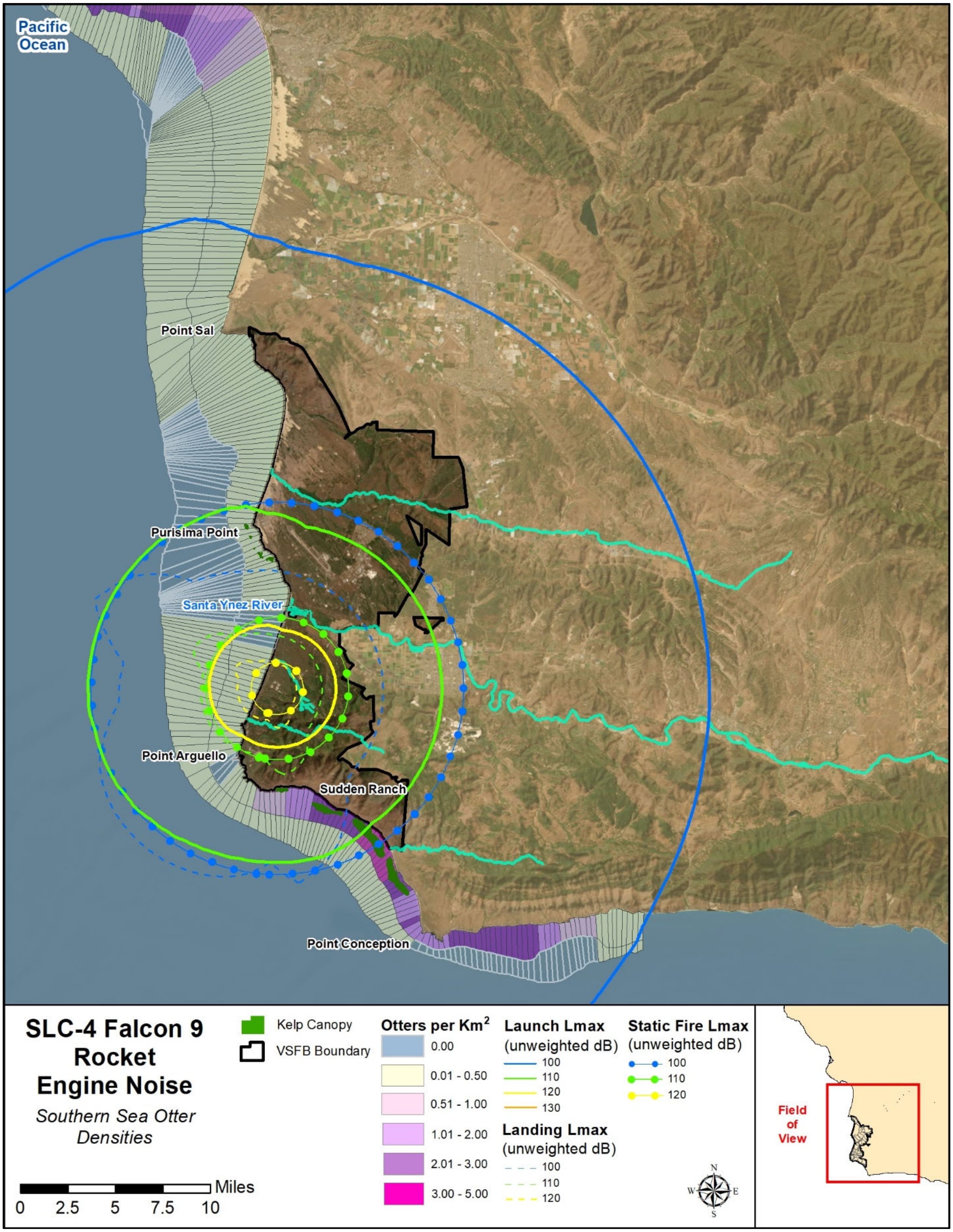

Figure 4.16-1. Southern sea otter densities and areas and modeled Falcon 9 SLC-4 static fire, launch, and landing rocket engine noise.

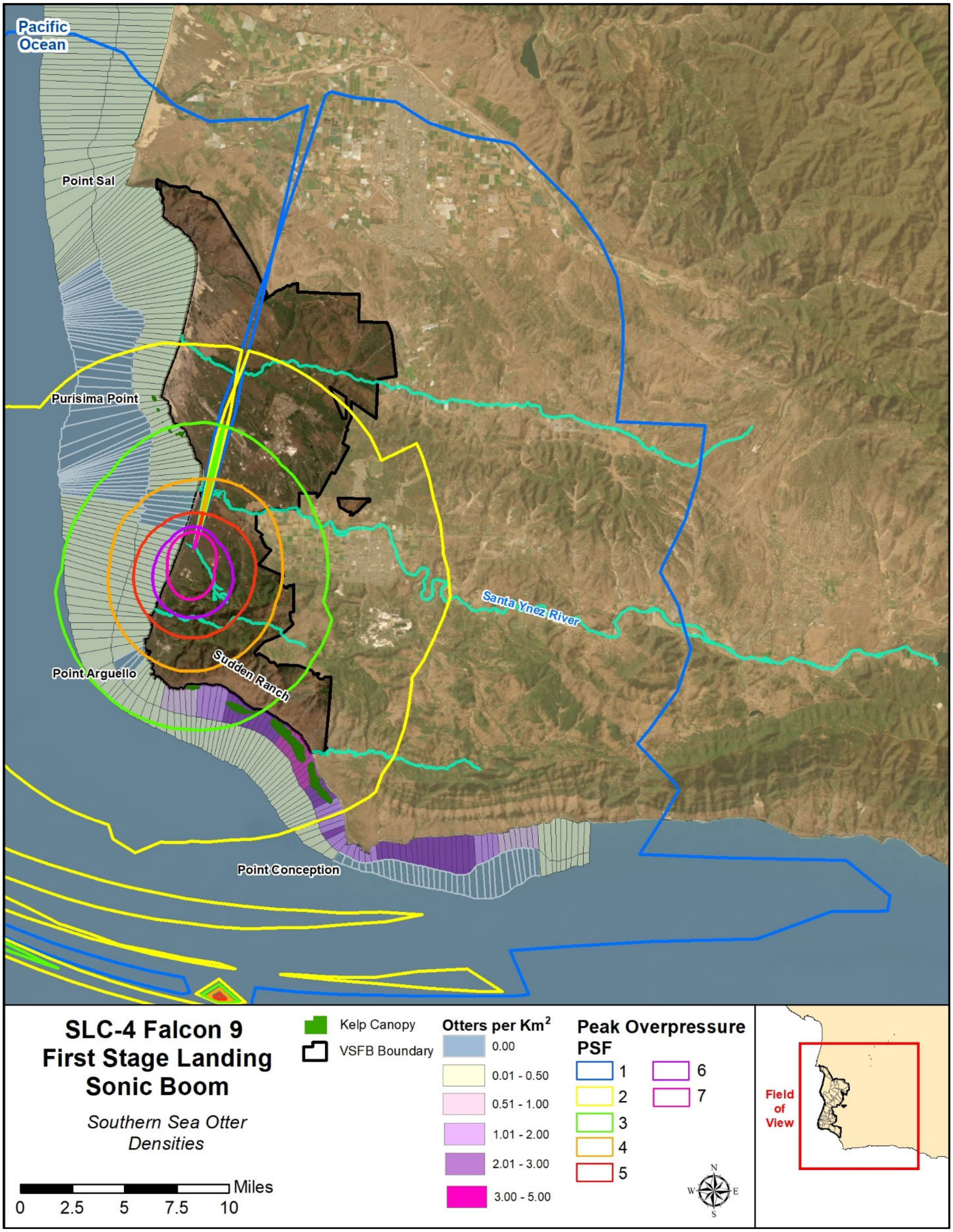

Figure 4.16-2. Southern sea otter densities and sample SLC-4 landing sonic boom model results.

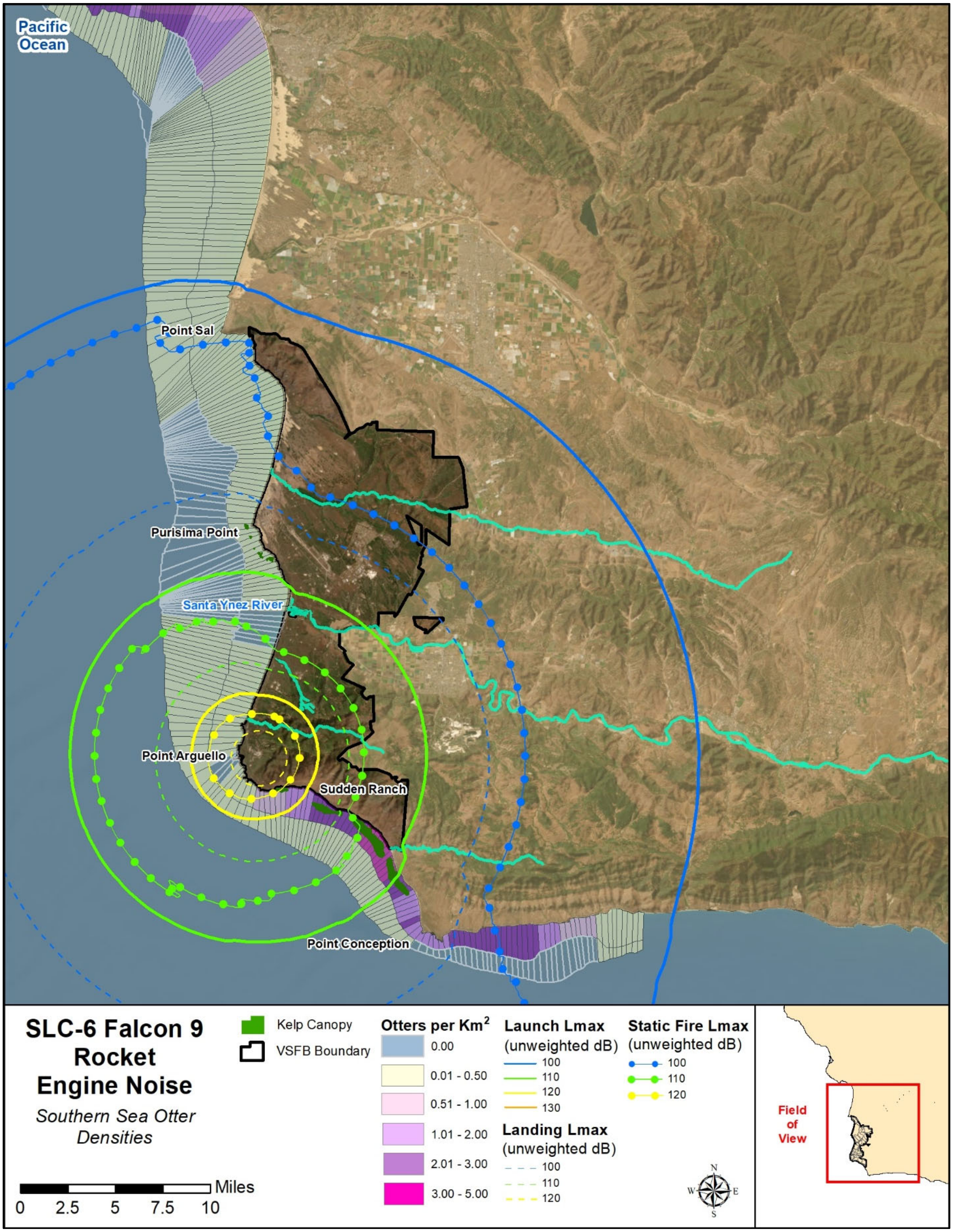

Figure 4.16-3. Southern sea otter densities and modeled Falcon 9 SLC-6 static fire, launch, and landing rocket engine noise.

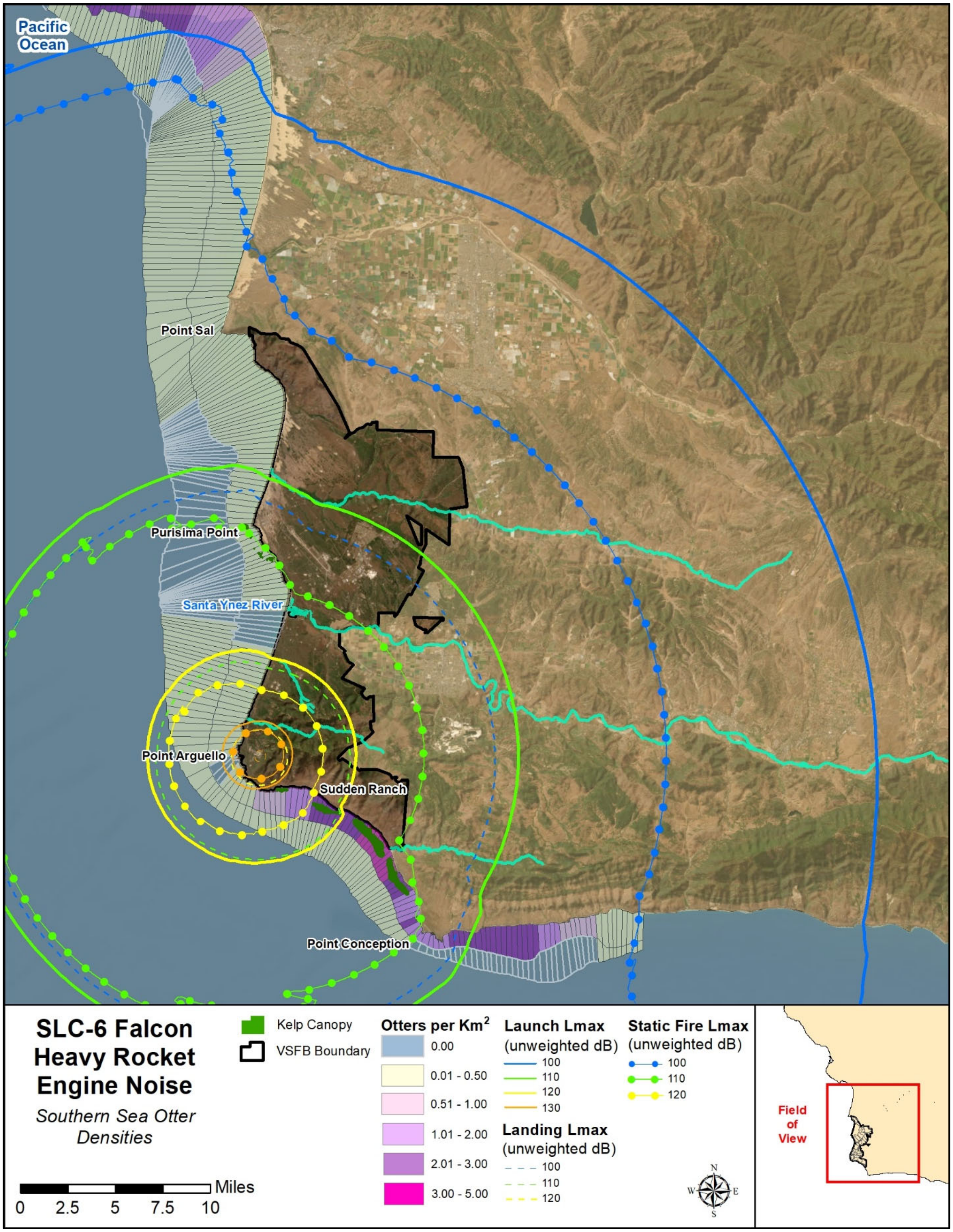

Figure 4.16-4. Southern sea otter densities and modeled Falcon Heavy SLC-6 static fire, launch, and landing rocket engine noise.

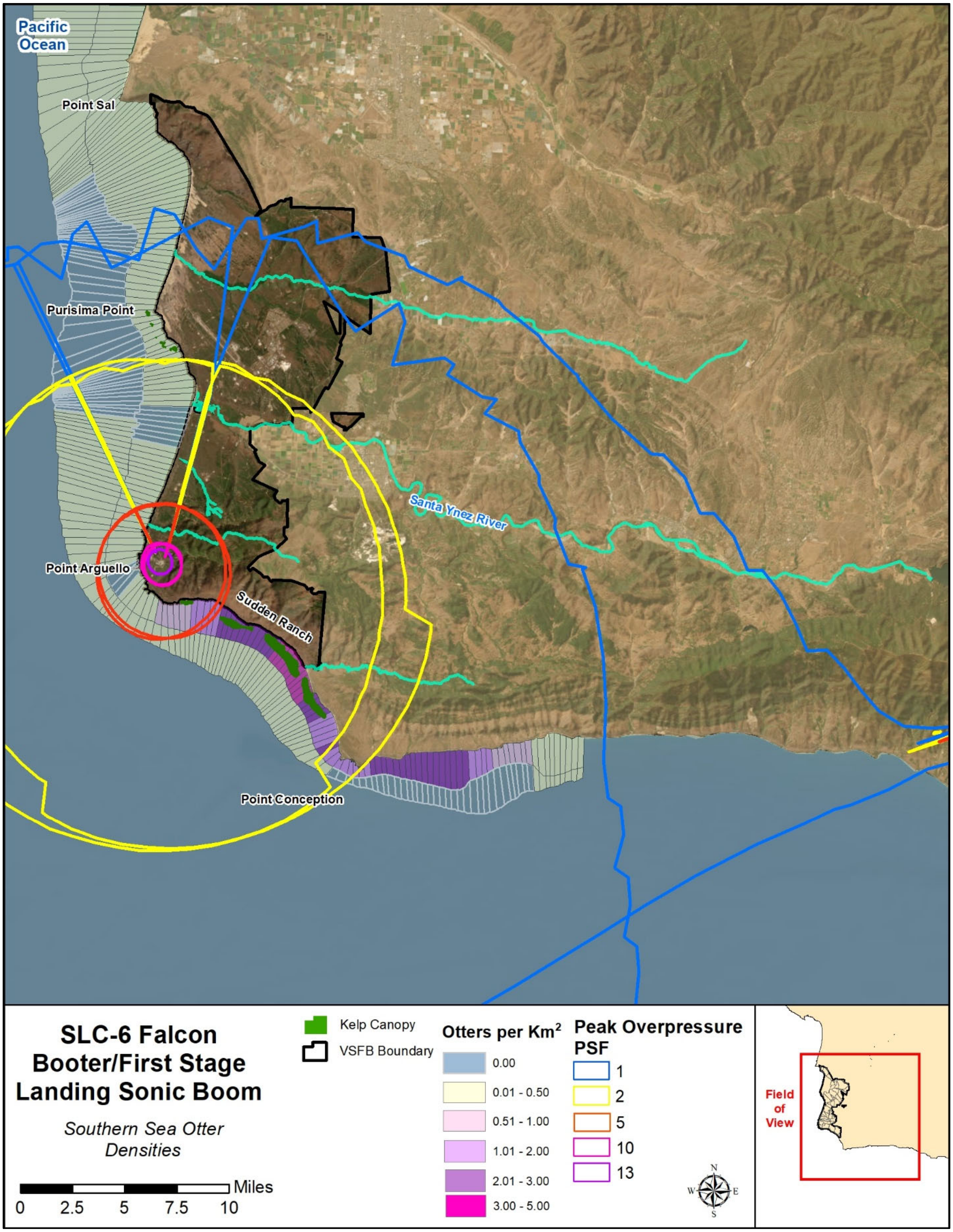

Figure 4.16-5. Southern sea otter densities and two sample SLC-6 booster/first stage landing sonic boom model results.

5 Analysis of Effects of the Proposed Action

"Effects of the action" are 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 but that are not part of the 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.

5.1 Effects of Action on Species

The potential direct impacts to species that may be caused by the Proposed Action vary by species, but include loss or degradation of habitat, injury or mortality during construction and water releases, and disturbance due to noise, vibration, and visual cues. Potential indirect impacts could result from water use, which is currently extracted from the San Antonio Creek Basin. Indirect impacts that may affect some species include potential long-term effects of increasing the launch frequency on VSFB over the next several years.

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

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

This approach and the results of these analyses were independently reviewed by Dr. Robert Dooling and Dr. Lucas Hall. Dr. Dooling is Professor Emeritus at the University of Maryland Department of Psychology and noted expert in comparative aspects of hearing and acoustic communication with over 250 scientific publications. Dr. Hall is Assistant Professor of Biology at California State University Bakersfield studying how environmental change alters long-term dynamics of wildlife in human-modified landscapes with 54 scientific publications in conservation biology, community ecology, animal behavior, spatial ecology, and bioacoustics. Both authors provided valuable feedback that led to improvements in these analyses and validation of the expected effects of noise exposure presented herein.

Finally, note that the anticipated noise levels presented in this section are estimated based on model results. Over the past two decades a large amount of field noise recordings of various space vehicles over a broad geographic area at and around VSFB, including over 115 recordings of the Falcon 9 vehicle over the past 6 years, have shown that the models are reasonably good at predicting experienced levels. However, actual received levels may vary slightly from predicted levels as a result of various factors, including meteorology, landforms that attenuate noise, and slight differences in trajectories.

5.1.1 Tidewater Goby

5.1.1.1 Physical Impacts

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

5.1.1.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at TWG habitat and extant localities are presented in Table 5.1-1 and Table 5.1-2 and Figure 4.4-1 through Figure 4.4-5. The estimate for engine noise are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). Actual measurements at Honda Creek during Falcon 9 missions from SLC-4 had an average launch noise level of 115.6 dB L_{max} (n=13), although in one instance (Starlink G8-1) launch a noise level of 127.9 dB L_{max} was measured, exceeding the modeled estimate of 125 dB L_{max}. The average landing noise level measured at Honda Creek is 104.3 dB L_{max} (n=3), substantially below the estimated level of 120 dB L_{max}. Appendix B includes all noise levels measured during Falcon 9 launches as of 24 January 2025.

Table 5.1-2 presents sonic boom levels predicted from the model produced for the Falcon 9 Bandwagon-2 mission in December 2024, which had a relatively large geographic impact area and relatively higher levels predicted than for other missions and therefore was used for this BA to represent a potential worst-case scenario (see Appendix A for variability). Of the locations listed in Table 5.1-1, sonic boom measurements have only been recorded at Honda Creek. The mission-specific model results for landing events that have required CRLF monitoring have predicted sonic booms ranging from 1 to 5.5 psf at Honda Creek for Falcon 9 landing events at SLC-4 (Appendix B). Measured sonic boom levels at Honda Creek for these missions have averaged 5.04 psf (n=7) and ranged from 2.42 to 9.86 psf (Transporter 10; Appendix B).

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Table 5.1-1. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at TWG habitat and extant localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Honda Creek	118	120	125	122	119	125	129	120	130
Santa Ynez River	110	105	118	118	108	112	112	106	116
Jalama Creek	<100	<100	108	108	105	112	108	<100	110
San Antonio Creek	100	<100	108	100	<100	106	110	106	116

Table 5.1-2. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at TWG habitat and extant localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
Honda Creek	-	6	-	9.5	-	9.5
Santa Ynez River	-	4-5	-	2.5	-	2.5
Jalama Creek	-	2-3	-	3	-	3
San Antonio Creek	-	2.2	-	1-2	-	1-2

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

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

Because there is exceptionally little sound transmitted between the air-water interface (Godin 2008) and the low level of ascent sonic booms impacting Eastern Santa Barbara, Ventura, and Los Angeles Counties, ascent sonic booms caused during missions with easterly trajectories are not expected to have an effect on TWG in these areas.

5.1.1.3 Water Use

As described in Section 0, the Proposed Action would use up to 21.1 million gallons (65.6 ac-ft) of water per year. Annual VSFB water use from 2019 through 2021 has averaged 910,500,000 gallons (2,794 ac-ft) per year. The current water source for VSFB, including SLC-4, is via an existing connection between State Water and the VSFB water supply system. VSFB primarily relies on State Water; however, during annual maintenance that lasts two to three weeks, VSFB utilizes four water wells in the San Antonio Creek Basin.

TWG in San Antonio Creek would be negatively impacted if the water used for the Proposed Action reduced flow rates, hydration periods, or water levels in San Antonio Creek. SpaceX's proposed use of up to 21.1 million gallons (65.6 ac-ft) of water per year would represent approximately 2.3% of the total annual water usage on VSFB. VSFB primarily relies on State Water. But even if pumping this entire 65.6 ac-ft volume of water from the San Antonio Creek groundwater basin, it would have an indetectable effect of water levels and flow rates in the creek (G. Cromwell, USGS, pers. comm.). Since VSFB only relies on water from the San Antonio Creek groundwater basin during up to three weeks per year, SpaceX would only require pumping approximately 5.3 million gallons (16.4 ac-ft) from the groundwater basin, which would have substantially less impact on San Antonio Creek. The Proposed Action's water usage would not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek. Therefore, any potential effects on the TWG are expected to be insignificant.

5.1.1.4 Conclusion

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

5.1.2 Unarmored Threespine Stickleback

5.1.2.1 Physical Impacts

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

5.1.2.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

As discussed in Section 4.1, the UTS was introduced into Honda Creek, south of SLC-5, in 1984 (MSRS 2009a). Extensive surveys conducted in 2008, 2016, and 2017 did not detect any fish in the creek (MSRS 2009a, 2016a, 2018a). Between 2008 and 2022, Honda Creek has gone through multiple cycles of drying and rehydration, which would preclude occupancy by and persistence of fish. The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at UTS localities in San Antonio Creek are presented in Table 5.1-3 and Table 5.1-4 and Figure 4.4-1 through Figure 4.4-5. The estimated levels for engine noise are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.) and most measurements have been below the levels predicted by modeling (Appendix B). However, engine noise levels have not been measured at San Antonio Creek during Falcon 9 launches from SLC-4.. Sonic boom levels have not been measured at San Antonio Creek. As of 24 January 2024, sonic booms have been measured at 5 monitoring locations on VSFB during 22 Falcon 9 first stage events at SLC-4W, resulting in 50 measurements (Appendix B). All but 8 of the 50 measurements were within the range of predicted psf levels. Therefore, the sonic boom levels in Table 5.1-4, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact San Antonio Creek.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at San Antonio Creek compared to sonic booms created during landing events (see Figure 2.2-3).

Table 5.1-3. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at UTS localities at San Antonio Creek.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
San Antonio Creek	100	<100	108	100	<100	106	110	106	116

Table 5.1-4. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at UTS localities at San Antonio Creek.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
San Antonio Creek	-	2.2	-	1-2	-	1-2

Exceptionally little sound is transmitted between the air-water interface (Godin 2008). Therefore, in-air sound during launches, landings, and static fire events is not expected to cause more than a brief behavioral response, if any reaction, to UTS.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

Because there is exceptionally little sound transmitted between the air-water interface (Godin 2008) and the low level of ascent sonic booms impacting Eastern Santa Barbara, Ventura, and Los Angeles Counties, ascent sonic booms caused during missions with easterly trajectories is not expected to have an effect on UTS in these areas.

5.1.2.3 Water Use

As described in Section 5.1.2, at maximum cadence, the Proposed Action would use up to 21.1 million gallons (65.6 ac-ft) of water per year. Annual VSFB water use from 2019 through 2021 has averaged 910,500,000 gallons (2,794 ac-ft) per year. The current water source for VSFB, including SLC-4, is via an existing connection between State Water and the VSFB water supply system. VSFB primarily relies on State Water; however, during annual maintenance that lasts two to three weeks, VSFB utilizes four water wells in the San Antonio Creek Basin.

UTS in San Antonio Creek would be negatively impacted if the water used for the Proposed Action reduced flow rates, hydration periods, or water levels in San Antonio Creek. SpaceX's proposed use of up to 21.1 million gallons (65.6 ac-ft) per year would represent an increase of approximately 2.3% of the total annual water usage on VSFB. VSFB primarily relies on State Water and even if pumping this entire 65.6 ac-ft volume of water from the San Antonio Creek groundwater basin, it would have an indetectable effect of water levels and flow rates in the creek (G. Cromwell, USGS, pers. comm.). Since VSFB only relies on water from the San Antonio Creek groundwater basin during up to three weeks per year, SpaceX would only require pumping approximately 5.3 million gallons (16.4 ac-ft) from the groundwater basin, which would have substantially less impact on San Antonio Creek. The Proposed Action's water usage would not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek. Therefore, any potential effects on the UTS are expected to be insignificant.

5.1.2.4 Conclusion

Because of the minimal transfer of in-air noise into underwater noise and that the increase in water extraction from the San Antonio Creek Basin under the Proposed Action would be discountable, the DAF has determined that the Proposed Action may affect but is not likely to adversely affect the UTS.

5.1.3 California Tiger Salamander

5.1.3.1 Physical Impacts

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

5.1.3.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at CTS habitat and localities in the Santa Rita Hills and Santa Maria Valley are presented in Table 5.1-5 and Table 5.1-6 and Figure 4.3-1 through Figure 4.3-5. The estimated levels for engine noise are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.) and most measurements have been below the levels predicted by modeling (Appendix B). However, engine noise levels have not been measured at either of these locations during Falcon 9 launches from SLC-4.

Sonic boom levels have not been measured at the Santa Rita Hills or Santa Maria Valley. As of 24 January 2024, sonic booms have been measured at 5 monitoring locations on VSFB during 22 Falcon 9 first stage events at SLC-4W, resulting in 50 measurements (Appendix B). All but 8 of the 50 measurements were within the range of predicted psf levels. Therefore, the sonic boom levels in Table 5.1-6, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact these areas. The single explosive event during demolition would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Table 5.1-5. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at CTS localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Santa Rita Hills	<100	<100	105	100	<100	106	110	106	116
Santa Maria Valley	<100	<100	100	<100	<100	105	103	<100	108

Table 5.1-6. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at CTS localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
Santa Rita Hills	-	1-2	-	1.5	-	1.5
Santa Maria Valley	-	1-1.5	-	1	-	1

There is very little information regarding the hearing of salamanders. The hearing ability of this group is rudimentary and likely limited to physical vibrations, although tiger salamanders have been shown to detect air-borne sound (Weaver 1985), but with low sensitivity (Christensen et al. 2015). Salamanders do not have an inner ear cavity and likely only hear bone-conducted sound. Therefore, it is more likely that urodeles hear sound primarily through substrate, rather than in-air sound (Stebbens 1983; Christensen et al. 2015). The CTS spends the majority of their life underground, coming out once a year to migrate to and breed in temporary bodies of water. Exceptionally little sound is transmitted between the air-water interface (Godin 2008); thus, in-air sound is not likely to have an effect on submerged CTS. Likewise, exceptionally little sound is transferred underground. There is no known research on salamander's sensitivity to noise underground. However, due to the reflection from the ground, the intensity of the sonic boom would be greatly diminished at ground level (Ventre et al. 2002) and below ground level the overpressures would decrease approximately 30%for every centimeter, depending on the type of soil (Oelze et al. 2002). Since CTS are typically in burrows at depths between 0.2 m and 1.36 m underground (Barry & Shaffer 1994), essentially all noise energy would be attenuated before reaching subterranean CTS. Therefore, the sonic boom would not likely affect the CTS when underground.

Emergence from burrows and migration to breeding pools is strongly tied to the onset of significant rainfall (Loredo & Van Vuren 1996; Trenham et al. 2000; Cook et al. 2006; USFWS 2016). Literature searches failed to find any information on noise, either natural or human-caused, causing pre-mature emergence from burrows. It is unlikely that CTS use noise as a cue to emerge for the following reasons: 1: CTS tend to be deeper underground than surface noises would be able to reach (Barry & Shaffer 1994; Ventre et al. 2002); 2: Lightning (and therefore thunder) is rarely associated with winter rainstorms in Santa Barbara County (Meier & Thompson 2009); 3: CTS are not observed moving to breeding ponds until substantial rainfall events that have greater potential to fill pools are underway, suggesting that CTS may be primarily responding to inundation of their burrows with water (J. LaBonte, pers. obs.). Therefore, noise associated with the Proposed Action is unlikely to have any effect on CTS when below ground.

In the unlikely event that a CTS was above ground and exposed to a 1- to 1.5-psf overpressure or rocket engine noise, the noise could potentially cause a minor temporary behavioral reaction, if any. However, CTS are aboveground very infrequently and for short durations (at most several nights per year during transit between breeding ponds and upland habitat). Therefore, the action is very unlikely to cause disruption of normal behavior.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

There are no records of CTS in eastern Santa Barbara, Ventura, and Los Angeles Counties and there would be no noise impacts on this species in this area as a result of the Proposed Action.

5.1.3.3 Conclusion

Any potential impact on CTS from noise associated with the Proposed Action would be very unlikely to occur given the attenuation of noise due to landforms between SLC-4, SLC-6, and the nearest localities 14 mi to the east, as well as the low likelihood that CTS would be above ground during a launch event. Therefore, the Proposed Action may affect, but is not likely to adversely affect the CTS.

5.1.4 California Red-Legged Frog

5.1.4.1 Physical Impacts

Direct impacts on post-metamorphic CRLF, including injury and mortality, may inadvertently occur during removal of vegetation, site grading and contouring, construction, firebreak and fire establishment, and site maintenance from the operation of heavy equipment, machinery, and vehicles at SLC-6. CRLF that may disperse through the project area could become entrapped in any holes or trenches left open overnight. However, open holes and trenches would be covered overnight and the risk of impacts on CRLF will be reduced because biologists will monitor construction activities and search for animals trapped in open holes and trenches. Any CRLF detected within the construction area would be captured and relocated to nearby suitable habitat. In addition, when any demolition, contouring, or construction occurs at SLC-6, the active construction areas would be surrounded by exclusion fence (see Section 2.3.2). A USFWS approved biologist would be present to monitor vegetation-clearing activities and move any CRLF encountered to the nearest suitable habitat out of harm's way. Regardless, post-metamorphic frogs may be injured or killed during construction and vegetation clearing activities if they are not detected before or during construction. The risk of introducing or spreading chytrid fungus would be reduced by requiring implementation of the DAPTF Fieldwork Code of Practice (USFWS 2002a).

5.1.4.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

Construction noise during day and night hours would potentially disrupt CRLF if present within the area affected by these noise sources. Standard types of construction equipment would be employed that have well-known noise profiles. Noise during construction greater than 80 dB is not expected to extend more than 320 ft from the construction site (Table 2.2-1). There are no current extant CRLF populations or suitable breeding habitat within this distance; Semi-aquatic habitat exists at both the northern and southern drainages and the Industrial Wastewater Treatment Ponds where transitory CRLF could occur (Figure 4.4-6). However, any CRLF transiting through the area would be unlikely to remain at these locations for extended periods of time. In addition, transiting CRLF could be drawn to the vault structure and the flame trench. CRLF would be unlikely to spend extensive time in the flame trench due to the lack of aquatic vegetation and cover. Although CRLF could potentially be trapped in the vault structure, qualified biologists would survey the area while establishing a wildlife exclusion zone and capture and relocate any CRLF found in the vault, thus minimizing the risk that they would be exposed to loud noises at SLC-6. The nearest suitable CRLF breeding habitat and extant records is approximately 1.4 mi north at Honda Creek, well outside the typical dispersal distance of CRLF (210 meters). Therefore, construction noise is unlikely to have an effect on any CRLF. In the event that a CRLF is transiting through SLC-6 or upland habitat near the construction areas during construction activities, it could conceivably be exposed to noise levels of 80 dB or above. However, implementation of the avoidance and minimization measures during construction listed in Section 2.3.1 would greatly reduce the likelihood of CRLF being within this area since a wildlife exclusion zone would be established prior to construction which would be surveyed and monitored by a qualified biologist who would capture and relocate any CRLF encountered. Therefore, the likelihood of CRLF being disturbed by construction noise in upland habitat is very low.

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at CRLF localities are presented in Table 5.1-7 and Table 5.1-8 and Figure 4.4-1 through Figure 4.4-5. The estimated engine noise levels are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). Actual measurements at Honda Creek during Falcon 9 missions from SLC-4 had an average launch noise level of 115.6 dB L_{max} (n=13), although in one instance (Starlink G8-1) launch a noise level of 127.9 dB L_{max} was measured, exceeding the modeled estimate of 125 dB L_{max}. The average landing noise level measured at Honda Creek is 104.3 dB L_{max} (n=3), substantially below the estimated level of 120 dB L_{max}. Appendix B includes all noise levels measured during Falcon 9 launches as of 24 January 2025.

Table 5.1-7. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at CRLF localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Honda Creek	118	120	125	122	119	125	129	120	130
Santa Ynez River	110	105	118	118	108	112	112	106	116
Jalama Creek	<100	<100	108	108	105	112	108	<100	110
San Antonio Creek	100	<100	108	100	<100	106	110	106	116

Table 5.1-8. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at CRLF localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
Honda Creek	-	6	-	9.5	-	9.5
Santa Ynez River	-	4-5	-	2.5	-	2.5
Jalama Creek	-	2-3	-	3	-	3
San Antonio Creek	-	2.2	-	1-2	-	1-2

Sonic boom modeling is performed for each SpaceX mission.

Table 5.1-8 presents sonic boom levels predicted from the model produced for the Falcon 9 Bandwagon-2 mission in December 2024, which had a relatively large geographic impact area and relatively higher levels predicted than for other missions and therefore was used for this BA to represent a potential worst-case scenario (see Appendix A for variability). The mission-specific model results for landing events that have required CRLF monitoring have predicted sonic booms ranging from 1 to 5.5 psf at Honda Creek for Falcon 9 landing events at SLC-4 (Appendix B). Measured sonic boom levels at Honda Creek for these missions have averaged 5.04 psf (n=7) and ranged from 2.42 to 9.86 psf (Transporter 10; Appendix B). Sonic booms haven't been measured at the Santa Ynez River, Jalama Creek, or San Antonio Creek. However, as discussed previously, all but 8 of 50 sonic boom measurements during Falcon 9 first stage landing events at SLC-4W were within the range of predicted psf levels (Appendix B). Therefore, the sonic boom levels in Table 5.1-8, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact the Santa Ynez River, Jalama Creek, or San Antonio Creek.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Under the worst case scenario, modeled engine noise is predicted to reach as high as 150 dB L_{max} with sonic booms have been predicted up to 8.5 psf in upland CRLF dispersal habitat on SLC-4 (Figure 4.4-2), however, as noted above, acoustic monitoring during the Transporter 10 mission measured a 9.86 psf at Honda Creek, 2.1 mi south of SLC-4 which shows that levels can exceed predicted values (Appendix B). Modeling for landings at SLC-6 predict sonic booms potentially as high as 13 psf (Figure 4.4-5**Error! Reference source not found.**). However, vegetation management within and around SLC-4 and SLC-6 would make CRLF presence above ground within the SLCs unlikely during typical dry conditions.

There are no studies in the literature on the effects of noise on CRLF. Simmons et al. (2014) found that American bullfrogs, which are within the same Family as the CRLF (Ranidae), required long exposure (20 to 24 hours) to sound levels greater than 150 dB L_{max} (approximately equivalent to 13 psf) to consistently cause morphological damage of hair cells in the hearing structures. Even after such hearing damage, bullfrogs showed full functional recovery within 3 to 4 days; thus, the hearing damage was temporary (Simmons et al. 2014). CRLF in terrestrial environments may be exposed to engine noise levels of 150 dB L_{max} and sonic booms up to 8.5 psf; therefore, inferring from this study of the bullfrog, the most closely related species for which science is currently available, even temporary hearing damage would be unlikely for CRLF that may be present. Additionally, due to vegetation management around the proposed launch vehicle sites, the likelihood of CRLF being present in terrestrial environments exposed to these noise levels would be very low and few individuals would be impacted.

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

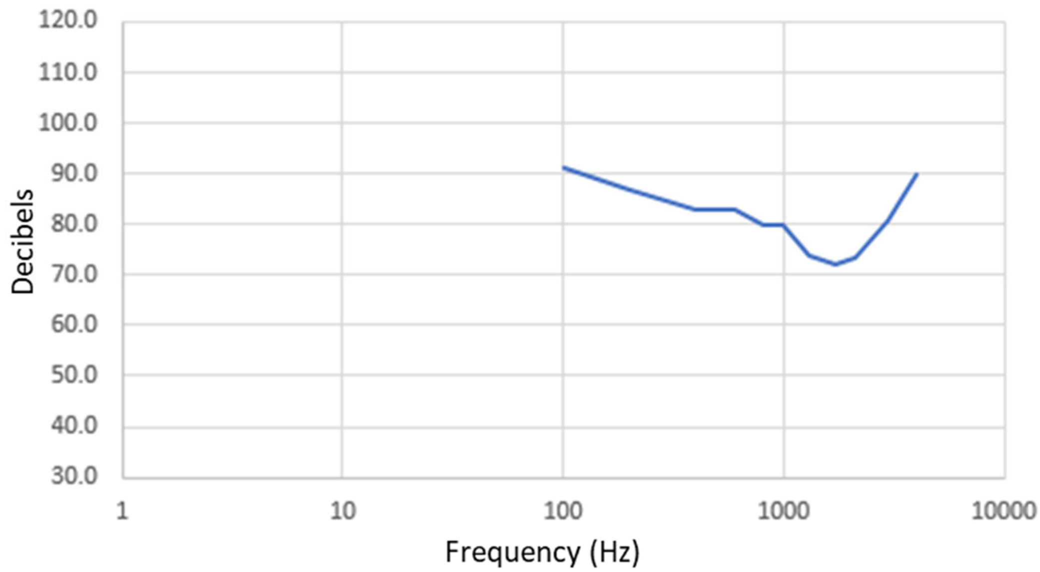

Figure 5.1-1. Mean Ranidae hearing sensitivity curve.

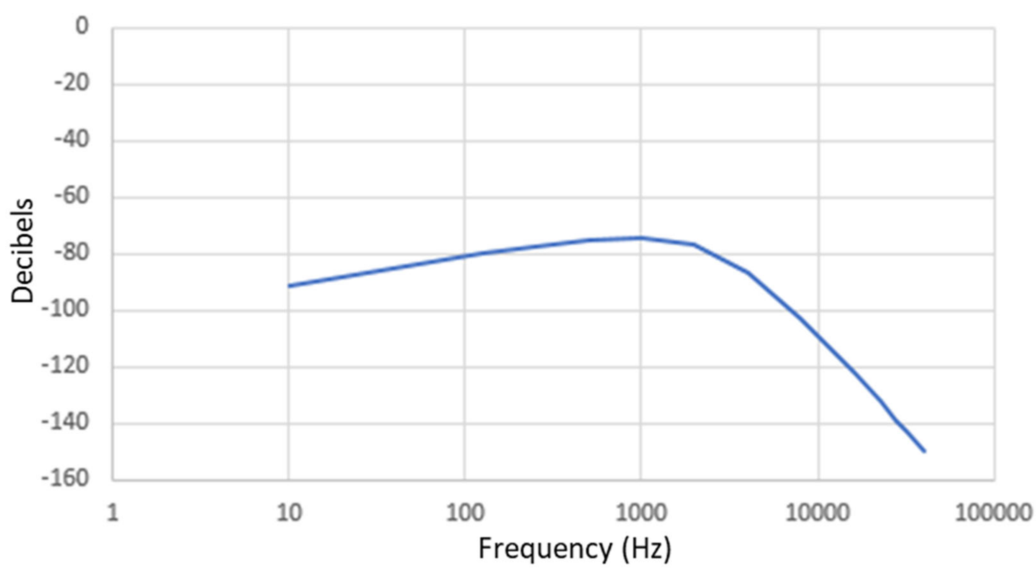

Figure 5.1-2. Ranidae weighting function.

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

Despite CRLF's low hearing sensitivity to rocket engine noise and sonic boom, it is assumed that the sonic boom and engine noise would likely trigger a startle response in CRLF if above water and near the launch site, potentially due to minor vibrations of the substrate underneath them caused by the noise and potential visual disturbance if under the path of the rocket. Straam Group (2025) performed a study of vibrations caused during Falcon 9 launch and landing events at SLC-4. Vibrations in soil were detected during engine noise and sonic boom events during this effort. At Spring Canyon, 0.27 mi from the launch site, mild vibrations were detected at a maximum peak particle velocity (PPV) of 0.96 inches per second, roughly equivalent to a magnitude 3-4 earthquake at a distance of several mi from the epicenter (Winant, T., pers. comm.). Those levels declined exponentially with distance from SLC-4. At Bear Creek, 1.4 mi from SLC-4, the maximum PPV measured was 0.04 inches per second, which is unlikely to be perceptible to humans and roughly equivalent to a magnitude 2 or less earthquake at 2 mi from the epicenter (Winant, T., pers. comm.). Ground vibrations as a result of earthquakes of this level are common. For instance, between 5 February 2025 and 7 March 2025, of the 3,387 earthquakes recorded in California, 41% of them were at levels between 1 and 2 (USGS 2025). It is unlikely that this level of vibration would disturb a CRLF. At the San Antonio Creek Oxbow site the peak acceleration during launch was approximately 0.01% of the acceleration measured at the Bear Creek (Straam Group 2025). Thus, CRLF near the launch site would be expected to experience a temporary behavioral disruption due to vibration, but further away, any effect due to vibration is unlikely.

Bioacoustic monitoring was performed during the CRLF breeding season during the NROL-87 mission on 2 February 2022 and the SWOT mission on 16 December 2022. MSRS performed bioacoustic monitoring during NROL-87 at two locations within the predicted boom impact area (MSRS 2022e), following the monitoring requirements of the 2017 BO (USFWS 2017a). Though the landing occurred during daylight hours, CRLF were detected calling at both monitoring locations, a drainage near the VSFB Recreation Center and lower Honda Creek. The sonic boom did not cause a measurable reduction in CRLF calling frequency at either of the two locations where the received overpressures were between 1 psf (VSFB Recreation Center, 6.8 mi northeast of SLC-4) and 2.4 psf (lower Honda Creek, 2.1 mi southwest of SLC-4). At both sites, CRLF calls were detected within 20 to 30 minutes after the sonic boom was received and the average number of calls per hour during the two nights following the sonic boom were greater than the night prior to the boom, suggesting that the noise disturbance did not prompt reduced calling behavior (MSRS 2022e). At the Recreation Center Drainage, three CRLF calls were detected during the hour prior to the sonic boom (1100–1200), and three were detected during the hour period when the sonic boom occurred (1200–1300). One of the three calls detected during the period when the boom was received was 30 minutes prior to the boom with the other two calls 23 and 24 minutes after the boom. At lower Honda Creek, no CRLF calls were detected during the hour period prior to the sonic boom (1100–1200), and four calls were detected during the hour when the boom occurred (1200–1300). Of the four calls that occurred during the hour period when the boom occurred, all four were detected after the boom, at 32, 37, 47, and 48 minutes post boom (MSRS 2022e).

During the SWOT mission in December 2022, no CRLF were detected calling at Honda Creek in the days prior to or during the launch. CRLF were calling at a Recreation Center Drainage approximately 6.8 mi northeast of SLC-4 and were monitored for the launch. There was no evidence that the noise from the launch or sonic boom negatively affected breeding behavior based on calls per hour. CRLF calling rates increased during the 5-hour period after the sonic boom; however, the increase did not appear to be in response to the sonic boom. During the hour immediately prior and following the sonic boom, CRLF calls were not detected prior and only one call was detected after. Call rate then steadily increased for the next several hours, peaking at or near sunrise (MSRS 2023b).

Lewis and Narins (1985) determined that white-lipped frogs (*Leptodactylus albilabris*) can detect seismic signals and use them in communication. This species is not closely related to CRLF; however, it may be reasonable to assume that the strongest reaction to engine noise and sonic booms may be the result of minor physical vibrations of water or the ground caused by the low frequency portion of the noise energy in combination with visual disturbance, rather than the noises themselves. In CRLF, this could translate to a startle response to noise, minor vibrations, and visual disturbance during launch, landing, and static fire, causing them to flee to water or attempt to hide in place. Because landing engine noise occurs approximately 5 to 7 minutes after launch noise and is typically slightly (seconds) before the sonic boom is received, individuals that flee into water because of launch disturbance would have a reduced likelihood of being exposed to the landing engine noise and sonic boom due to the attenuation of sound in water (Godin 2008). It is likely that any reaction would be dependent on the sensitivity of the individual, the behavior in which it is engaged when it experiences the noise, and past exposure to similar noise. Regardless, the reaction is expected to be the same—the frog's behavior would likely be disrupted, and it may flee to cover in a similar reaction to that of a frog reacting to a predator. As a result, there could be a temporary disruption of CRLF behaviors including foraging, calling, and mating (during the breeding season). However, frogs tend to return to normal behavior quickly after being disturbed.

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

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

Whether a result of minor physical vibrations caused by noise or overlap of some noise stimuli with various species hearing sensitivity range, there is a growing body of literature on the effects of anthropogenic noise disturbance on anurans. These studies have typically examined the impact of sustained vehicle noise associated with roads near breeding ponds and have generally shown negative effects on individual frog behavior and physiology which potentially have consequences for populations (see examples in Parris et al. 2009 and Tennessen et al. 2014). For instance, a variety of anurans have been shown to alter call signal structure in response to chronic exposure to traffic noise (Bee & Swanson 2007; Lengagne 2008; Cunnington & Fahrig 2010; Kaiser et al. 2011; Hanna et al. 2014) and airplane noise (Sun & Narins 2005, Kruger & Du Preez 2016). Researchers studying chronic exposure to sustained anthropogenic noise in anurans have also found higher levels of stress hormones, lowered immunity, and impacts to reproductive physiology and behavior, all of which may have negative consequences for populations. Tennessen et al. (2014) showed that prolonged exposure to traffic noise increased corticosterone and impaired mate attraction in wood frogs (*Lithobates sylvaticus*). Tennesen et al. (2014) also showed that populations of wood frogs in high traffic noise locations have undergone evolutionary adaptation to avoid physiological costs of the noise to fitness, suggesting that at least some species may be able to adapt to sustained noise. In an experiment where European tree frogs (*Hyla arborea*) were exposed to four hours of continuous recorded traffic noise nightly, Troïanowski et al. (2017) found increased stress hormone level that induced an immunosuppressive effect in the subjects. Similarly, White's treefrogs (*Litoria caerulea*) exposed to continuous, sustained noise (one week of recorded traffic noise) had higher levels of corticosterone and decreased sperm count and sperm viability (Kaiser et al. 2015). In chronic high-noise habitats adjacent to a busy highway (average 30,000 vehicles per day), the time and distance over which male Pacific chorus frogs (*Pseudacris regilla*) calls could be perceived for was significantly reduced, potentially having implications for the reproductive success of this species (Nelson et al. 2017). Japanese tree frogs (*Dryophytes japonicus*) exposed to persistent, low frequency noise caused by wind turbines had faster call rates, increased salivary concentrations of corticosterone, and lower innate immunity (Park & Do 2022). Eastern sedge frogs (*Litoria fallax*) tended to choose less attractive male calls significantly more often when experimentally exposed to background traffic noise, potentially having evolutionary and population level implications over the long term (Schou et al. 2021). There are no thresholds in the literature that quantify what level of noise or frequency of disturbance would elicit stress hormone responses, impacts to breeding and reproduction, or negative population level effects. While these studies show effects on behavior and physiology that could have impacts on fitness and populations, none of them present direct evidence of population impacts, so the long-term effects of chronic exposure to anthropogenic noise on populations is unknown for these species.

None of the preceding studies are directly comparable to the noise impacts of the Proposed Action, which is likely to be minimally perceptible in the hearing range of CRLF and infrequent. While the Proposed Action may cause vibrations that would be sensed, the noise and vibrations would be of short duration and infrequent (up to 100 events per year) compared to the available literature, which examines sustained traffic noise and multiple daily airplane flights, and therefore are likely to result in minimal disturbance on CRLF.

Monitoring survey data from 2024 shows that CRLF populations in Honda Creek and Bear Creek have increased significantly despite the increased cadence in 2024. Table 5.1-9 shows the established baseline CRLF night survey results for a set survey stretch in lower Honda Creek that has been surveyed repeatedly since 2013 using the same methods. During 2024, both the total number of adult CRLF and CRLF detected per survey hour are approximately twice as high as pre-project implementation.

Table 5.1-9. Baseline and post-project implementation CRLF night survey results for lower Honda Creek*.

Survey Date	Adults Detected	Total Survey Time	CRLF per Survey hour
Pre-Project Baseline (annual high number of adults detected)			
7/17/2013	9	2:18	3.9
5/3/2016	9	5:19	1.7
6/23/2017	1	1:46	0.6
8/18/2020	10	1:36	6.3
1/25/2022	7	1:36	4.4
Pre-Project Baseline Average	**7.2**	**2:31**	**2.9**
Post-Project Implementation Monitoring Surveys			
4/30/2024	15	3:40	4.1
5/22/2024	14	2:35	5.4
8/28/2024	13	1:49	7.2
Post-Project Average	**14**	**2:41**	**5.2**
* Lower Honda Creek survey stretch begins downstream at estuary (34.608208°, -120.637200°) and ends at a waterfall (34.605609, -120.628571).			

The most recent thorough pre-project baseline night survey efforts of Bear Creek were performed in 2013. A total of 12 post-metamorphic CRLF were observed within the creek across two night surveys in March 2013 (MSRS 2014a). Drought conditions persisted from 2013 through 2022, which impacted CRLF habitat quality in Bear Creek during this period. In 2023, above average rainfall levels rehydrated portions of Bear Creek, including the basin at the western terminus of the creek. Biologists performed a night survey of this basin in April 2023, but only detected Baja California tree frogs despite suitable CRLF habitat. Rainfall during the 2023-2024 wet season was again above average. Extensive vegetation which had overgrown the creek during the drought from 2013 through 2022 required a large trail cutting effort in order to access the creek which delayed entry to the upper portions of the creek until later in the season. Additionally, the increase in hydrated portions of the creek required it to be surveyed across four separate set stretches to obtain a full survey of the creek each quarter. Table 5.1-10

Table 5.1-10 shows the results of these survey efforts with the baseline from 2013 for comparison. Because of the differences in survey stretches surveyed in 2013 and 2024 and missing survey lengths for 2013, they are not directly comparable; however, the numbers of CRLF observed in 2024 are clearly greater than 2023, suggesting that available habitat (i.e., hydrated portions of the stream) is the driving factor in CLRF presence.

Table 5.1-10. Baseline and post-project implementation CRLF night survey results for Bear Creek.

Survey Date		Adults Detected	Total Survey Time	CRLF per Survey hour
Pre-Project Baseline*				
Lagoon + Lower	3/14/2013	11	*	*
Upper 1 + Upper 2	3/20/2013	1	*	*
Post-Project Implementation Monitoring Surveys				
Lagoon	2/27/2024	23	2:39	8.7
Lagoon	3/11/2024	4	2:18	1.7
Lagoon	5/23/2024	16	4:14	3.8
Lagoon	7/2/2024	15	2:20	6.4
Lagoon	8/13/2024	15	1:12	12.5
Lower	5/23/2024	0	1:47	0.0
Lower	7/2/2024	0	1:36	0.0
Lower	8/13/2024	1	1:01	1.0
Upper 1	4/29/2024	0	3:04	0.0
Upper 1	7/8/2024	0	2:30	0.0
Upper 1	8/14/2024	1	1:05	0.9
Upper 2	6/12/2024	3	2:47	1.1
Upper 2	7/1/2024	1	1:42	0.6
Upper 2	8/15/2024	1	2:43	0.4
* In 2013, CRLF night surveys of the entire hydrated portions of Bear Creek required two night survey efforts, however survey data was not available to provide the survey length for each date and CRLF per survey hour.				

Quarterly protocol night surveys of the Santa Ynez River at the 13th Street Bridge on VSFB, performed from winter 2014 through fall 2015, documented between 4 and 13 adult CRLF per survey, with an average of 8.5 adult CRLF per survey. The majority of these observations were within an agricultural runoff channel on the southeastern side of the 13th Street Bridge (MSRS 2016a). Upstream of the bridge, only one adult CRLF was detected in the stretch of the Santa Ynez River extending from approximately 200 meters east of the bridge to the base boundary during survey efforts in 2008 and 2015 (MSRS 2009b, 2016a). The 13th Street Bridge was replaced during a two-year construction effort from August 2016 to October 2017. During this project, the agricultural runoff channel was almost entirely removed. The channel was reconstructed at the end of the project, with efforts made to recreate the deep pools the channel had included prior to construction. Sedimentation of the drainage from off-base agricultural fields quickly decreased the depth of these pools to approximately 6 inches on average. During monthly night surveys of the area impacted by bridge replacement project from November 2017 through October 2018, between 0 and 5 adult (average 1.25) CRLF were observed per survey, with an overall average of 0.47 adult CRLF per surveyor-hour (MSRS 2018b). Most CRLF were observed in the main channel of the Santa Ynez River, with very low numbers within the agricultural runoff channel. Although up to 5 CRLF were detected calling in 2018, no tadpoles were observed during seine surveys in July 2018 (MSRS 2018b). The lower number of observations and detection rates suggests that the loss of the agricultural channel impacted the CRLF population in the area surrounding the bridge.

As of 2022, the habitat in the agricultural channel remained shallow and completely filled with emergent vegetation (A. Abela, pers. comm.). Therefore, the pre-project baseline was estimated to be 5 adult CRLF at the 13th Street Bridge (including the agricultural channel). High flow events during 2024 delayed monitoring surveys of the river due to safety concerns; however, 8 adult CRLF were detected during a night survey of the 13th Street bridge stretch on 20 March 2024, 4 adults on 30 May 2024, and 1 adult on 20 August 2024. Although robust baseline data are not available for the lower Santa Ynez River (west of the 13th Street Bridge), a night survey on 26 August 2024 detected 77 adult CRLF on this stretch. These data are still being analyzed to compare to environmental variables, but overall, CRLF on the Santa Ynez River appear to shift occurrence based on changes in habitat quality in this highly dynamic system, and there is no indication that launch noise is causing declines in this system.

Because noise and vibrations would be minimally perceptible, of short duration and infrequent, and monitoring data collected to date does not indicate declines in populations, the Proposed Action is likely to result in minimal disturbance and effects on CRLF on VSFB and nearby areas. The DAF will continue to implement a monitoring program (see Section 2.3.2) to track CRLF habitat occupancy, breeding behaviors, and tadpole densities in Lower Honda Creek (the area to receive the highest noise levels), Bear Creek, the Santa Ynez River, and will add monitoring in Jalama Creek as the launch cadence increases under the Proposed Action. The DAF will also continue to use passive bioacoustic recorders and analyze these data to assess any associated impacts on the CRLF population. As required under the 2024 BO, the DAF is offsetting potential effects to CRLF by creating CRLF breeding habitat at the San Antonio Creek Oxbow Restoration Area.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

Approximately 65% of missions with easterly trajectories are predicted to create sonic booms that will overlap at least one CRLF population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these ascent sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of CRLF localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.4-9. Figure 5.1-4 and Table 5.1-11 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of CRLF localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that ascent sonic booms greater than 1.0 psf would impact CRLF populations in these areas infrequently and the lack of any coupled visual stimuli, which can heighten the perception of a threat in animals (Partan & Marler 2005; Stevens 2013), ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on CRLF.

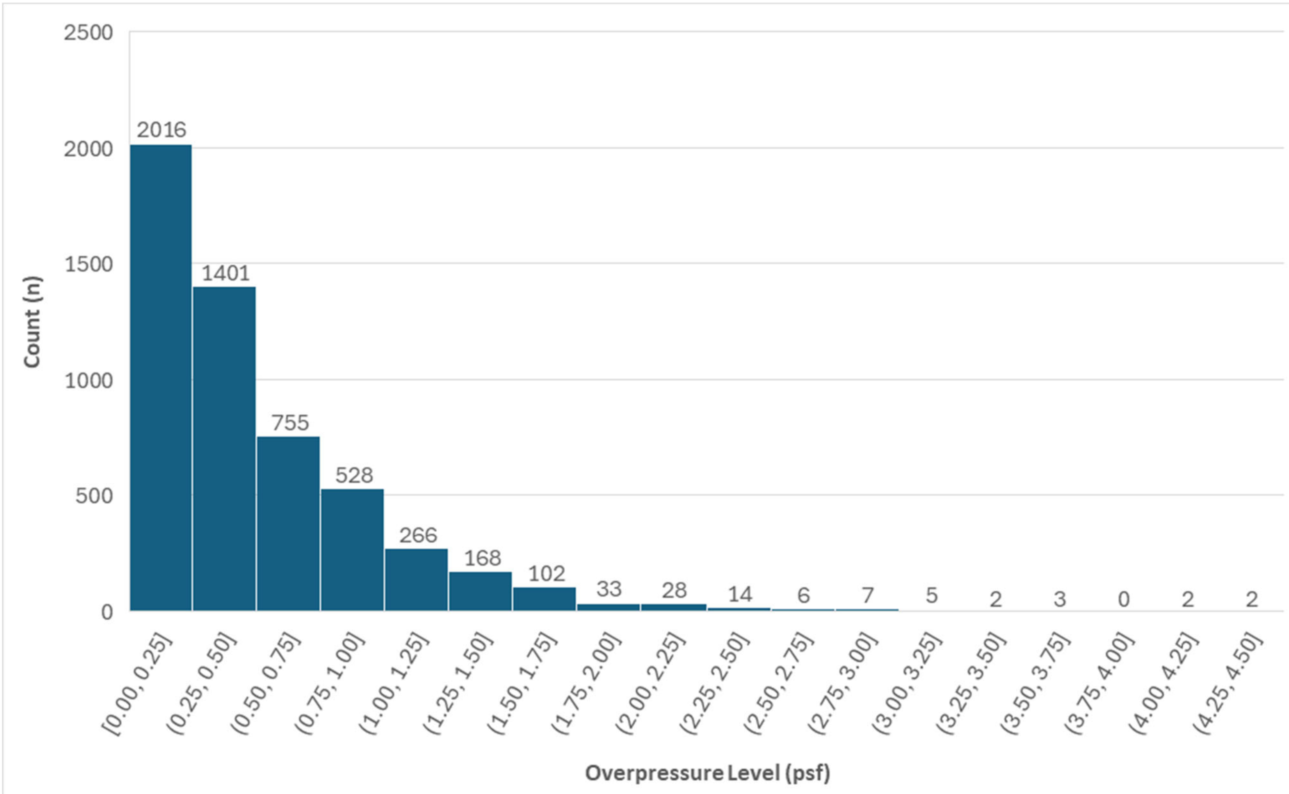

Figure 5.1-4. Distribution of PCBoom ascent sonic boom modeling results within 10 km of CRLF localities shown in Figure 4.4-9.

Table 5.1-11. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of CRLF localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	199	308	64.6%
1-2	84	308	27.3%
2-3	35	308	11.4%
3-4	8	308	2.6%
4-5	4 (4.5 psf)	308	1.3%

5.1.4.3 Water Use

As described above, at maximum cadence, the Proposed Action would use up to 21.1 million gallons (65.6 ac-ft) of water per year. Annual VSFB water use from 2019 through 2021 has averaged 910,500,000 gallons (2,794 ac-ft) per year. The current water source for VSFB, including SLC-4, is via an existing connection between State Water and the VSFB water supply system. VSFB primarily relies on State Water; however, during annual maintenance that lasts two to three weeks, VSFB utilizes four water wells in the San Antonio Creek Basin.

CRLF in San Antonio Creek would be negatively impacted if the water used for the Proposed Action reduced flow rates, hydration periods, or water levels in San Antonio Creek. SpaceX's proposed use of up to 21.1 million gallons (65.6 ac-ft) per year would represent approximately 2.3% of the total annual water usage on VSFB. VSFB primarily relies on State Water and even with pumping this entire 65.6 ac-ft volume of water from the San Antonio Creek groundwater basin, it would have an indetectable effect of water levels and flow rates in the creek (G. Cromwell, pers. comm.). Since VSFB only relies on water from the San Antonio Creek groundwater basin during up to three weeks per year, SpaceX would only require pumping approximately 5.3 million gallons (16.4 ac-ft) from the groundwater basin, which would have substantially less impact on San Antonio Creek. The Proposed Action's water usage would not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek. Therefore, any potential effects on the CRLF are expected to be insignificant.

5.1.4.4 Conclusion

The DAF has determined that, although it is highly unlikely that CRLF may be encountered while performing construction activities at SLC-6, if a CRLF is encountered, capture and relocation may affect, and is likely to adversely affect, CRLF on VSFB. Launch noise, sonic booms, and visual disturbance within the action area may induce minor behavioral responses in individual CRLF. Although monitoring data from 2024 does not suggest that there is population-level decline in areas impacted by existing launch noise, which is of short duration and occurs only intermittently, further monitoring will help determine if behavioral responses may result in any population declines within the area affected by noise. Therefore, the DAF has determined that noise as a result of the Proposed Action may affect, and is likely to adversely affect the CRLF.

5.1.5 Arroyo Toad

5.1.5.1 Physical Impacts

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

5.1.5.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

There would be no noise impacts to ARTO in the VSFB area.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

Approximately 45% of missions with easterly trajectories are predicted to create ascent sonic booms that overlap an ARTO population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of ARTO localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.5-1. Figure 5.1-5 and Table 5.1-12 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of ARTO localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that ascent sonic booms greater than 1.0 psf would be very unlikely to impact ARTO populations and the lack of any coupled visual stimuli, which can heighten the perception of a threat in animals (Partan & Marler 2005; Stevens 2013), ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on ARTO.

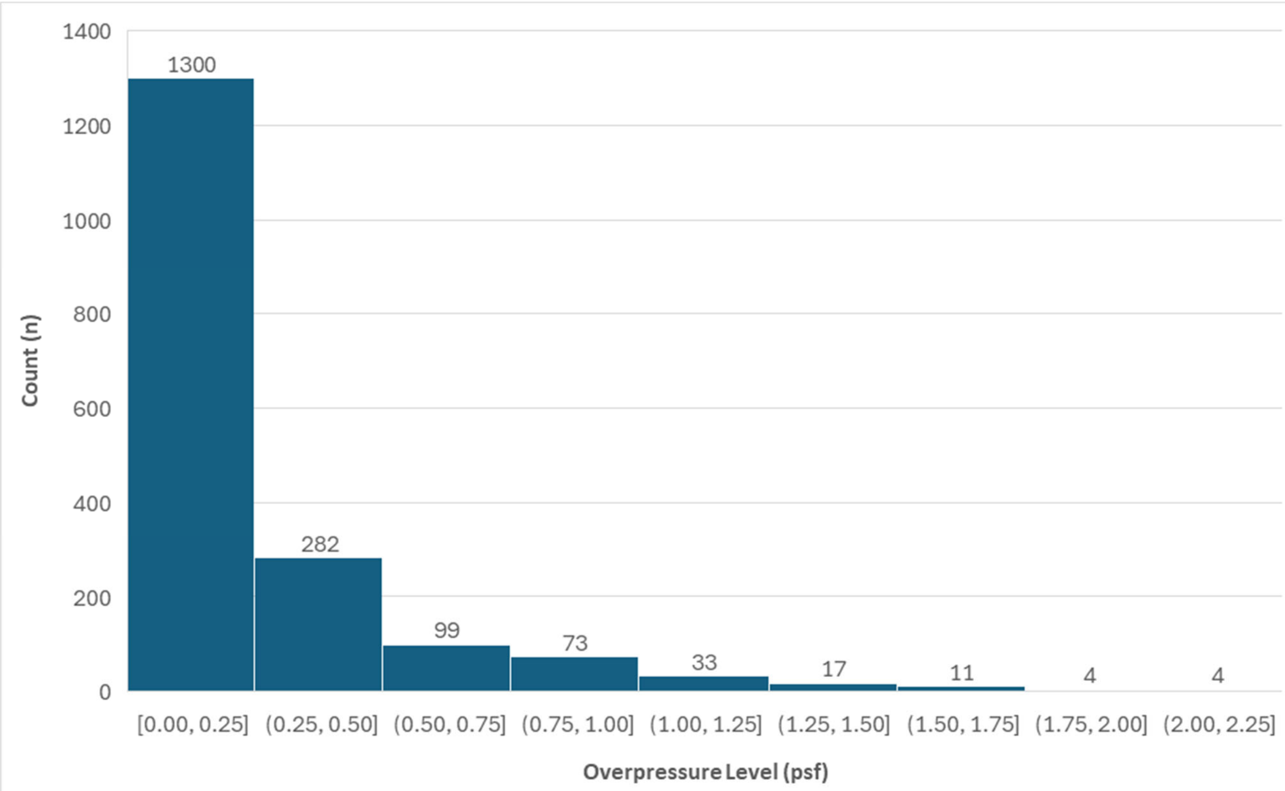

Figure 5.1-5. Distribution of PCBoom ascent sonic boom modeling results within 10 km of ARTO localities shown in Figure 4.5-1.

Table 5.1-12. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of ARTO localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	140	308	45.5%
1-2	18	308	5.8%
2-3	4 (2.1 psf)	308	1.3%
3-4	0	308	0%
4-5	0	308	0%

5.1.5.3 Conclusion

Given that ascent sonic booms greater than 1.0 psf would be very unlikely to impact ARTO populations and the lack of any coupled visual stimuli, the DAF has determined that noise as a result of the Proposed Action is discountable and may affect, but is not likely to adversely affect, ARTO.

5.1.6 Marbled Murrelet

5.1.6.1 Physical Impacts

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

5.1.6.2 Noise and Visual Disturbance

Noise Impacts in Western Santa Barbara County

MAMU do not nest on VSFB, so exposure to noise impacts would be limited to foraging adults that have occasionally been observed between the late summer through winter off the coast of south VSFB (eBird 2024).

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at the nearest coastline location to each SLC are presented in Table 5.1-13 and Table 5.1-14 and Figure 4.6-1 through Figure 4.6-5. Engine noise levels have not been measured at these locations during Falcon 9 launches from SLC-4. However, the estimated engine noise levels are likely to be conservatively high because the models do not consider attenuation due to land forms (e.g., mountains, hills, valleys, etc.) and most measurements have been below the levels predicted by modeling (Appendix B). Additionally, the majority of MAMU are found in a band about 984 to 6,561 ft from shore (Strachan et al. 1995) where noise levels would be much lower because of the distance of individuals from the source of the noise.

Table 5.1-13. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at the nearest coastline to each launch facility.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Nearest Coastline	122	130	140	130	120	140	130	120	130

Table 5.1-14. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at the nearest coastline to each launch facility.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
Nearest Coastline	-	7-8	-	10	-	10

Sonic boom levels have not been measured at the coastline nearest to SLC-4 during Falcon 9 launches from SLC-4. However, as of 24 January 2024, sonic booms have been measured at 5 monitoring locations on VSFB during 22 Falcon 9 first stage events at SLC-4W, resulting in 50 measurements (Appendix B). All but 8 of the 50 measurements were within the range of predicted psf levels. Therefore, the sonic boom levels in Table 5.1-14, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact these areas.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

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

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

There are no records of MAMU in eastern Santa Barbara, Ventura, and Los Angeles Counties, and there would be no noise impacts on this species in this area as a result of the Proposed Action.

5.1.6.3 Conclusion

Because MAMU would be unlikely to be present during a launch, landing, or static fire event, and the expected impact would be a temporary behavioral reaction in response to noise, the Proposed Action would have a discountable effect on MAMU. Therefore, the DAF has determined that the Proposed Action may affect, but is not likely to adversely affect, the MAMU.

5.1.7 Southwestern Willow Flycatcher

5.1.7.1 Physical and Habitat Impacts

No ground disturbing activities or vegetation management activities would occur within SWFL habitat and avoidance and minimization measures discussed in Section 2.3.1 would ensure that there are no SWFL near the construction area. Therefore, these actions would have no effect on SWFL.

5.1.7.2 Noise and Visual Disturbance

Noise Impacts in Western Santa Barbara County

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at historic and extant SWFL localities at the 13th Street Bridge area at the Santa Ynez River and Buellton are presented in Table 5.1-15 and Table 5.1-16 and Figure 4.7-1 through Figure 4.7-5. The estimated levels for engine noise are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.) and most measurements have been below the levels predicted by modeling (Appendix B). However, engine noise levels have not been measured at either of these locations during Falcon 9 launches from SLC-4.

Table 5.1-15. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at historic and extant SWFL localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
13th Street Bridge	110	105	118	118	108	112	112	106	116
Buellton	<100	<100	102	<100	<100	102	100	<100	107

Table 5.1-16. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at historic and extant SWFL localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
13th Street Bridge	-	4-5	-	2.5	-	2.5
Buellton	-	1-1.5	-	1-1.5	-	1-1.5

Sonic boom levels have not been measured at the 13th Street Bridge at the Santa Ynez River or at Buellton. However, as of 24 January 2024, sonic booms have been measured at 5 monitoring locations on VSFB during 22 Falcon 9 first stage events at SLC-4W, resulting in 50 measurements (Appendix B). All but 8 of the 50 measurements were within the range of predicted psf levels. Therefore, the sonic boom levels in Table 5.1-16, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact these areas.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Although there are no SWFL-specific audiograms or other data on this species' hearing sensitivity available, most bird species' greatest sensitivity to sounds is within a relatively narrow range from 1 kHz - 4 kHz (Konishi 1970). Most of the noise energy produced by rocket engines is less than 200 Hz (Figure 5.1-6). In addition, noise energy in higher frequencies ranges attenuates more quickly while traveling through the atmosphere; therefore, the maximum noise levels within bird's hearing sensitivity range that would reach SWLF sites near Buellton, approximately 22 mi from SLC-6, would have reduced significantly as noise travels through the atmosphere. Finally, the predicted noise levels based on modeling are conservative since the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). It is therefore reasonable to conclude that perceived noise levels for SWFL at this location would be substantially less than 105 dB and very little of the noise energy perceivable by SWFL would reach these sites.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

Approximately 48% of missions with easterly trajectories are predicted to impact a SWFL population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these ascent sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of SWFL localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.7-6. Figure 5.1-6 and Table 5.1-17 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of SWFL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that ascent sonic booms greater than 1.0 psf would be very unlikely to impact SWFL populations and the lack of any coupled visual stimuli, sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on SWFL.

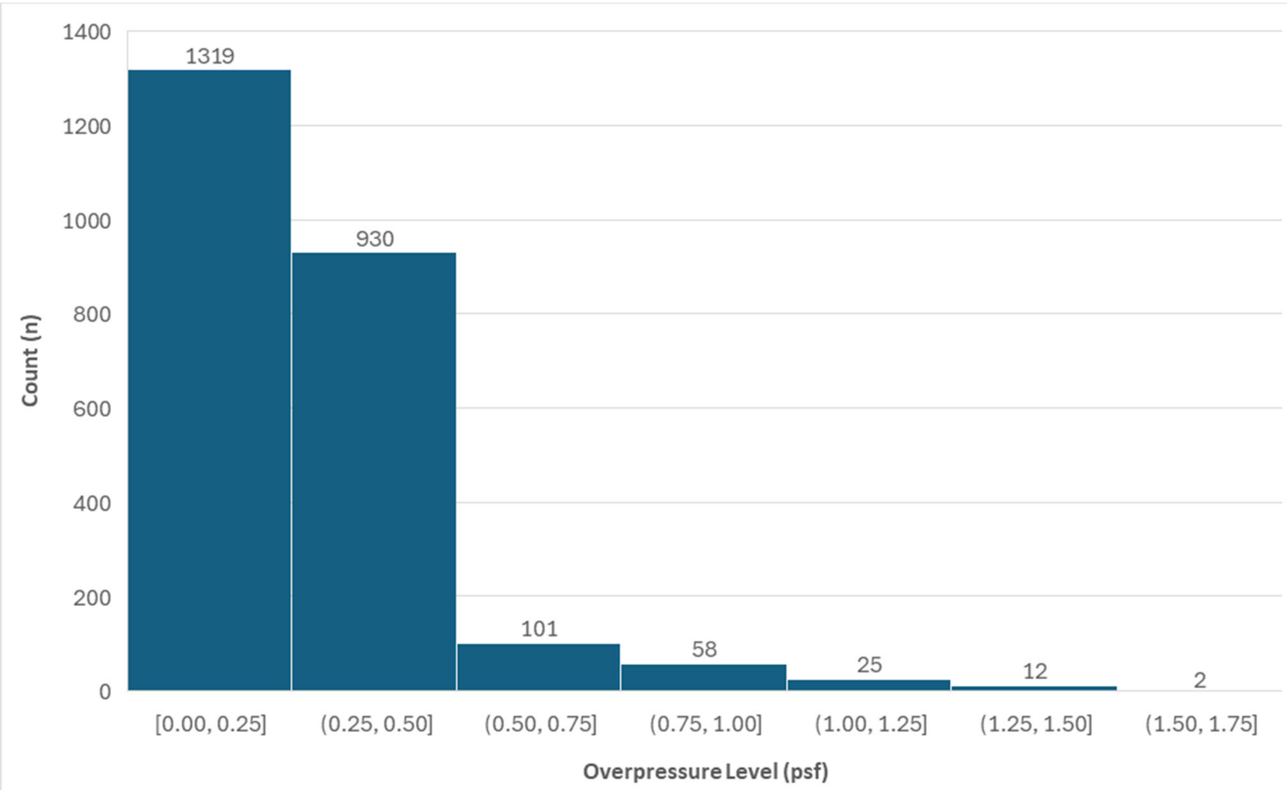

Figure 5.1-6. Distribution of PCBoom ascent sonic boom modeling results within 10 km of SWFL localities shown in Figure 4.7-6.

Table 5.1-17. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of SWFL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	146	308	47.4%
1-2	14 (1.7 psf)	308	4.5%
2-3	0	308	0.0%
3-4	0	308	0.0%
4-5	0	308	0.0%

5.1.7.3 Conclusion

Given the lack of an extant SWFL breeding population on VSFB, SWFL presence on VSFB is likely limited to migrants. Recent observations of SWFL at the Santa Ynez River in Buellton were limited to one territorial male with suspected, but unconfirmed, pairing. SWFL occurrence and breeding activity within the Action Area during a launch event is, therefore, rare. Additionally, attenuation of noise over 22 mi from SLC-6 to SWLF sites would reduce noise levels within the sensitivity range of birds. Finally, ascent sonic booms greater than 1.0 psf at SWFL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties would be very rare. For these reasons, the DAF has determined that the Proposed Action would have a discountable effect and may affect, but is not likely to adversely affect the SWFL.

5.1.8 Least Bell's Vireo

5.1.8.1 Physical and Habitat Impacts

No ground disturbing activities or vegetation management activities would occur within LBVI habitat and avoidance and minimization measures discussed in Section 2.3.1 would ensure that there are no LBVI near the construction area. Therefore, these actions would have no effect on LBVI. The potential effects of noise are discussed below.

5.1.8.2 Noise and Visual Disturbance

Noise Impacts in Western Santa Barbara County

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at historic and extant LBVI localities at the 13th Street Bridge area at the Santa Ynez River and Buellton are presented in

Table **5.1-18** and Table 5.1-19 and Figure 4.8-1 through Figure 4.8-5. The estimated levels for engine noise are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.) and most measurements have been below the levels predicted by modeling (Appendix B). However, engine noise levels have not been measured at either of these locations during Falcon 9 launches from SLC-4.

Table 5.1-18. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at historic and extant LBVI localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Santa Ynez River	110	105	118	118	108	112	112	106	116
Buellton	<100	<100	102	<100	<100	102	100	<100	107

Table 5.1-19. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at historic and extant LBVI localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
13th Street Bridge	-	4-5	-	2.5	-	2.5
Buellton	-	1-1.5	-	1-1.5	-	1-1.5

Sonic boom levels have not been measured at the 13th Street Bridge at the Santa Ynez River or at Buellton. However, as of 24 January 2024, sonic booms have been measured at 5 monitoring locations on VSFB during 22 Falcon 9 first stage events at SLC-4W, resulting in 50 measurements (Appendix B). All but 8 of the 50 measurements were within the range of predicted psf levels. Therefore, the sonic boom levels in Table 5.1-19, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact these areas.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Although there are no LBVI-specific audiograms or other data on this species' hearing sensitivity available, most bird species' greatest sensitivity to sounds is within a relatively narrow range from 1 kHz - 4 kHz (Konishi 1970). Most of the noise energy produced by rocket engines is less than 200 Hz (Figure 5.1-7). In addition, noise energy in higher frequencies ranges attenuates more quickly while traveling through the atmosphere; therefore, the maximum noise levels within bird's hearing sensitivity range that would reach LBVI sites near Buellton, approximately 22 mi from SLC-6, and Santa Maria, approximately 30 mi from SLC-6, would have reduced significantly as they travel through the atmosphere. Finally, the predicted noise levels based on modeling are conservative since the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). It is therefore reasonable to conclude that perceived noise levels for LBVI at this location would be substantially less than 105 dB at Buellton and less than 102 dB in the Santa Maria Valley and very little of the noise energy perceivable by LBVI would reach these sites.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

Approximately 88% of missions with easterly trajectories are predicted to impact a LBVI population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these ascent sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of LBVI localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.8-6. Figure 5.1-7 and Table 5.1-20 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of LBVI localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that sonic booms greater than 1.0 psf would be very unlikely to impact LBVI populations and the lack of any coupled visual stimuli, ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on LBVI.

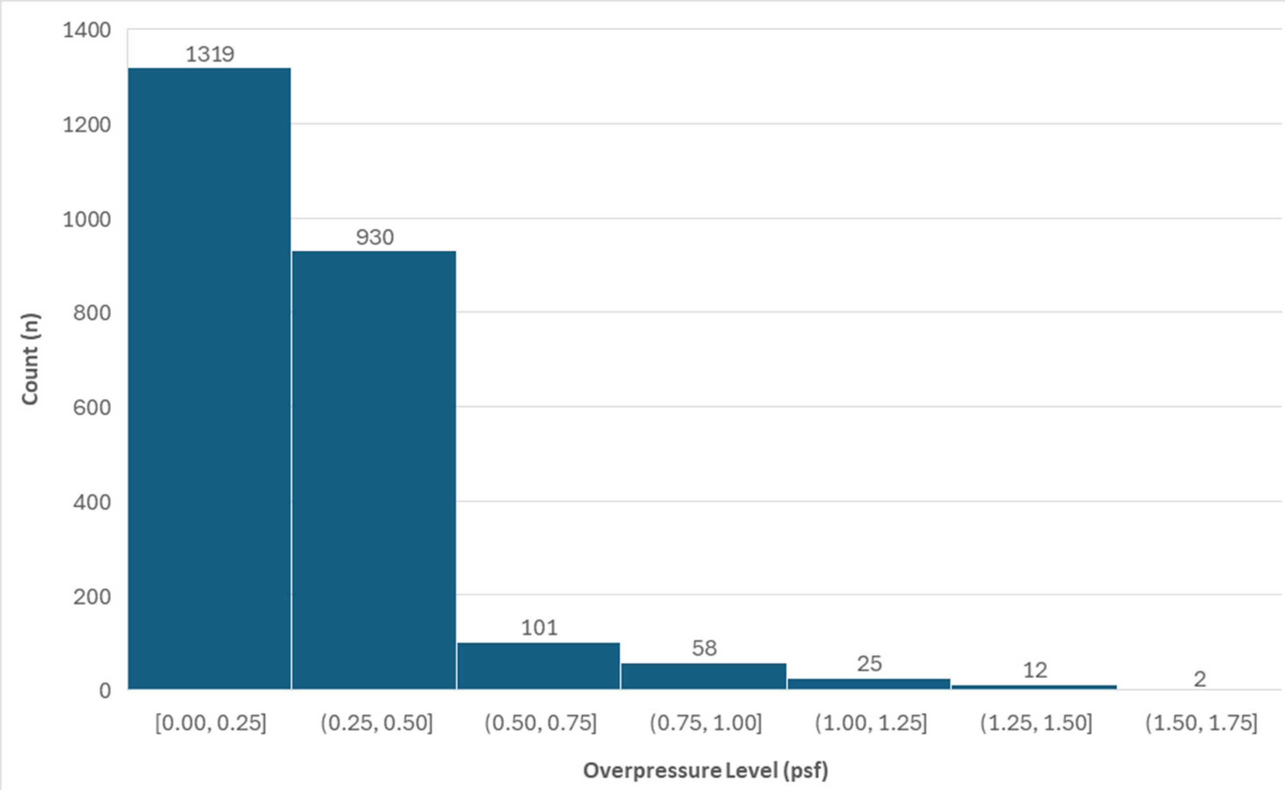

Figure 5.1-7. Distribution of PCBoom ascent sonic boom modeling results within 10 km of LBVI localities shown in Figure 4.8-6.

Table 5.1-20. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of LBVI localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	272	308	88.3%
1-2	93	308	30.2%
2-3	20	308	6.5%
3-4	3 (3.7 psf)	308	1.0%
4-5	0	308	0.0%

5.1.8.3 Conclusion

Given the lack of an extant LBVI breeding population on VSFB, LBVI presence on VSFB is likely limited to migrants. Recent observations of LBVI at the Santa Ynez River in Buellton were limited to one territorial male with suspected, but unconfirmed, pairing. LBVI occurrence and breeding activity within the Action Area during a launch event is, therefore, rare. Additionally, attenuation of noise over the 22 mi from SLC-6 to LBVI sites at Buellton and 30 mi to LBVI sites in the Santa Maria Valley would reduce noise levels within the sensitivity range of birds. Finally, ascent sonic booms greater than 1.0 psf at LBVI localities in eastern Santa Barbara, Ventura, and Los Angeles Counties would be very rare. For these reasons, the DAF has determined that the Proposed

Action would have a discountable effect and may affect, but is not likely to adversely affect the LBVI.

5.1.9 Western Snowy Plover

5.1.9.1 Physical Impacts

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

5.1.9.2 Noise and Visual Disturbance

Noise Impacts in Western Santa Barbara County

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at SNPL localities are presented in Table 5.1-21 and Table 5.1-22 and Figure 4.9-1 through Figure 4.9-5. As discussed previously, the estimated engine noise levels are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). Noise measurements have not been collected at the nearest area of Surf Beach to SLC-4 which was the location evaluated to produce the estimated levels in Table 5.1-21; however, measurements collected during Falcon 9 missions from SLC-4 at a location used for SNPL monitoring, approximately 1.6 mi north, had an average launch noise level of 117.4 dB L_{max} (n=15), less than the modeled estimate of 122 dB L_{max} for the monitoring location (Appendix B). The average landing noise level measured at the monitoring location is 109.0 dB L_{max} (n=5), below the estimated level of 110 dB L_{max}, with one measurement of 113.8 dB L_{max} (Transporter 7) exceeding the estimated level. Appendix B includes all noise levels measured during Falcon 9 launches as of 24 January 2025.

Table 5.1-21. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at SNPL localities.

South Surf Beach	122	130	130	115	111	118	119	111	123
Guadalupe Dunes	<100	<100	<100	<100	<100	<100	<100	<100	103
Jalama Beach	<100	<100	107	105	102	108	110	102	112

Table 5.1-22. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at SNPL localities.

					Falcon Heavy at SLC-6	
	Launch	**Landing**	**Launch**	**Landing**	**Launch**	**Landing**
South Surf Beach	-	7-8	-	4	-	4
Guadalupe Dunes	-	1	-	<1	-	<1
Jalama Beach	-	2	-	3	-	3

Sonic boom modeling is performed for each SpaceX mission. Table 5.1-22 presents sonic boom levels predicted from the model produced for the Falcon 9 Bandwagon-2 mission in December 2024, which had a relatively large geographic impact area and relatively higher levels predicted than for other missions and therefore was used for this BA to represent a potential worst-case scenario (see Appendix A for variability). The mission-specific model results for landing events that have required SNPL monitoring have predicted sonic booms ranging from 1 to 7 psf at a

South Surf Beach monitoring location for Falcon 9 landing events at SLC-4 (Appendix B). Measured sonic boom levels at the South Surf monitoring location for these missions have averaged 3.51 psf (n=10) and ranged from 1.95 to 4.54 psf (Appendix B). Sonic booms haven't been measured at the Guadalupe Dunes or Jalama Beach. However, as discussed previously, all but 8 of 50 sonic boom measurements during Falcon 9 first stage landing events at SLC-4W were within the range of predicted psf levels (Appendix B). Therefore, the sonic boom levels in Table 5.1-22, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact the Guadalupe Dunes or Jalama Beach.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Launch and landing noise events would last less than one minute and static fire noise would last less than 7 seconds. Launch engine noise and, to a lesser extent, landing engine noise would be coupled with the visual disturbance of the rocket engines firing during lift off and landing. When animals perceive both auditory and visual disturbances, the combined stimuli often lead to a stronger perception of danger (Partan & Marler 2005; Stevens 2013).

There are no SNPL-specific audiograms or other data on this species' hearing sensitivity available. A weighted noise function for SNPL was deduced from the budgerigar (*Melopsittacus undulatus*), which has a similar vocal spectrum, size, and body mass, and thus may be used as a surrogate species. There is a strong correlation between the range of hearing in birds and the frequency spectrum of bird vocalizations (Dooling & Popper 2007). That is, except for some nocturnal predators, birds hear best in the spectral region of their species-specific vocalizations. Typical frequency components of SNPL call and song were identified using field recordings from California. As presented in Figure 5.1-8, the highest energy in a plover call falls between 1.2 and 4 kHz, equating to a best hearing range between 1.2 and 4 kHz. This range was used to review several avian hearing curves (i.e., audiograms) to identify an approximate match for the SNPL that could be used in developing a weighting filter. In addition, the mass of bird species is significantly correlated with the size of the basilar papilla while the noise frequency sensitivity for bird species is inversely correlated to body mass and the length of the basilar papilla (Gleich et al. 2005). After conferring with Dr. Robert Dooling, the hearing curve for the budgerigar (Figure 5.1-9; Dooling 2002) was used as surrogate data for the SNPL (Dooling 2024, personal communication).

This budgerigar hearing curve was processed following methods established in Southall et al. (2019), to derive an auditory weighting function serving as a frequency-specific filter to quantify how noise would be perceived by SNPL (Figure 5.1-10) and how that would relate to the spectral characteristics of a SNPL's potential susceptibility to noise. Weighting functions are used to de-emphasize noise at frequencies where susceptibility is lower and emphasize noise at frequencies where sensitivity is greater. The high and low frequency cutoffs of the audiogram were noted as were the "fall-offs" outside of the range of best hearing. The slopes of the lower and upper frequency cutoffs were measured (dB/decade) and used to estimate the amount of weighting to be applied at each frequency (Figure 5.1-10).

Finally, this weighting function was applied to the timewave form recording of the June 2022 Falcon 9 SARah-1 launch. The unfiltered time waveform had frequency spectra with an unweighted peak level of approximately 110 dB Lmax (Figure 5.1-11). Given the high falloff rates outside the range of best hearing, both the low- and high-frequency component of the rocket launch noise were notably reduced. After applying the SNPL weighting function, the peak level was approximately 104 dB Lmax (Figure 5.1-11). In comparison to human hearing sensitivity, 104 dBA is equivalent to the noise level of a typical musical concert. For SNPL on VSFB, the level of impact expected from this level of noise and the coupled visual stimuli is consistent with the minor behavioral reactions observed in SNPL during video monitoring for launch and landing events.

Figure 5.1-8. Western snowy plover call frequency.

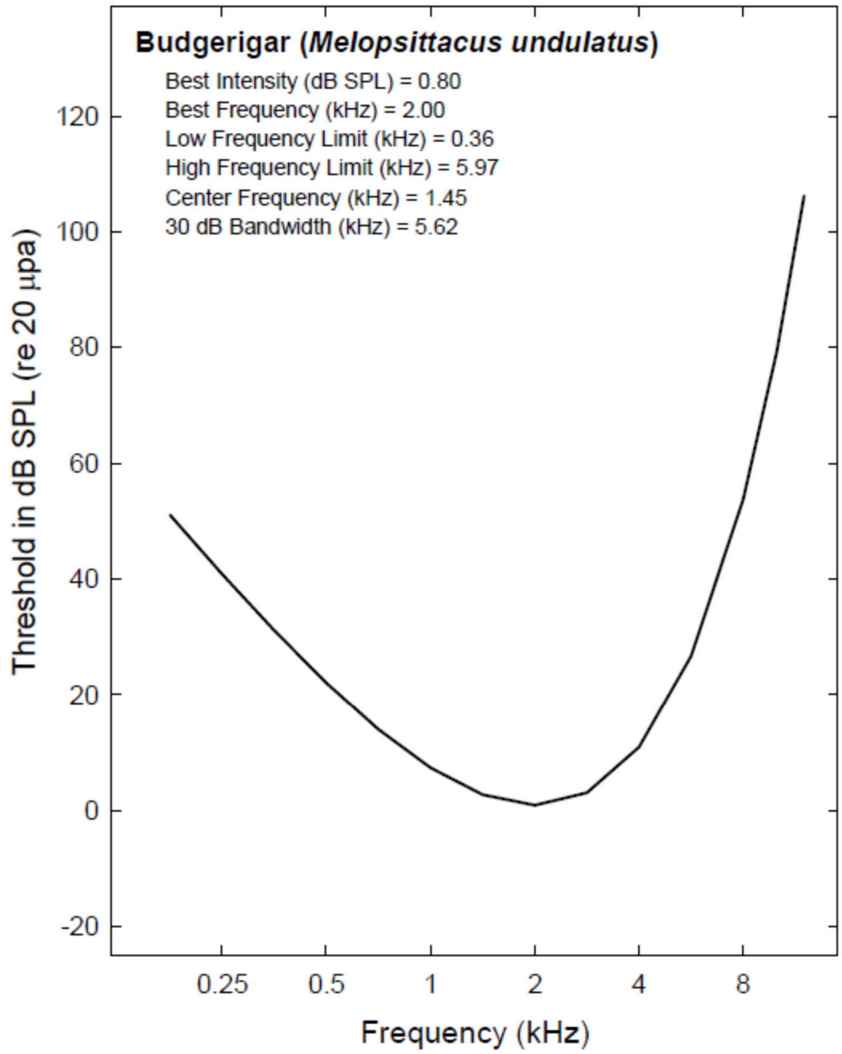

Figure 5.1-9. Budgerigar hearing sensitivity curve (Dooling 2002).

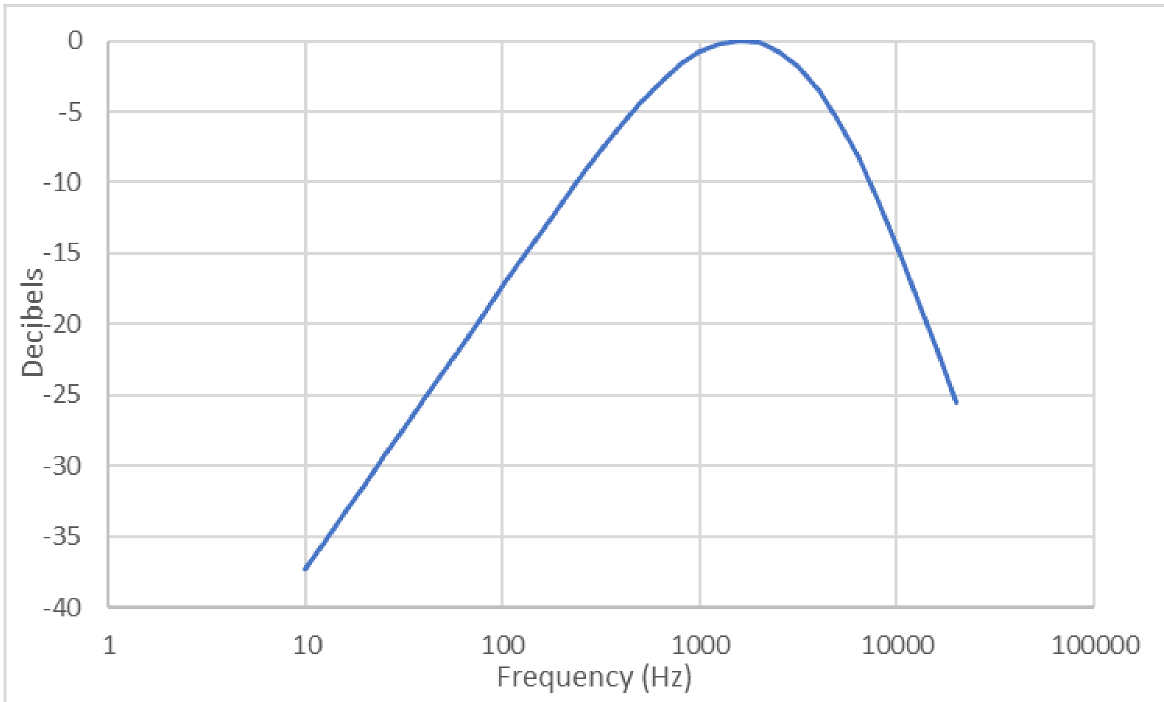

Figure 5.1-10. Budgerigar weighting function.

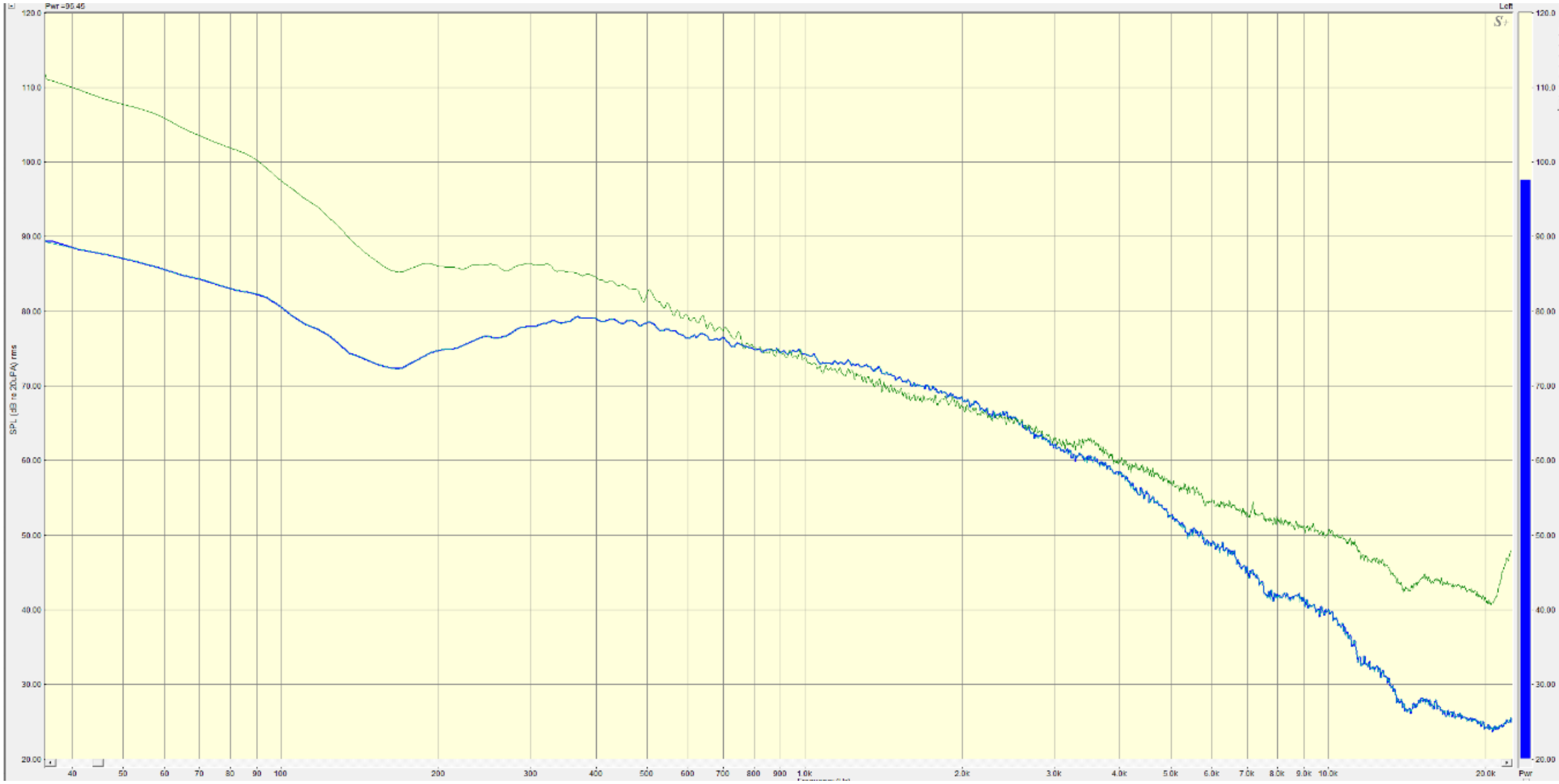

Figure 5.1-11. Launch peak noise level comparison of unweighted (green) versus SNPL-weighted (blue) decibels (note: time waveform recording from the June 2022 Falcon 9 SARah-1 launch).

The DAF has monitored SNPL during the breeding and non-breeding seasons on VSFB during numerous launches over the past 24 years, including 10 Falcon 9 missions with boostback and landing at SLC-4W. The monitoring has routinely demonstrated that launch noise only has a minor effect on SNPL behavior, and no incidents of injury or mortality to adults, young, or eggs attributable to launch activities have been documented (SRS Technologies, Inc. 2001, 2006a, 2006b, 2006c, 2006f, 2006g, 2006h, 2006i, 2006j, 2006k; MSRS 2007a, 2008a, 2008b, 2008c, 2009c, 2010a, 2010b, 2013; Robinette & Ball 2013; Robinette & Miller 2017a, 2017b; Robinette & Rice 2019; Robinette & Rice 2022a, 2022b; Robinette et al. 2024a, 2024b).

Incubating SNPLs were captured on video during two Falcon 9 launches with first stage landing in 2022, eleven Falcon 9 launch events, some with first stage landing, in 2023, and thirteen Falcon 9 launch events, some with first stage landing, in 2024. The majority of these SNPL's only exhibited alerting behavior involving minor head movements; a smaller proportion showed a startle effect, where the bird was observed to physically jolt, often accompanied by quick head movements; and an even smaller proportion "hunkered down" on the nest (Robinette & Rice 2022a, 2022b; Robinette et al. 2024a, 2024b). In 2023, these videos showed that 92% of observed individuals had minor alerting, 11% startled, 7 % hunkered, and 0% flushed off nests during launch noise events (n=26; Robinette et al. 2024a). In response to sonic booms during first stage SLC-4 landings in 2023, 100% exhibited minor alerting, 43% startled, 14% hunkered, and 0% flushed off nests during sonic booms (n=7; Robinette et al. 2024a). In 2024, SNPL video nest monitoring during launches showed that 95% had minor alerting, 69% startled, 35% hunkered, and 5% flushed off nests during launch noise events (n=77; Robinette et al. 2024b). Video monitoring of nests for sonic booms during first stage SLC-4 landings showed that 91% startled, 54% hunkered, and 0% flushed (n=24; Robinette et al. 2024b). In 2022, 2023, and 2024, there were no significant changes in incubation rates, overall plover abundance, or nest attendance before and after the launches and boost-back events. Rates of nest abandonment were lower in 2024 compared to 2023 when a high abandonment rate was documented for the Surf South beach section closest to SLC-4, which was likely attributed to many high surf and wind events during 2023 (Robinette et al. 2024a, 2024b). Additionally, both hatch rates and abandonment rates were similar among north and south VSFB beaches in 2024 (Robinette et al. 2024).

From 2019 through 2024, there have been five cases of failed eggs being found within areas that are exposed to launch and landing noise that may have been damaged on or around the date of the launch. During 2019, one SNPL egg that failed to hatch was found on north Surf Beach with signs of potential damage (a slight crack). This egg was part of a three-egg clutch in which the other two eggs successfully hatched. Based on inspection of the failed egg, the embryo may have stopped developing around the time of monitoring for the 12 June 2019 Falcon 9 Radarsat lauch (Robinette and Rice 2019). Similarly, one failed SNPL egg was found at north Wall Beach in 2022 that had a long crack. The damaged egg had an approximately three-week-old embryo that may have stopped developing around the time of the 18 June 2022 Falcon 9 SARah-1 mission (Robinette & Rice 2022b). During 2023, two failed eggs were found: one a dented egg with an embryo at Wall Beach that would have stopped developing around 16 May 2023, near the 20 May 2023 Falcon Iridium mission; and a second undamaged egg at Wall Beach that stopped developing around 22 June 2023, the date of the Falcon 9 Starlink G5-7 mission (Robinette et al. 2024a). During 2024, one damaged egg was found in a SNPL nest located south of the Santa Ynez

River mouth, west of Ocean Park, in an area of high human impact with an embryo that stopped developing close to the timing of the 18 June 2024 Starlink G9-1 mission (Robinette et al. 2024b).

In all five cases, there was no evidence of what caused the damage to the eggs or chicks to stop developing. The sonic booms produced during first stage landing are of vastly insufficient levels to break avian eggs (Ting et al. 1997). Bowles et al. (1994) found that sonic boom forces up to 30 psf were not sufficient to damage chicken eggs or embryos. While chicken eggs are larger than snowy plover and least tern eggs, Bowles et al. (1994) argued that chicken eggs were more susceptible to damage than smaller eggs because larger eggs will resonate more with the low frequencies produced by a sonic boom. Furthermore, Bowles et al. (1991) found that sonic boom forces up to 200 – 400 psf were not sufficient to damage intact eggs or further damage eggs with pre-existing cracks. Finally, Ting and Bowles (2002) predicted that a sonic boom would need to create a minimum force of 250 psf before damage to an egg would occur.

There are many natural events that can damage plover eggs, including tide events that destroy nests, high wind events that cover nests in sand, and predation events where not all eggs are taken by the predator (Robinette et al. 2024b). It is unknown whether the damaged eggs are related to launch impacts, other human-related impacts, or a natural event that we were unable to detect. One hypothesis for why an egg would be damaged in the absence of natural damaging events is that the hunker down or flushing behaviors can lead to damage. However, none of the 33 launch noise events monitored in 2023 showed any SNPL flushing off nests and only 4 SNPL were observed to flush during 77 SNPL responses to noise events video recorded in 2024, making this explanation unlikely. Although VSFB does not yet have data on how often eggs are damaged under normal (i.e., non-launch) circumstances, it is common that one or more eggs from a successful nest do not hatch (Robinette and Rice 2019; Robinette & Rice 2022b). Overall, all the monitoring that has been performed has shown there are no changes in bird abundance, nest attendance, or hatching rates, before and after launches.

In 2024, video/in-person monitoring of non-nesting SNPL was performed, as required under the 2024 BO for the first time during two launch events. During the OneWeb-4 mission on 19 October 2024, thermal scopes were used to attempt to film reactions to the launch and subsequent landing at SLC-4. Although challenges were encountered with this first attempt at obtaining video footage during a nighttime launch, a small number of SNPL were observed to have brief behavioral reactions to the launch and subsequent sonic boom but appeared to return to normal behavior quickly. For the 24 October 2024 NROL-167 mission, video monitoring was not performed, but two monitors observed a flock of 78 SNPL during the launch. The flock responded to the launch by tilting their head, appearing to look at the rocket as it took off. This response was observed prior to the noise of the rocket heard on the beach by the monitors. No other movement or response by the plovers was observed. No birds flushed; all remained roosting in the same area.

Despite an increase in launch cadence (16 launches in 2024 breeding season and 11 launches in 2023 breeding season) and the associated minor behavioral responses, the number of adult SNPL observed on all VSFB beaches combined during the nesting season was 309 in 2024, a 31% increase from that observed in 2023 (235; Robinette et al. 2024c). In recent years, the number of adult plovers on South Beaches has shown a curvilinear trend, increasing from 2009 through 2017 and then decreasing through 2024. Adult numbers on North Beaches have shown the opposite trend, with numbers increasing since 2017. These trends are suspected to be primarily driven by restoration efforts on South Beaches in 2013 and 2014. Vegetation removal on Surf North in 2013 and Wall in 2014 increased the amount of nesting habitat for SNPL, and adult numbers quickly responded to both restoration efforts. However, vegetation has since grown in these areas, reducing the amount of available nesting habitat on South Beaches which has likely led to adult SNPL moving to North Beaches (Robinette et al. 2024c). Nesting habitat availability, predation, and nest destruction by wind and tides are the primary factors of nesting locations, hatch success, and fledging success on VSFB (Robinette et al. 2024c). Overall, the breeding population and number of nests on VSFB has been relatively stable since 2011, although year to year fluctuations are observed (Robinette et al. 2024d).

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

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

The effect of increasing noise disturbances on SNPL populations is uncertain based on scientific literature. However, none of the scientific literature studies are directly comparable to the noise impacts of the Proposed Action. Launch engine noise and sonic booms are acute, non-sustained, and unpredictable. It is most similar to aircraft noise disturbance yet would be much less frequent. Due to this uncertainty, the DAF has determined that launch and landing noise as a result of the Proposed Action may affect and is likely to adversely affect the SNPL on VSFB.

Noise Impacts at the NCI

Since 2017 and as of 20 October 2024, of the launches that produced sonic booms that impacted the surface of the earth, approximately 67%have impacted the NCI, with approximately 50%of those impacting Santa Rosa Island where SNPL is considered a permanent resident. However, conservatively, it is assumed that up to 100 Falcon missions each year may result in a 1 psf sonic boom or greater, impacting SNPL at Santa Rosa Island. Depending on mission trajectories, ascent sonic boom may occasionally reach approximately 8 psf. Sonic boom footprints vary by mission-specific trajectories and weather conditions and the actual number of impacts above 1 psf would likely be less than 100 per year. As established through monitoring on VSFB (discussed above), SNPL would be expected to have a startle reaction to a sonic boom on Santa Rosa Island. However, there would not be any exposure to associated visual stimuli, which can heighten the perception of threats, as discussed above. Since the sonic boom would be disassociated from these other stimuli, SNPL on Santa Rosa Island would likely have less intensity than on VSFB but would still expected to have a brief startle reaction. Reactions would likely be short term and be unlikely to cause any long-term consequences for individuals or populations. However, the effect of increasing noise disturbances on SNPL populations is uncertain based on scientific literature. Due to this uncertainty, the DAF has determined that launch and landing noise as a result of the Proposed Action may affect and is likely to adversely affect the SNPL on the NCI.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

An estimated 89% of missions with easterly trajectories are predicted to result in ascent sonic booms that overlap SNPL population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of SNPL localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.9-8. Figure 5.1-12 and Table 5.1-23 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of SNPL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that ascent sonic booms greater than 1.0 psf would be very unlikely to impact SNPL populations and the lack of any coupled visual stimuli which can increase the perception of danger, as discussed above, ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on SNPL.

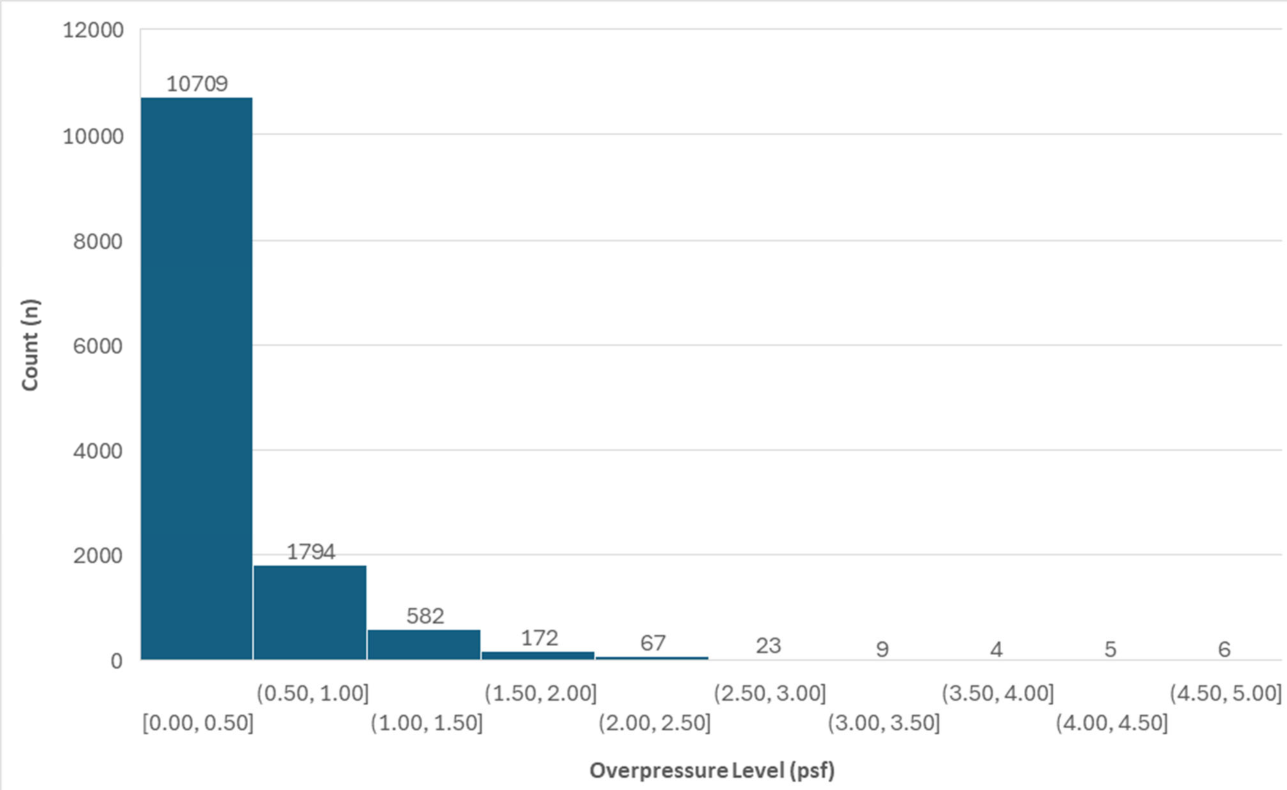

Figure 5.1-12. Distribution of PCBoom ascent sonic boom modeling results within 10 km of SNPL localities shown in Figure 4.11-8.

Table 5.1-23. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of SNPL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	275	308	89.3%
1-2	127	308	41.2%
2-3	53	308	17.2%
3-4	12	308	3.9%
4-5	8 (5.0 psf)	308	2.6%

5.1.9.3 Conclusion

The DAF has determined that the Proposed Action may affect, and is likely to adversely affect, the SNPL on VSFB. Individuals nesting, roosting, and foraging in the action area on VSFB are likely to be disturbed by visual cues and noise from launch and landing activities. These disturbances may startle SNPL and temporarily disrupt foraging or breeding activities. If launch and landing occur during the breeding season (approximately March through September), brooding birds may startle and flush which could potentially damage eggs or leave eggs or chicks unattended. Unattended eggs and chicks may become vulnerable to exposure or predation. Noise exposure may cause effects that are not immediately evident and may cause reduced numbers of nesting adults or reduced productivity in the action area over time.

5.1.10 California Least Tern

5.1.10.1 Physical Impacts

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

5.1.10.2 Noise and Visual Disturbance

Noise Impacts in Western Santa Barbara County

The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at the LETE Purisima colony and the Santa Ynez River estuary roosting site are presented in Table 5.1-24 and Table 5.1-25 and Figure 4.10-1 through Figure 4.10-5. As discussed previously, the estimated engine noise levels are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). Noise measurements collected at the Purisima colony during Falcon 9 launches from SLC-4 have averaged 104.5 dB L_{max} (n=5), less than the modeled estimate of 112 dB L_{max} at this location (Appendix B).

Table 5.1-24. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at LETE localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Purisima Point	102	<100	112	105	102	108	110	102	113
Santa Ynez River	110	105	118	118	108	112	112	106	116

Table 5.1-25. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at LETE localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
Purisima Point	-	3	-	1-2	-	1-2
Santa Ynez River	-	4-5	-	2.5	-	2.5

Sonic boom modeling is performed for each SpaceX mission. Table 5.1-25 presents sonic boom levels predicted from the model produced for the Falcon 9 Bandwagon-2 mission in December 2024, which had a relatively large geographic impact area and relatively higher levels predicted than for other missions and therefore was used for this BA to represent a potential worst-case scenario (see Appendix A for variability). The mission-specific model results for landing events that have required LETE monitoring have predicted sonic booms ranging from 0.5 to 4 psf at the Purisima colony monitoring location for Falcon 9 landing events at SLC-4 (Appendix B). Measured sonic boom levels at the Purisima colony for these missions have averaged 1.62 psf (n=3) and ranged from 1.07 to 2.66 psf (Appendix B).

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

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

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

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

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

In 2023, monitoring over the entire season showed no significant difference in incubation rates before and after launches (Robinette, et al. 2024a). Video footage of incubating LETE during Falcon 9 launches in 2023 (n=7) showed that 100% of LETE reacted, 43% flushed off nests, and all flushed birds returned to nest within 45 seconds (Robinette, et al. 2024a). Video footage of incubating LETE for Falcon 9 launches with SLC-4 landings during the LETE nesting season in 2023 (n=5) showed that 100% reacted, 100% startled, 40% hunkered, 40% flushed, and all returned to nest within 45 seconds. In 2024, video footage of incubating LETE during Falcon 9 launches (n=21) found that 90% of the adults alerted, 50% were startled, less than 20% hunkered or shifted on their nests, and less than 10% flushed off their nests (Robinette et al. 2024b).

In 2024, there were no Falcon 9 launches with SLC-4 landings during the LETE breeding season. However, there were active LETE nests during five Falcon 9 launches with downrange barge landings in 2024 (Starlink G8-8, Starlink G9-1, Starlink G9-2, NROL-186, and Starlink G9-3). During these launches, video cameras were used to record 21 LETE acute responses to initial launch noise. The video footage showed that the majority (~90%) of incubating adults reacted to initial launch noise, were startled during almost 50% of launches, hunkered or shifted on their nests during <20% of events, and flushed off their nests during <10% of events (Robinette et al. 2024d). There was no difference in incubation rates before and after launches and LETE reproductive success at VSFB was well above the long-term average for the first time since 2016 (Robinette et al. 2024d). There was only one LETE nest abandoned in 2024, and this was due to one of the breeding adults being depredated by an owl. Thus, aside from increased disturbance resulting in a short-term response, we have no direct evidence that launches from SLC-4 had an impact on nesting LETE at VSFB in 2024 (Robinette et al. 2024d).

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

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

The effect of increased launch and landing noise on LETE is uncertain based on scientific literature. None of these studies in scientific literature are directly comparable to the noise impacts of the Proposed Action. Launch engine noise and sonic booms are acute, non-sustained, and unpredictable. It is more similar to aircraft noise disturbances studied in the literature, but would occur much less frequently. In 2024, despite the minor behavioral disruptions recorded during launch events, DAF monitoring found that LETE reproductive success at VSFB was well above the long-term average for the first time since 2016 (Robinette et al. 2024a, 2024b). There was only one LETE nest abandoned in 2024 and that was due to one of the breeding adults being depredated by an owl, not due to a launch event. Predation and food availability, rather than launch noise, appear to be the primary drivers acting on these populations (Robinette et al. 2024a, 2024b). Due to this uncertainty, the DAF has determined that launch and landing noise as a result of the Proposed Action may affect and is likely to adversely affect the LETE on VSFB.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

An estimated 89% of missions with easterly trajectories are predicted to impact a LETE population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these ascent sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of LETE localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.10-6. Figure 5.1-13 and Table 5.1-26 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of LETE localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that sonic booms greater than 1.0 psf would be very unlikely to impact LETE populations and the lack of any coupled visual stimuli, ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on LETE.

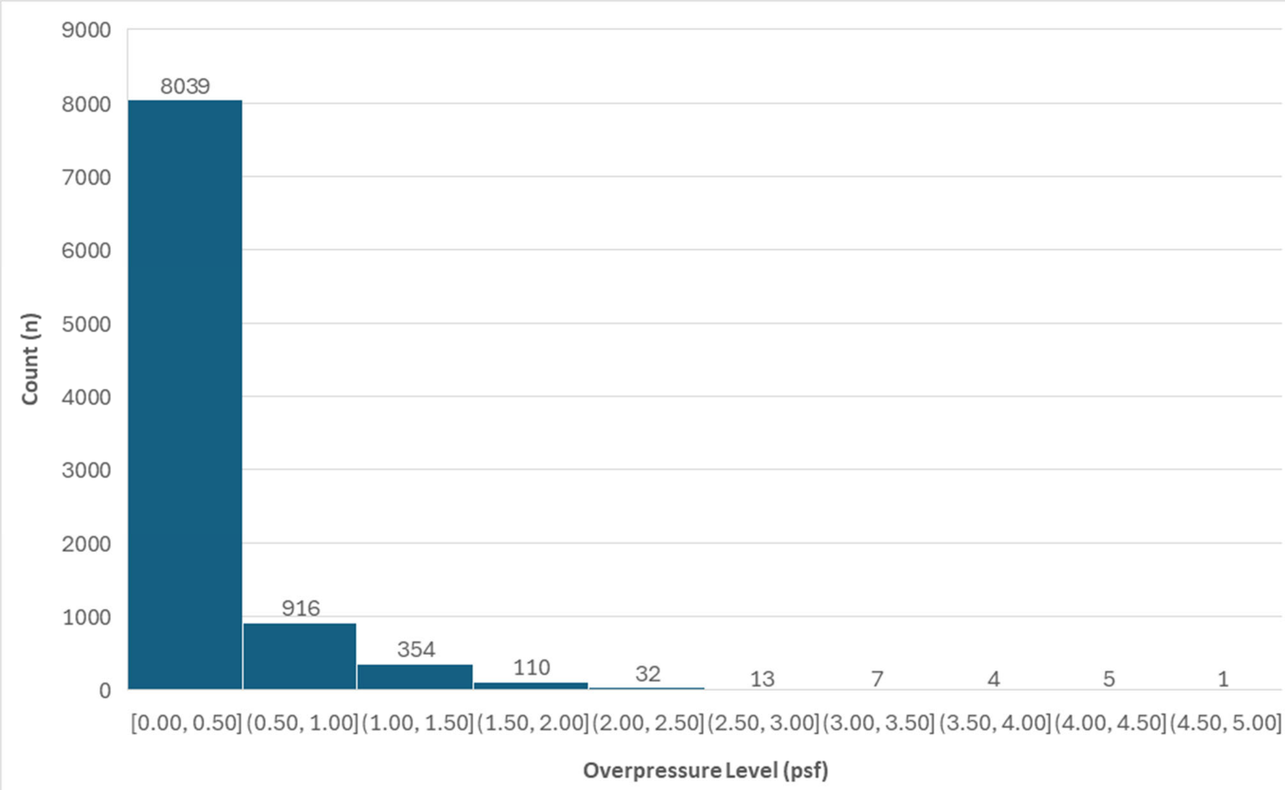

Figure 5.1-13. Distribution of PCBoom ascent sonic boom modeling results within 10 km of LETE localities shown in Figure 4.10-6.

Table 5.1-26. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of LETE localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	274	308	89.0%
1-2	87	308	28.2%
2-3	30	308	9.7%
3-4	10	308	3.2%
4-5	5 (5.0 psf)	308	1.6%

5.1.10.3 Conclusion

As of November 2024, many launch and landing events have occurred and been monitored during the LETE breeding season. Although a proportion of brooding birds may startle and a smaller proportion may flush, there is no evidence that exposure to rocket engine sound and sonic booms from Falcon launches has caused reduced numbers of nesting adults or reduced productivity of the nesting colony over the past several years, as evident from 2024 reproductive success exceeding the long-term average for the first time since 2016 (Robinette et al. 2024a, 2024b, 2024d). LETE have been observed to be more sensitive to disturbance while initiating nesting. Analysis of monitoring data will help determine if population declines occur. As a result, the DAF has determined that the Proposed Action may affect, and is likely to adversely affect, the LETE.

5.1.11 California Condor

5.1.11.1 Physical Impacts

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

5.1.11.2 Noise and Visual Disturbance

Noise Impacts in Western Santa Barbara County

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

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

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

An estimated 24% of missions with easterly trajectories are predicted to cause ascent sonic booms that would overlap a California condor population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of California condor localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.11-1. Figure 5.1-14 and Table 5.1-27 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of California condor localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that ascent sonic booms greater than 1.0 psf would be very unlikely to impact California condor populations and the lack of any coupled visual stimuli, ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on California condors.

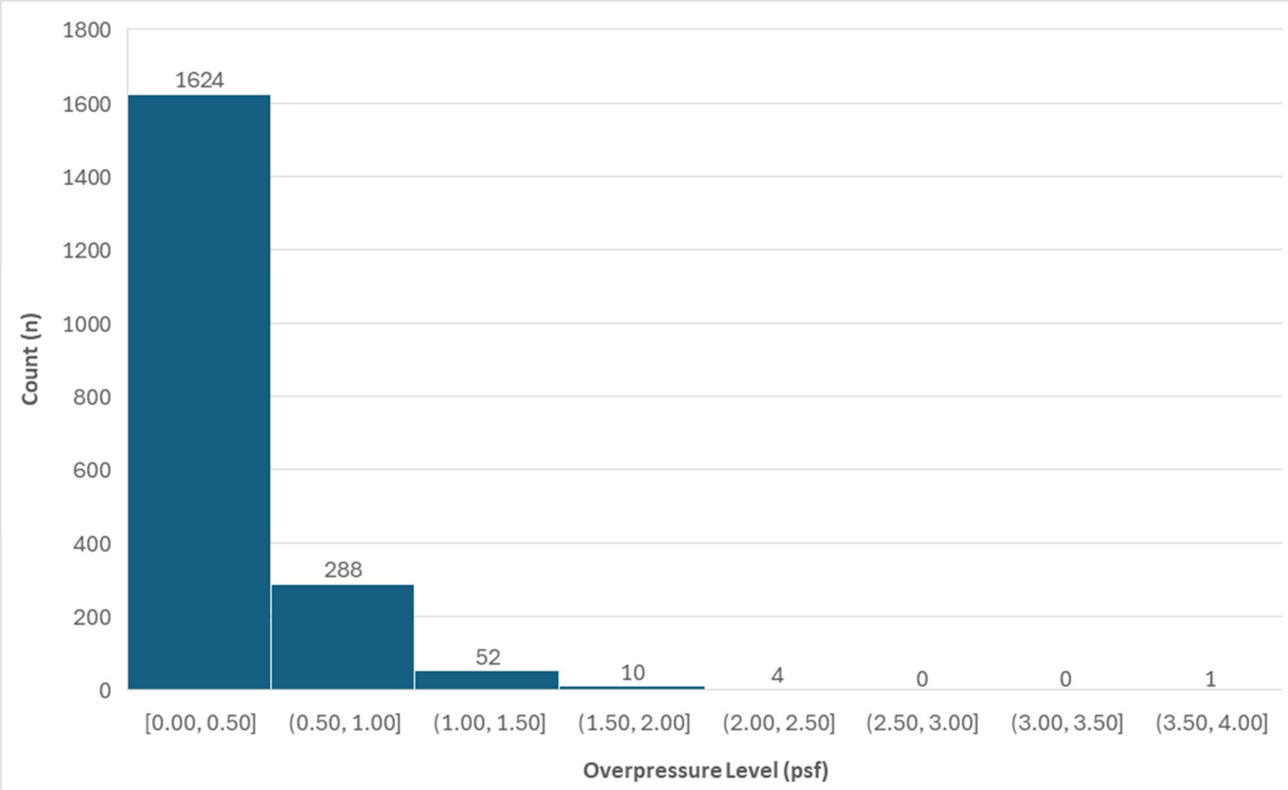

Figure 5.1-14. Distribution of PCBoom ascent sonic boom modeling results within 10 km of California condor localities shown in Figure 4.11-1.

Table 5.1-27. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of California condor localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	74	308	24.0%
1-2	19	308	6.2%
2-3	3	308	1.0%
3-4	1 (3.5 psf)	308	0.3%
4-5	0	308	0.0%

5.1.11.3 Conclusion

The overall likelihood of a California condor occurring at VSFB during a launch, landing, or static fire event is extremely unlikely, hence, discountable. Additionally, the likelihood that missions with an easterly trajectory generate an ascent sonic boom greater than 1.0 psf that would overlap California condor localities is very low. Therefore, the DAF has determined that Proposed Action may affect, but is not likely to adversely affect, the California condor. The DAF will continue to coordinate with the USFWS and Ventana Wildlife Society to monitor condor presence at VSFB prior to launches.

5.1.12 Coastal California Gnatcatcher

5.1.12.1 Physical Impacts

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

5.1.12.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

There would be no noise impacts to CAGN in the Western Santa Barbara County.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

An estimated 84% of missions with easterly trajectories are predicted to create an ascent sonic boom that would overlap a CAGN population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of CAGN localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.12-1. Figure 5.1-15 and Table 5.1-28 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of SNPL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that sonic booms greater than 1.0 psf would be very unlikely to impact CAGN populations and the lack of any coupled visual stimuli, ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on CAGN.

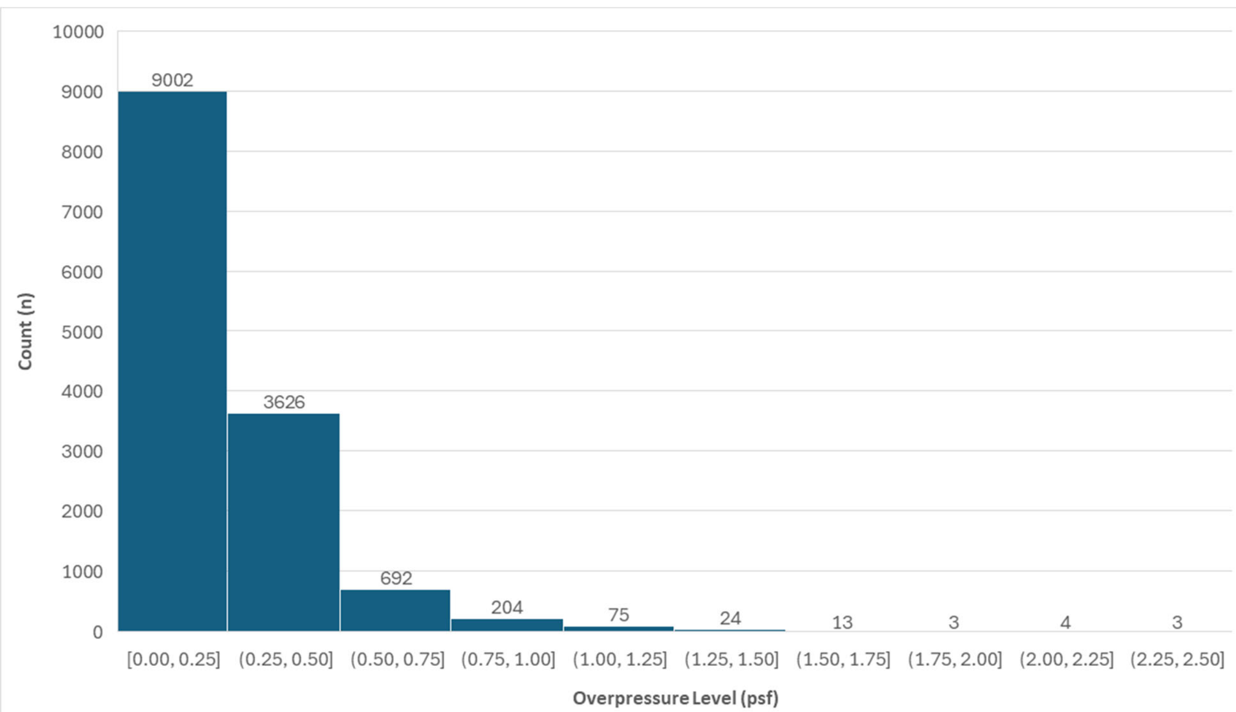

Figure 5.1-15. Distribution of PCBoom ascent sonic boom modeling results within 10 km of CAGN localities shown in Figure 4.12-1.

Table 5.1-28. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of CAGN localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	259	308	84.1%
1-2	50	308	16.2%
2-3	6	308	1.9%
3-4	0	308	0.0%
4-5	0	308	0.0%

5.1.12.3 Conclusion

The likelihood that missions with an easterly trajectory generate an ascent sonic boom greater than 1.0 psf that would impact CAGN localities is very low. Therefore, the DAF has determined that Proposed Action may affect, but is not likely to adversely affect, CAGN.

5.1.13 Light-footed Ridgeway's Rail

5.1.13.1 Physical Impacts

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

5.1.13.2 Noise Impacts

Noise Impacts in Western Santa Barbara County

There would be no noise impacts to RIRA in Western Santa Barbara County.

Noise Impacts in Eastern Santa Barbara, Ventura, and Los Angeles Counties

An estimated 98% of missions with easterly trajectories are predicted to create an ascent sonic boom that would overlap a RIRA population in eastern Santa Barbara, Ventura, and Los Angeles Counties. To estimate the potential levels of these sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of RIRA localities onto the PCBoom model output described in Section 2.2.6 and as depicted in Figure 4.13-1. Figure 5.1-16 and Table 5.1-29 present the proportion of the sonic booms levels of model results that overlapped the 10 km buffer of SNPL localities in eastern Santa Barbara, Ventura, and Los Angeles Counties. Given that sonic booms greater than 1.0 psf would be very unlikely to impact RIRA populations and the lack of any coupled visual stimuli, ascent sonic booms created during missions with easterly trajectories are not expected to have an adverse effect on RIRA.

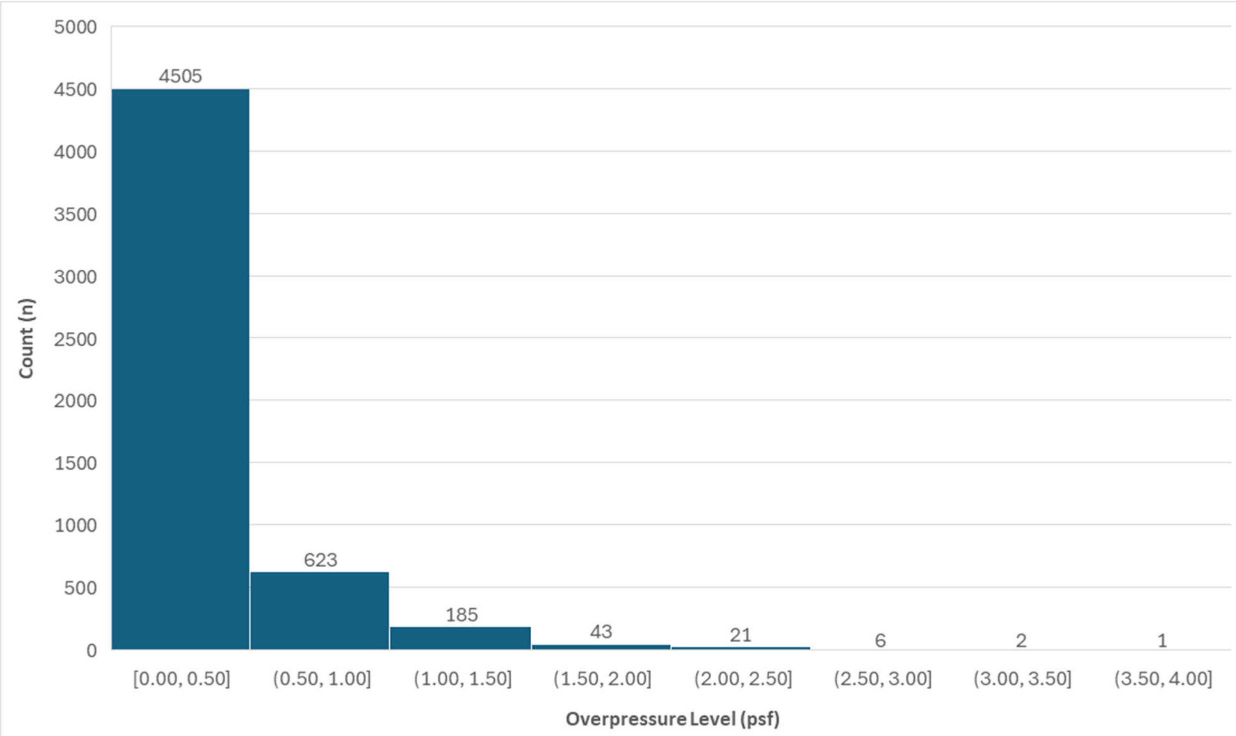

Figure 5.1-16. Distribution of PCBoom ascent sonic boom modeling results within 10 km of RIRA localities shown in Figure 4.13-1.

Table 5.1-29. Proportion of the sonic booms levels of model results that overlapped the 10 km buffer of RIRA localities in eastern Santa Barbara, Ventura, and Los Angeles Counties (Note: largest sonic boom level in parentheses).

Sonic Boom Levels (psf)	# Model Runs Overlapping Buffer	Total # Model Runs	% of Sonic Boom Levels Overlapping Buffer
0-1	272	308	88.3%
1-2	73	308	23.7%
2-3	19	308	6.2%
3-4	3 (3.7 psf)	308	1.0%
4-5	0	308	0.0%

5.1.13.3 Conclusion

The likelihood that missions with an easterly trajectory generate a sonic boom greater than 1.0 psf that would impact RIRA localities is very low. Therefore, the DAF has determined that Proposed Action may affect, but is not likely to adversely affect, RIRA.

5.1.14 Short-tailed Albatross

5.1.14.1 Physical Impacts

No aspects of the Proposed Action would have potential physical impacts on short-tailed albatross.

5.1.14.2 Noise Impacts

While above the water surface, short-tailed albatross may be exposed to landing engine noise and sonic boom within the recovery area if within the vicinity of the barge during a landing event. While diving, birds would not be exposed to these noises. The hearing capabilities of short-tailed albatross have not been measured; therefore, their hearing capabilities are inferred from other species. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kHz (Beason 2004; Dooling 2002). Very few can hear below 20 Hz, most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling 2002). Hearing capabilities have been studied for only a few seabirds (Beason 2004; Beuter et al. 1986; Crowell et al. 2015; Johansen et al. 2016; Maxwell et al. 2017; Mooney et al. 2019; Thiessen 1958; Wever et al. 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general.

Landing engine noise and sonic boom may cause temporary physiological or behavioral disturbances to short-tailed albatross. These disturbances would be short in duration and may startle individuals, causing minor behavioral disruptions. The potential effects would vary among individuals due to temperament, sex, age, and prior experience with noise, as well as the distance to the noise source. Due to the short-term, transient nature of engine noise and sonic boom and low densities of this species within the Action Area, the potential effects are only anticipated to be behavioral and temporary. These behavioral reactions would likely be short term (minutes) and would be unlikely to cause long-term consequences for individuals or populations.

5.1.14.3 Conclusion

Given the low densities of short-tailed albatross in the Action Area any exposure to sonic boom or landing engine noise would be unlikely and only cause short-term disturbances. Therefore, the DAF has determined that Proposed Action may affect, but is not likely to adversely affect, the short-tailed albatross.

5.1.15 Hawaiian Petrel

5.1.15.1 Physical Impacts

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

5.1.15.2 Noise Impacts

The hearing capabilities of Hawaiian petrels have not been measured; therefore, their hearing capabilities are inferred from other species. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kHz (Beason 2004; Dooling 2002). Very few can hear below 20 Hz, most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling 2002). Hearing capabilities have been studied for only a few seabirds (Beason 2004; Beuter et al. 1986; Crowell et al. 2015; Johansen et al. 2016; Maxwell et al. 2017; Mooney et al. 2019; Thiessen

1958; Wever et al. 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general.

Landing engine noise and sonic boom may cause temporary physiological or behavioral disturbances to Hawaiian petrels. These disturbances would be short in duration and may startle individuals, causing minor behavioral disruptions. The potential effects would vary among individuals due to temperament, sex, age, and prior experience with noise, as well as the distance to the noise source. Due to the short-term, transient nature of engine noise and sonic boom and low densities of this species within the Action Area, the potential effects are only anticipated to be behavioral and temporary. These behavioral reactions would likely be short term (minutes) and would be unlikely to cause long-term consequences for individuals or populations.

5.1.15.3 Conclusion

Given the low densities of Hawaiian petrels in the Action Area any exposure to sonic boom or landing engine noise would be unlikely and only cause short-term disturbances. Therefore, the DAF has determined that Proposed Action may affect, but is not likely to adversely affect, the Hawaiian petrel.

5.1.16 Southern Sea Otter

5.1.16.1 Physical Impacts

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

5.1.16.2 Noise and Visual Disturbance

Historically, at least one SSO was consistently observed at Purisima Point; however, SSO are currently only occasionally observed along the coast between Purisima Point and Point Arguello transiting through the area between suitable habitat to the north and south. Beginning at the VSFB harbor and continuing south along Sudden Flats, the inshore habitat supports expansive kelp beds and a relatively high density of SSO. The estimated Falcon rocket engine noise (produced by RNoise) and sonic boom (produced by PCBoom) exposures at these areas are presented in

Table **5.1-30** and Table 5.1-31 and Figure 4.16-1 through Figure 4.16-5. As discussed previously, the estimated engine noise levels are likely to be conservatively high because the models do not take into account attenuation due to land forms (e.g., mountains, hills, valleys, etc.). Launch engine noise measurement collected at Sudden Ranch during Falcon 9 missions from SLC-4 have averaged 109.8 dB L_{max} (n=13), less than the modeled estimate of 116 dB L_{max} at this location (Appendix B). Landing engine noise has averaged 96.5 dB L_{max}, less than the modeled estimate of 108 dB L_{max}. Appendix B includes all noise levels measured during Falcon 9 launches as of 24 January 2025.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

Table 5.1-30. Estimated maximum Falcon rocket engine noise levels (dB L_{max}) at SSO localities.

Location	Falcon 9 at SLC-4			Falcon 9 at SLC-6			Falcon Heavy at SLC-6		
	Static Fire	Landing	Launch	Static Fire	Landing	Launch	Static Fire	Landing	Launch
Nearest Coastline	122	130	140	130	120	130	130	110	135
VSFB Harbor	108	108	116	120	119	125	128	118	129
Sudden Ranch	108	108	116	120	119	125	128	118	129

Table 5.1-31. Estimated maximum Falcon sonic boom levels (psf) during launches and landings at SSO localities.

Location	Falcon 9 at SLC-4		Falcon 9 at SLC-6		Falcon Heavy at SLC-6	
	Launch	Landing	Launch	Landing	Launch	Landing
Nearest Coastline	-	7-8	-	10	-	10
VSFB Harbor	-	3.5-4	-	5-8	-	5-8
Sudden Ranch	-	2-3	-	3	-	3

Sonic boom modeling is performed for each SpaceX mission. Table 5.1-31 presents sonic boom levels predicted from the model produced for the Falcon 9 Bandwagon-2 mission in December 2024, which had a relatively large geographic impact area and relatively higher levels predicted than for other missions and therefore was used for this BA to represent a potential worst-case scenario (see Appendix A for variability). The mission-specific model results for landing events that have required SSO monitoring have predicted sonic booms ranging from 2 to 6 psf at a Sudden Ranch monitoring location for Falcon 9 landing events at SLC-4 (Appendix B). Measured sonic boom levels at the monitoring location for these missions have averaged 2.72 psf (n=16) and ranged from 0.71 to 5.57 psf (Appendix B). Sonic booms haven't been measured at the coastline nearest to SLC-4. However, as discussed previously, all but 8 of 50 sonic boom measurements during Falcon 9 first stage landing events at SLC-4W were within the range of predicted psf levels (Appendix B). Therefore, the sonic boom levels in Table 5.1-31, which represents a potential worst-case scenario, and the potential variation in boom model results presented in Appendix A, should be representative of the levels that would impact these areas.

The single explosive event during demolition activities at SLC-6, as discussed in Section 2.2.3, would result in substantially lower impulsive noise impacts at these locations compared to sonic booms created during landing events (see Figure 2.2-3).

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

SSO in the nearshore environment of south VSFB that are not submerged during a launch or return landing may experience non-impulsive noise from rocket engines during liftoff and impulsive noise from a sonic boom during first stage landings. Specific noise exposure thresholds for temporary and permanent hearing damage in SSO have not been established. However, similarities in the biology and hearing sensitivity between otariid pinnipeds and SSO make otariid thresholds a suitable proxy for SSO (Ghoul & Reichmuth 2014; Southall et al. 2019). The National Marine Fisheries Service established noise exposure thresholds for in-air impulsive noise for temporary threshold shift [TTS] in hearing sensitivity and for permanent threshold shifts [PTS] in hearing sensitivity for otariid and phocid pinnipeds (NMFS 2021) based on species' audiograms and the results of studies measuring threshold shifts and behavioral responses (Table 5.1-32). NMFS has not established thresholds for PTS or TTS due to in-air non-impulsive noise for pinnipeds; however, Southall et al. (2019) estimated the lower limit for TTS as a result of in-air non-impulsive noise for otariids and "other marine carnivores" (OCA) is 157 dB M-weighted Sound Exposure Level (SEL), and the lower limit for PTS is 177 dB M-weighted SEL (Table 5.1-33). M-weighting is adjusted for the hearing sensitivity of otariids and OCA per Southall et al. 2019. Applying M-weighted thresholds to unweighted exposure levels is a conservative approach to determining if thresholds are exceeded (i.e., unweighted dB would be greater than the same levels with an M-weighted filter applied and therefore overestimate an individuals perceived noise exposure).

Table 5.1-32. In-air impulsive noise thresholds for TTS and PTS in otariid pinnipeds in peak decibels and equivalent pounds per square foot.

TTS (unweighted; re 20 µPa)	PTS (unweighted; re 20 µPa)
170 dB L_{max} (132.1 psf)	176 dB L_{max} (263.6 psf)

Source: NMFS 2021
L_{max} = maximum sound pressure level; dB = decibels; dB re 20 µPa = decibels related to 20 micropascals

Table 5.1-33. In-air non-impulsive noise thresholds for TTS and PTS in otariid pinnipeds.

TTS (M-weighted*; re 20 µPa)	PTS (M-unweighted; re 20 µPa)
157 dB SEL	177 dB SEL

Source: Southall et al. 2019
SEL = sound exposure level; dB = decibels; dB re 20 µPa = decibels related to 20 micropascals
* M-weighted is based on a filter applying otariid hearing sensitivity presented in Southall et al. 2019.

The DAF applied these thresholds, modeling results, and ground measurements as the best available science to estimate the effects of in-air impulsive and non-impulsive noise exposures presented herein. PCBoom estimated that the loudest potential sonic booms (impulsive noise) may occur during double booster landings at SLC-6. The levels predicted at the nearest coastline location, where transiting SSO are rarely observed, is 0.6 mi from the proposed landing zones and are predicted to be up to approximately 10.0 psf (Figure 4.16-5). The highest level measured during a Falcon Heavy double booster landing at the Kennedy Space Center during the Arabsat 6A mission on 11 April 2019 was 7.7 psf at 0.3 mi from the landing pads (National Academies of Sciences, Engineering, and Medicine 2020). Both the maximum sonic boom level estimated by PCBoom and measured at 0.3 mi during the Arabsat 6A mission are an order of magnitude less than the TTS-onset threshold for in-air impulsive noise (132 psf; Table 5.1-32). The landing zone at SLC-4 is a similar distance (0.6 mi) from coastline where transiting SSO are rarely observed and much further (5.5 mi) from areas where SSO are regularly observed near the Boat Dock. Therefore, no SSO would be exposed to impulsive noise levels that would cause TTS or PTS as a result of Falcon 9 launches from SLC-4 or SLC-6 or Falcon Heavy launches from SLC-6.

Models for rocket engine noise do not currently produce M-weighted estimates of noise metrics to directly compare to the in-air non-impulsive thresholds presented in **Table 5.1-33** developed by Southall et al. 2019. However, unweighted measurements of SEL were collected during the Falcon Heavy Arabsat 6A mission at varying distances from the launch pad and, as noted above, comparing M-weighted thresholds to unweighted received levels is a conservative approach in determining if thresholds would be exceeded. During the Arabsat 6A launch, the nearest recording station to the launch pad, 0.3 mi, measured 152 dB unweighted SEL, less than the 157 dB M-weighted SEL threshold (Table 5.1-33; National Academies of Sciences, Engineering, and Medicine 2020). The nearest coastline to the launch pad where transiting SSO are rarely observed is at SLC-6 is 0.9 mi, and the nearest location where SSO are routinely observed is near the Boat Dock at 2.2 mi from SLC-6 (Figure 4.16-1 through Figure 4.16-5). During the Arabsat 6A launch, one recording station was 2.0 mi from the launch pad and measured 141.9 dB unweighted SEL, substantially below the threshold of 157 dB M-weighted SEL. The Falcon 9, with only one first stage compared to the equivalent of three first stages on the Falcon Heavy, is a quieter vehicle. In addition, SLC-6 and the proposed landing zones are closer to potential SSO locations than SLC-4. Therefore, no SSO would be exposed to in-air non-impulsive noise that would cause TTS or PTS as a result of Falcon 9 from SLC-4 or SLC-6 or Falcon Heavy launches from SLC-6.

Extensive launch monitoring has been conducted for SSO on both north and south VSFB, with pre- and post-launch counts and observations conducted at rafting sites immediately south of Purisima Point for numerous Delta II launches from SLC-2 and one Taurus launch from Launch Facility-576E and at the rafting sites off of Sudden Flats for two Delta IV launches from SLC-6. No abnormal behavior, mortality, or injury of effects on the population has ever been documented for SSO as a result of launch-related noise and visual disturbance (SRS Technologies, Inc. 2006b, 2006d, 2006e, 2006f, 2006g, 2006i, 2006k, 2006l; MSRS 2007a, 2007b, 2007c, 2008a, 2008b, 2009d; 2021c). More recently, for the SpaceX Falcon 9 SAOCOM launch and landing on 7 October 2018, SSO were monitored during pre- and post-launch surveys on south VSFB (MSRS 2018d). The sonic boom received at the SSO monitoring location was estimated at 0.71 psf and the maximum landing engine noise at this location was estimated at 99.5 dB L_{max}. Count totals of both pups and adults were similar before and after the launch and there was no discernable impact on SSO on south VSFB. Additionally, SSO were monitored during 2 Falcon 9 launches with SLC-4 landings during 2022 and 4 launches with SLC-4 landings during 2023. For each of these missions SSO totals during post-launch counts were either similar to pre-launch counts or were lower because of factors other than the sonic boom (e.g., high winds, high swell, and rain) that impacted the south VSFB rafting sites (U.S. Space Force 2024). None of the sonic booms produced during any of the first stage landings had discernible impacts on overall SSO numbers at the monitoring sites (MSRS 2024b).

Launches and landings and accompanying noise and visual disturbance would be expected to result in minor behavioral response. This has been confirmed by monitoring and recording groups of SSO during two Falcon 9 missions which included first stage landing at SLC-4: Transporter 11 and OneWeb-4. During the Transporter 11 mission during the day on 16 August 2024, SSO reacted to the launch by alerting and diving and had a similar reaction during the landing and sonic boom with the SSO resurfacing within minutes and the entire group completely resettled at approximately 30 minutes after the launch (MSRS 2024c). During the OneWeb-4 mission during the night of 19 October 2024, all SSO reacted to the launch by diving, which corresponded to peak visual disturbance and launch noise, but had no reaction to the sonic boom during landing. Individuals began resurfacing within one to two minutes, with all SSO resettled within approximately 9 minutes of the launch (MSRS 2024d).

If disturbed, SSO typically dive under the water and therefore minimize potential noise exposure anyway. As noted in Section 2.2.4, landing noise follows launch by approximately 5 to 7 minutes and typically occurs slightly before the sonic boom impacts land. Therefore, any individuals that flee into water as a result of launch disturbance would reduce their likelihood of being exposed to the landing engine noise and sonic boom due to the attenuation of sound in water (Godin 2008). As a result, there would not be an opportunity for chronic noise exposure in SSO. However, SSO are the smallest marine mammal and lack some of the thermoregulatory adaptations that are seen in cetaceans and pinnipeds, which results in elevated thermal energetic costs for SSO (Costa & Kooyman 1984; Yeates et al. 2007). As a result, if resting SSO are disrupted frequently, there may be energetic consequences that could affect fitness and survival of individuals. Yeates et al. (2007) found that mean metabolic rate for single dives (non-foraging dives), typically lasting 1 to 3 minutes, were only 1.3 times as great as resting metabolic rate in the SSO. Most of the reactions documented during the Transporter 11 and OneWeb-4 missions were short dives; however, some individuals swam for approximately nine minutes in addition to diving. Swimming is approximately 2 times as great as resting metabolic rate (Yeates et al. 2007). Using the metabolic rates, activity budget, and energetic costs for male SSO reported in Yeates et al. (2007), the energetic cost of a male SSO disturbed from rest and swimming for 10 minutes was estimated to be an increase of approximately 1% in energetic cost over one day (Table 5.1-34). Because there would only be approximately two launch events per week and not all SSO are expected to react to this degree (most resume normal behavior within 2 to 3 minutes), the effect on energetic expenditure would be insignificant.

Table 5.1-34. Activity budget and energetic expenditure for "normal" and "disturbed" male southern sea otter, adapted from Yeates et al. 2007. (Note: values in red reflect assumed changes in energetic expenditure due to a 10-minute disturbance from resting to swimming. Total MJ per day calculated assuming a mean body mass of adult male sea otters is 27.7 kg)

Behavior	Proportion of 24-hr day normal	Minutes day^{-1} normal	Proportion of 24-hr day disturbed	Minutes day^{-1} disturbed	MJ day^{-1} kg^{-1} normal	MJ day^{-1} kg^{-1} disturbed	Total MJ day^{-1} normal	Total MJ day^{-1} disturbed
Resting	0.402	579	0.395	569	0.156	0.154	4.33	4.27
Feeding	0.363	522	0.363	522	0.224	0.224	6.22	6.22
Grooming	0.091	131	0.091	131	0.077	0.077	2.21	2.21
Swimming	0.085	122	0.092	132	0.072	0.078	1.94	2.16
Other	0.073	105	0.073	105	0.051	0.051	1.39	1.39
						Total MJ	**16.09**	**16.25**

MJ = megajoule, kg = kilogram

For a lactating female SSO with a large post-molt pup, an average swimming metabolic rate (0.49 KJ/min/kg) and average resting rate (0.27 KJ/min/kg) were used after applying a correction factor of 51.8% (Thometz et al. 2016). The resulting adjusted rates for lactating females were 0.744 KJ/min/kg for swimming and 0.41 KJ/min/kg for resting. The same approach was applied as above for male SSO to estimate the metabolic cost of a 10 minute disruption in rest caused by a rocket launch, with the assumption that lactating females behaviors were spent in the same proportions to male behaviors throughout a day. The energetic cost of a lactating female SSO disturbed from rest and swimming for 10 minutes was estimated to be an increase of less than 1% in energetic cost over one day (0.07 MJ increase). Following an approach used in Barrett et al. (2025) the additional feeding requirements needed to meet this cost was evaluated by converting MJ to kilocalories (kcal) using a conversion factor of 1 MJ = 239 kcal (Oftedal et al. 2007); therefore, the total additional caloric intake to meet this cost is 17 kcal. Oftedal et al. (2007) provided estimates of caloric values of various prey. A female otter foraging on purple urchin (*Strongylocentrotus purpuratus*; 0.393 kcal/gram; average mass 14.43 gram), which are a relatively low value, low mass prey present in the waters off of sudden ranch, approximately 3 extra urchins would need to be consumed to meet the cost of disturbance. As noted above, there would only be approximately two launch events per week and not all SSO are expected to react to this degree. Therefore, the effect of the disturbance on energetic expenditure would be insignificant.

Table 5.1-35. Activity budget and energetic expenditure for "normal" and "disturbed" lactating female southern sea otter, adapted from Yeates et al. 2007. (Note: values in red reflect assumed changes in energetic expenditure due to a 10-minute disturbance from resting to swimming. Total MJ per day calculated assuming a mean body mass of a lactating female sea otters is 21.3 kg)

Behavior	Proportion of 24-hr day normal	Minutes day^{-1} normal	Proportion of 24-hr day disturbed	Minutes day^{-1} disturbed	MJ day^{-1} kg^{-1} normal	MJ day^{-1} kg^{-1} disturbed	Total MJ day^{-1} normal	Total MJ day^{-1} disturbed
Resting	0.402	579	0.395	569	0.237	0.233	5.05	4.97
Feeding	0.363	522	0.363	522	0.388	0.388	8.27	8.27
Grooming	0.091	131	0.091	131	0.097	0.097	2.08	2.08
Swimming	0.085	122	0.092	132	0.091	0.098	1.93	2.09
Other	0.073	105	0.073	105	0.078	0.078	1.66	1.66
						Total MJ	**19.00**	**19.07**

MJ = megajoule, kg = kilogram

The lack of any demonstrated impact from launches on populations off the coast of Sudden Ranch and minimal behavioral reactions observed is likely because there is little overlap in the hearing sensitivity of SSO (primarily 2 to 22 kHz) and launch engine noise, which is primarily below 250 Hz, with moderate energy to 2 kHz range, and little energy above 2 kHz, as discussed below. While a 2-psf sonic boom is approximately 135 dB (unweighted) L_{max}, it is likely that most of that acoustic energy from the sonic boom is not heard by SSO anyway. Similarly, the frequency spectrum of a 1.5-psf sonic boom (recorded at San Nicolas Island on 12 December 2014) has little overlap with the hearing curve of a SSO (Ghoul & Reichmuth 2014; Figure 5.1-17). Most of the sonic boom energy is less than 250 Hz, well below the region of best sensitivity of the SSO (2–22.6 kHz; Figure 5.1-17). While the SSO would likely hear the sonic boom, it would only be responding to acoustic energy that is above 250 Hz and total sound levels much less than 135 dB unweighted L_{max}. As the sonic boom increases in pressure, it is likely that more energy would be detected by the SSO, most notably in frequencies higher than 250 Hz.

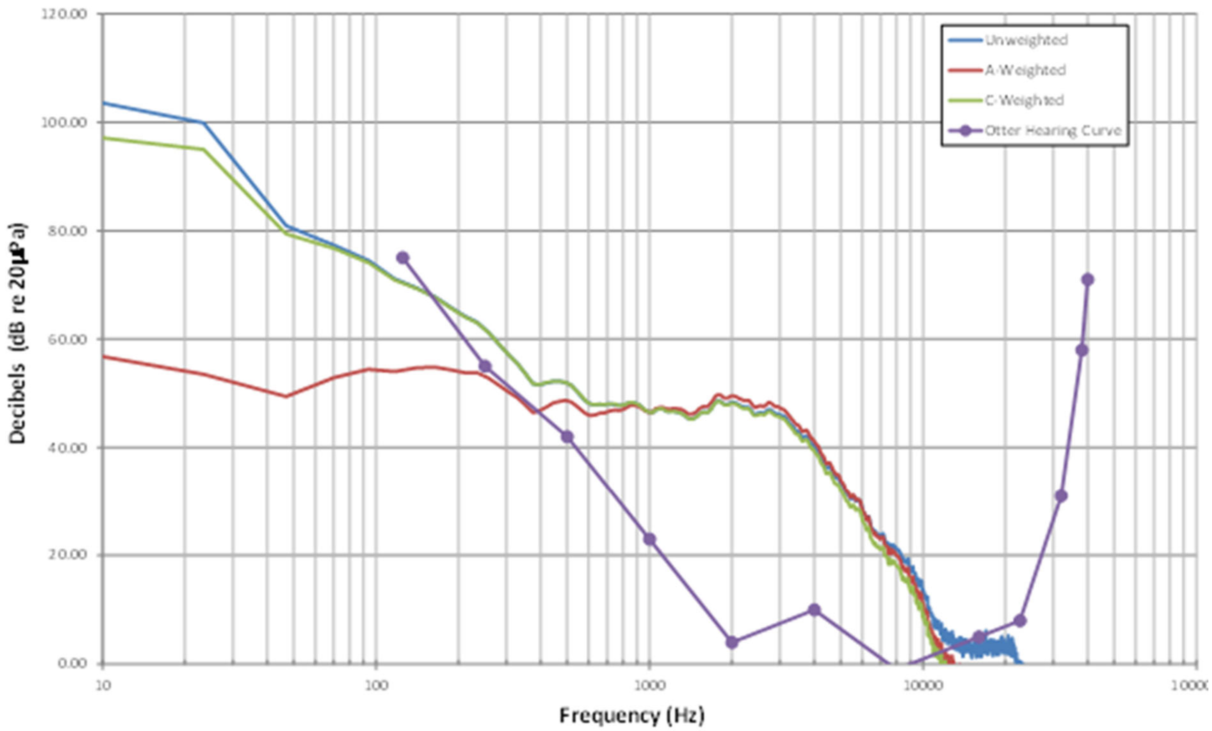

Figure 5.1-17. Sonic boom spectrum and sea otter hearing sensitivity curve.

To determine how much rocket engine noise SSO would be able to sense, a frequency-weighting filter was developed for SSO. Ghoul & Reichmuth (2014) developed an audiogram for the northern sea otter (*Enhydra lutris kenyoni*; Figure 5.1-18). Following methods established in Southall et al. (2019), this audiogram was used to derive an auditory weighting function to serve as a frequency-specific filter to quantify how noise may be perceived by SSO, given its spectral content (Figure 5.1-19), and how that would relate to the spectral characteristics of an otter's potential susceptibility to noise. Weighting functions are used to de-emphasize noise at frequencies where susceptibility is lower and emphasize noise at frequencies where sensitivity is greater.

To determine the resultant level of in-air noise that is potentially perceived by a SSO during launch, the otter weighting function was applied to the timewave form recording of the June 2022 Falcon 9 SARah-1 launch. The unfiltered time waveform had a frequency spectra with an unweighted peak level of approximately 110 dB L_{max} (Figure 5.1-20). After applying the otter weighting function, the peak level was approximately 70 dB L_{max} (Figure 5.1-20), which by comparison to human hearing sensitivity is equivalent to the sound level of a household washing machine. Therefore, the perceived noise during rocket launches under the Proposed Action would be significantly less than the unweighted modeling results of between 100 and 110 dB L_{max} at Sudden Ranch would suggest.

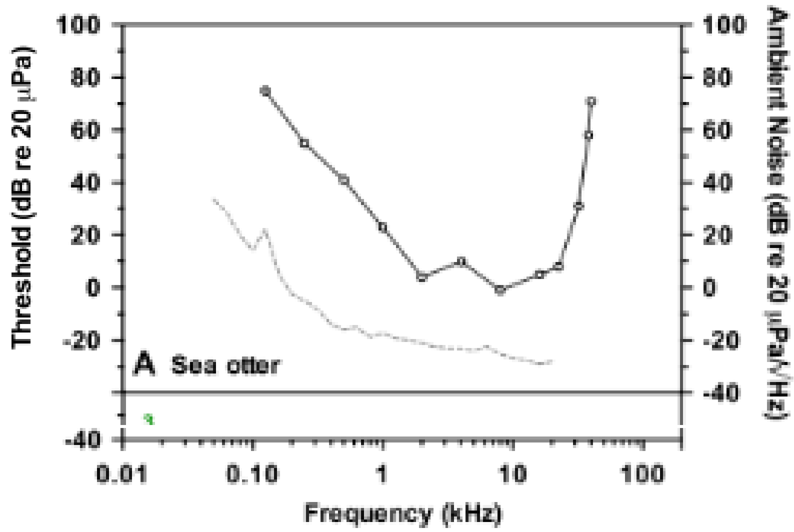

Figure 5.1-18. Northern sea otter audiogram (solid dotted line; source: Ghoul & Reichmuth 2014).

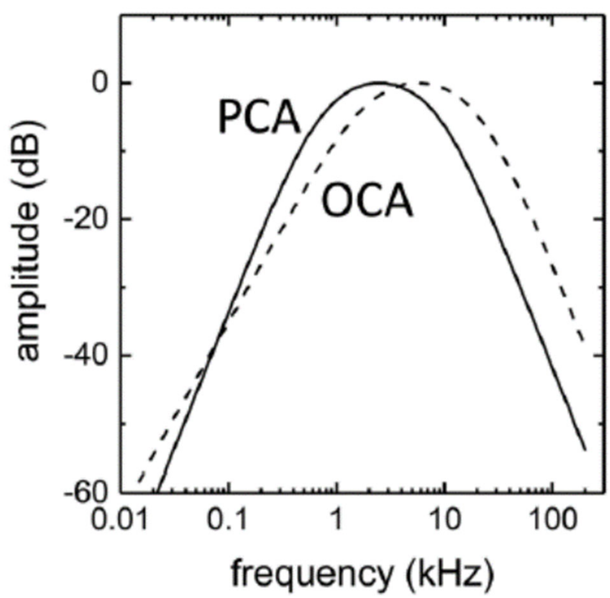

Figure 5.1-19. Sea otter derived auditory weighting function (dotted line; OCA = other carnivores in-air and is appropriate for otters; PCA = phocids in-air; Source: Southall et al. 2019).

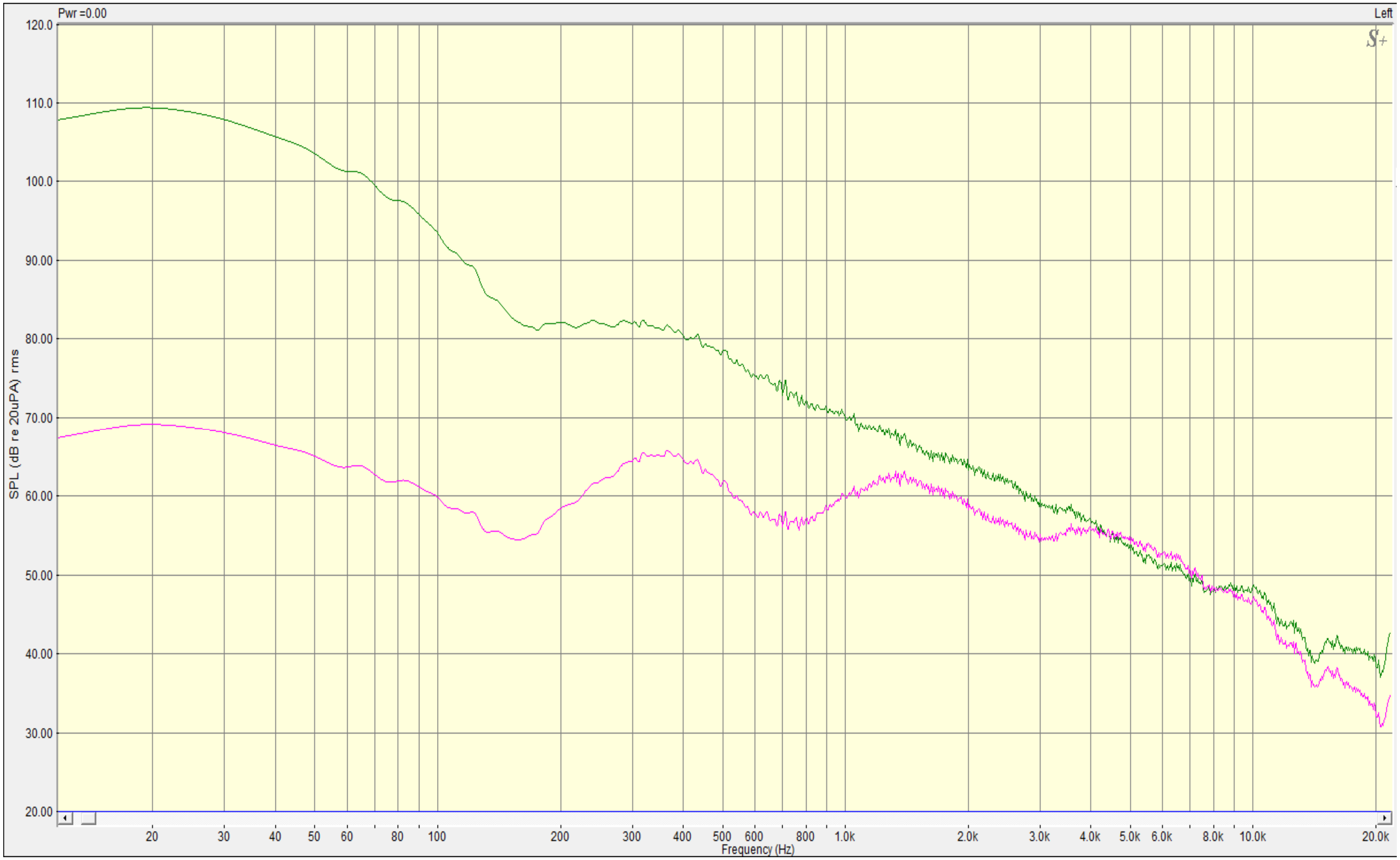

Figure 5.1-20. Launch peak noise level comparison of unweighted (green) versus otter-weighted (purple) decibels (note: time waveform recording from the June 2022 Falcon 9 SARah-1 launch).

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

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

5.1.16.3 Conclusion

Because there is very little overlap in the hearing sensitivity of SSO and noise produced during rocket launches and landings, SSO would perceive very little noise during launch activities. Additionally, if SSO do react to the launch and landing, the disturbance, if at rest, would result in an increase of approximately only 1%of daily energy expenditure. However, because such potential disturbance would be more frequent under the Proposed Action, the DAF has determined that impacts on SSO under the Proposed Action may affect, and is likely to adversely affect, the SSO off the coast of VSFB.

5.2 Direct and Indirect Effects on Critical Habitat

5.2.1 Tidewater Goby

The potential ascent sonic boom footprint from missions with easterly trajectories overlaps Critical Habitat Units SB-8, 9, 10, 11, and 12, VEN-1, 2, 3, and 4, and LA-1, 2, 3, and 4 (Figure 4.1-2). Sonic booms would not affect any of the PCEs for Critical Habitat (i.e., substrates, submerged and emergent aquatic vegetation, or the presence of sandbars at lagoons or estuaries; see Section 4.1.4). Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.2 California Tiger Salamander

The Action Area includes designated Critical Habitat Units 1, 2, 3, 4, 5, and 6 for the Santa Barbara DPS of the CTS (Figure 4.3-1 through Figure 4.3-5). The Proposed Action would have no ground disturbing activities or impacts on any of the PCEs for Critical Habitat (i.e., standing bodies of fresh water, upland habitats adjacent to breeding ponds, or upland dispersal habitat; see Section 4.3.4). Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.3 California Red-Legged Frog

The Action Area includes the following designated Critical Habitat units for the CRLF: STB-2, STB-4, STB-5, and STB-6 (Figure 4.4-1 through Figure 4.4-5). The potential ascent sonic boom footprint from missions with easterly trajectories overlaps STB-7, VEN-1, VEN-2, VEN-3, and LOS-1 (Figure 4.4-9). The Proposed Action would have no ground disturbing activities or impacts on water quality within Critical Habitat. Therefore, the Proposed Action would not affect any of the PCEs for Critical Habitat (i.e., space for individuals and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding; and habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distribution of the species). Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.4 Southwestern Willow Flycatcher

The Action Area includes the designated Critical Habitat along the Santa Ynez River east of Lompoc (Figure 4.7-1 through Figure 4.7-5). Additionally, in the region potentially impacted by ascent sonic booms during missions with easterly trajectories, Critical Habitat has been designated in the upper Santa Ynez River, the Ventura River, and the Santa Clara River drainage in Ventura and Los Angeles Counties (Figure 4.7-6). The Proposed Action would have no ground disturbing activities within SWFL Critical Habitat and would not affect any of the PCEs (i.e., riparian vegetation or prey populations; see Section 4.7.4). Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.5 Least Bell's Vireo

In the region potentially impacted by ascent sonic booms during missions with easterly trajectories, Critical Habitat has been designated in the upper Santa Ynez River in eastern Santa Barbara County and the Santa Clara River drainage in Ventura and Los Angeles Counties (Figure 4.8-6). There are no activities under the Proposed Action that would impact physically impact LBVI Critical Habitat. Subsequently the Proposed Action would not affect any of the PCEs (i.e., "riparian woodland vegetation that generally contains both canopy and shrub layers, and includes some associated upload habitats"; 59 FR 4845-4867).. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.6 Western Snowy Plover

The Action Area includes portions of Santa Rosa Island which are designated Critical Habitat for the SNPL (Figure 4.9-6 and Figure 4.9-7). These areas would receive ascent sonic booms greater than 1 psf during up to 100 Falcon missions each year. Depending on mission trajectories, ascent sonic boom may occasionally reach approximately 8 psf. Sonic boom footprints vary by mission-specific trajectories and weather conditions and the actual number of impacts above 1 psf would likely be less than 100 per year. Additionally, in the region potentially impacted by sonic booms during missions with easterly trajectories, the Action Area includes various Critical Habitat units along the coast of eastern Santa Barbara, Ventura, and Los Angeles Counties (Figure 4.9-9). The Proposed Action does not include any ground disturbance within Critical Habitat nor would it appreciably diminish the species' prey base or effect any other PCEs.

The DAF interprets the designation of Critical Habitat and development of PCEs (78 FR 344-534) as clearly focused on the physical presence of humans, pets, and off-highway vehicles (OHVs), not noise. The definition of "undisturbed areas" points to physical presences of humans, pets, and off-highway vehicles (OHVs) rather than noise, for example "*humans or pets approach too closely*", "*dogs may also deliberately chase plovers and inadvertently trample nests, while vehicles may directly crush adults, chicks, or nests, separate chicks from brooding adults, and interfere with foraging and mating activities*", "*use of OHVs has been documented to crush plover nests and strike plover adults*", and the potential for "*repeated flushing of incubating plovers*". In evaluation of the status of subunits, the analysis repeatedly focused on physically present threats, for example: "*The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, predators, OHVs, and disturbance from equestrians and humans with pets*". Areas without noise disturbance were not included in the PCEs. Therefore, because the Proposed Action would have no physical impact on Critical Habitat, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.7 California Condor

The potential ascent sonic boom footprint from missions with easterly trajectories overlaps the Sisquoc-San Rafael, Matilija, and Sespe-Piru Critical Habitat units (Figure 4.11-1). The Critical Habitat designation for California condor did not include a description of Physical and Biological Features; however, no ground disturbing activities under the Proposed Action would occur in designated Critical Habitat for this species and sonic booms greater than 1.0 psf would be very rare. Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.2.8 California Gnatcatcher

The potential ascent sonic boom footprint from missions with easterly trajectories overlaps Unit 13 in western Los Angeles and Ventura Counties (Figure 4.12-1). There are no ground disturbing activities within CAGN Critical Habitat; subsequently, the Proposed Action would not have any impacts on the Critical Habitat PCEs for CAGN (i.e., dynamic and successional sage scrub habitats or non-sage habitats in proximity to sage scrub; see Section 4.12.1). Therefore, the Proposed Action would have no effect on Critical Habitat for this species.

5.3 Cumulative Effects

Cumulative effects are defined in 50 C.F.R. § 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation." Reasonable, foreseeable, future federal actions, and potential future federal actions, that are unrelated to the Proposed Action, are not considered in the analysis of cumulative effects because they would require separate consultation pursuant to Section 7 of the ESA. There are no activities within the Action Area that would contribute to cumulative effects related to the Proposed Action.

5.4 Potentially Related Activities

There are no other activities with a "but for" relationship to the Proposed Action and reasonably certain to occur that would contribute to effects of the action.

6 Conclusion

SpaceX proposes to increase the Falcon annual launch cadence at VSFB to 100 per year cumulatively between SLC-4 and SLC-6, including up to 5 Falcon Heavy mission per year at SLC-6. SpaceX will continue to land up to 12 first stage recoveries per year at SLC-4W, proposes to land up to 17 first stages/boosters per year at SLC-6, as described in Section 2.2.6, and will continue to recover first stages downrange on offshore landing locations in the Pacific Ocean. SpaceX will also redevelop SLC-6 to accommodate the Falcon program and a new landing zone. This Proposed Action would result in increases in airborne noise and visual disturbance during launches, static fire, and landing events within the Action Area, as well as potential physical impacts during construction.

After reviewing the Proposed Action, including the proposed avoidance, minimization, monitoring, and mitigation measures (Section 2.3), the DAF has come to the conclusions which are summarized in Tables 6.0-1 and 6.0-2.

Table 6.0-1. Federally listed species with potential to occur in the Action Area and summary of effects determinations.

Common Name	Scientific Name	Federal Listing	Effects Determinations for the Proposed Action
Tidewater Goby	*Eucyclogobius newberryi*	Endangered	May affect, not likely to adversely affect.
Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	Endangered	May affect, not likely to adversely affect.
California Tiger Salamander Santa Barbara DPS	*Ambystoma californiense*	Endangered	May affect, not likely to adversely affect.
California Red-legged Frog	*Rana draytonii*	Threatened	**May affect, likely to adversely affect**.
Arroyo Toad	*Anaxyrus californicus*	Endangered	May affect, not likely to adversely affect.
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	May affect, not likely to adversely affect.
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	May affect, not likely to adversely affect.
Least Bell's Vireo	*Vireo bellii pusillus*	Endangered	May affect, not likely to adversely affect.
Western Snowy Plover	*Charadrius nivosus*	Threatened	**May affect, likely to adversely affect.**
California Least Tern	*Sternula antillarum browni*	Endangered	**May affect, likely to adversely affect**.
California Condor	*Gymnogyps californianus*	Endangered	May affect, not likely to adversely affect.
California Gnatcatcher	*Polioptila californica californica*	Threatened	May affect, not likely to adversely affect.

Common Name	Scientific Name	Federal Listing	Effects Determinations for the Proposed Action
Light-footed Clapper Rail	*Rallus obsoletus levipes*	Endangered	May affect, not likely to adversely affect.
Short-tailed Albatross	*Phoebastria (=Diomedea) albatrus*	Endangered	May affect, not likely to adversely affect.
Hawaiian Petrel	*Pterodroma sandwichensis*	Endangered	May affect, not likely to adversely affect.
Southern Sea Otter	*Enhydra lutris nereis*	Threatened	**May affect, likely to adversely affect**.

Table 6.0-2. Designated critical habitat within the Action Area and effects determinations.

Common Name	Scientific Name	Federal Listing	Effects Determinations for the Proposed Action
Tidewater Goby	*Eucyclogobius newberryi*	Endangered	No Effect
California Tiger Salamander	*Ambystoma californiense*	Endangered	No Effect
California Red-legged Frog	*Rana draytonii*	Threatened	No Effect
Arroyo Toad	*Anaxyrus californicus*	Endangered	No Effect
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	No Effect
Least Bell's Vireo	*Vireo bellii pusillus*	Endangered	No Effect
Western Snowy Plover	*Charadrius nivosus*	Threatened	No Effect
California Condor	*Gymnogyps californianus*	Endangered	No Effect
California Gnatcatcher	*Polioptila californica californica*	Threatened	No Effect

7 Literature Cited

Alquezar, R.D., R.H. Macedo, J. Sierro, and D. Gill. 2020. Lack of consistent responses to aircraft noise in dawn song timing of bird populations near tropical airports. Behavioral Ecology and Sociobiology 74(88). 12 pp.

Austin, O.L. 1949. The Status of Steller's Albatross. Pacific Science 3: 283-295.

Baldwin, B.G. 2009. Morphological and molecular reconsideration of *Deinandra increscens* subsp. *villosa*. Jepson Herbarium and Dept. of Integrative Biology University of California, Berkeley, California. 31 pp.

Ball, M.L., McCreedy, C., Geupel, G.R., and D. Robinette. 2012. Protocol-level Southwestern Willow Flycatcher Surveys of the Santa Ynez River and San Antonio Creek: 2012 Breeding Season. Unpublished Report, PRBO Conservation Science, Petaluma, CA.

Barrett, H.E., M.T. Tinker, G. Bentall, and B.I. McDonald. 2025. Energetic cost of human disturbance on the southern sea otter (*Enhydra lutris nereis*). The Journal of Wildlife Management 2025;e70012. https://doi.org/10.1002/jwmg.70012

Barry, S., and B. Shaffer. 1994. The Status of the California Tiger Salamander (*Ambystoma californiense*) at Lagunita: A 50-Year Update. The Journal of Herpetology: 28(2): 159-164.

Beason, R. 2004. What Can Birds Hear? Lincoln, NE: University of Nebraska.

Bee, M.A., and E.M. Swanson. 2007. Auditory masking of anuran advertisement calls by road traffic noise. Animal Behaviour 74: 1765–1776.

Bellefleur, D., P. Lee, and R.A. Ronconi. 2009. The impact of recreational boat traffic on Marbled Murrelets (*Brachyramphus marmoratus*). Journal of Environmental Management 90(1): 531-538.

Beuter, K.J., R. Weiss, and B. Frankfurt. 1986. Properties of the auditory system in birds and the effectiveness of acoustic scaring signals [Type]. Presented at the Bird Strike Committee Europe, 18th Meeting Part I, 26–30 May 1986. Copenhagen, Denmark.

Bowles, A.E., F.T. Aubrey, and J.R. Jehl. 1991. The effects of high-amplitude impulsive noise on hatching success: a reanalysis of the sooty tern incident. Report to Noise and Sonic Boom Impact Technology, Wright-Patterson AFB. Hubbs/Sea World Research Institute. San Diego, CA.

Bowles, A.E., M. Knobbler, M.D. Seddon, and B.A. Kugler. 1994. Effects of simulated sonic booms on the hatchability of white leghorn chicken eggs. Report to Armstrong Laboratory, Occupational & Environmental Health Directorate, Wright-Patterson AFB. Hubbs/Sea World Research Institute. San Diego, CA.

Bradley, F., C. Brook, and A.E. Bowles. 1990. Effects of low-altitude aircraft overflights on domestic turkey poults. BBN Laboratories, Inc., Canoga Park, Ca. Prepared for Noise and Sonic Boom Impact Technology Program, Wright-Patterson Air Force Base, Ohio. 145 pp.

California Department of Fish and Wildlife (CDFW). 2024. California Natural Diversity Database (CNDDB) Management Framework. California Department of Fish and Wildlife.

Christensen, C.B., H. Lauridsen, J. Christensen-Dalsgaard, M. Pedersen, and P.T. Madsen. 2015. Better than fish on land? Hearing across metamorphosis in salamanders. Proceedings of the Royal Society B: 282(1802):20141943. doi: 10.1098/rspb.2014.1943

Christopher, S.V. 2002. Sensitive amphibian inventory at Vandenberg Space Force Base, Santa Barbara County, California, summary of preliminary results and site maps Appendix A Field Survey Data. Prepared for 30 CES/CEI.

Christopher, S.V. 2018. A review and case study of California red-legged frog (*Rana draytonii*) movement patterns in terrestrial habitats. Prepared for 30 CES/CEI. Cook, D. 1997. Biology of the California red-legged frog: a synopsis. Transactions of the Western Section of the Wildlife Society 33(1997): 79-82.

Collins, P.W. 2006. Results of surveys for California tiger salamanders (*Ambystoma californiense*) on Vandenberg Air Force Base, Santa Barbara County, California. Santa Barbara Natural History Technical Reports No. 4.

Conomy, J.T., J.A. Dubovsky, J.A. Collazo, and W.J. Fleming. 1998. Do Black Ducks and Wood Ducks Habituate to Aircraft Disturbance? The Journal of Wildlife Management 62(3): 1135-1142.

Cook, D.G., P.C. Trenham, and P.T. Northen. 2006. California tiger salamander (*Ambystoma californiense* in an urban landscape. Northwestern Naturalist 87(3): 215-224.

Cromwell, G. 2024. Personal communication from Geoff Cromwell (U.S. Geological Service) to Darryl York (VSFB CEIEA), Tiffany Whitsitt (VSFB CEIEA), and John LaBonte (ManTech) on conference call regarding ground water and flow modeling of San Antonio Creek by and SpaceX's proposed water usage.

Crowell, S.E., A.M. Wells-Berlin, C.E. Carr, G.H. Olsen, R.E. Therrien, S.E. Ynnuzzi, and D.R. Ketten. 2015. A comparison of auditory brainstem responses across diving bird species. Journal of Comparative Physiology A 201 (8): 803–815. DOI:10.1007/s00359-015-1024-5

Cunnington, G.M., and Fahrig, L. 2010. Plasticity in the vocalizations of anurans in response to traffic noise. Acta Oecologica 36: 463–470.

Curland, J. M. 1997. Effects of disturbance on sea otters (*Enhydra lutris*) near Monterey, California. Master's Thesis. San Jose State University, California. 47 pp.

Davis, R., T. Williams, and F. Awbrey. 1988. Sea Otter Oil Spill Avoidance Study. Minerals Management Service: 76.

Delay, S.J., O. Urquhart, and J.D. Litzgus. 2023. Wind farm and wildfire: spatial ecology of an endangered freshwater turtle in a recovering landscape. Canadian Journal of Zoology 00: 1-22. https://doi.org/10.1139/cjz-2023-0100

DiGaudio, R., N.E. Seavy, M. Holmgren, M. Ball, G.R. Geupel, and D. Robinette. 2011. Trends in Riparian Bird Abundance on Vandenberg Air Force Base: 1998 to 2011. Unpublished Report, PRBO Conservation Science, Petaluma, California. 53 pp.

Dooling, R.J. 2002. Avian Hearing and the Avoidance of Wind Turbines. Prepared for National Renewable Energy Laboratory, Contract No. DE-AC36-99-GO10337. 84 pp.

Dooling, R.J., and A.N. Popper. 2007. The effects of highway noise on birds. Prepared for The California Department of Transportation, Division of Enivronmental Analysis. Environmental Bioacoustics LLC, Rockville, MD. 74 pp.

Dooling, R.J. 2024. Personal communication in emails dating between 7 October 2024 and 1 November 2024 on noise exposure, hearing sensitivity, and damage to hearing organs in birds.

Dupuis, J.R., S.M. Geib, K.H. Osborne, D. Rubinoff. 2020. Genomics confirms surprising ecological divergence and isolation in an endangered butterfly. Biodiversity and Conservation 29: 1897–1921.

eBird. 2024. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org. (Accessed: 15 November 2024).

ESA PWA. 2010. An Assessment of Potential Restoration Actions to Enhance the Ecological Functions of the Lower Santa Ynez River Estuary. Prepared for Audubon California, California Coastal Conservancy, the Nature Conservancy, California Department of Fish and Game, US. Fish and Wildlife Service, and Vandenberg Air Force Base. 142 pp.

Farmer, C., S.I. Rothstein, and M.A. Holmgren. 2003. The Distribution and Abundance of Southwestern Willow Flycatchers on the Lower Santa Ynez River, California. Studies in Avian Biology 26: 30-35.

Fay, R.R. 1988. Hearing in vertebrates: a psychophysics databook. Hill-Fay Associates, Winnetka, IL. 621 pp.

Fellers, G.M., A.E. Launer, G. Rathbun, S. Bobzien, J. Alvarez, D. Sterner, R.B. Seymour, and M. Westphal. 2001. Overwintering tadpoles in the California red-legged frog (*Rana aurora draytonii*). Herpetological Review 32(3): 156-157.

Francis, C.D., and J.R. Barber. 2013. A framework for understanding noise impacts on wildlife: an urgent conservation priority. Fronteirs in Ecology and the Environment 11(6): 305-313.

Francis, C.D., C.P. Ortega, and A. Cruz. 2011a. Noise Pollution Filters Bird Communities Based on Vocal Frequency. PlosONE 6(11): e27052.

Francis, C.D., J. Paritsis, C.P. Ortega, and A. Cruz. 2011b. Landscape patterns of avian habitat use and nest success are affected by chronic gas well compressor noise. Landscape Ecology 26: 1269–1280.

Ghoul, A., and C. Reichmuth. 2014. Hearing in the sea otter (*Enhydra lutris*): auditory profiles for an amphibious marine carnivore. Journal of Comparative Physiology. doi:10.1007/s00359-014-0943-x.

Gleich, O., R.J. Dooling, and G.A. Manley. 2005. Audiogram, body mass, and basilar papilla length: correlations in birds and predictions for extinct archosaurs. Naturwissenschaften 92: 595-598.

Godin, O. 2008. Sound transmission through water–air interfaces: new insights into an old problem. Contemporary Physics 49(2): 105-123.

Goudie, R.I., and I.L. Jones. 2004. Dose-response relationships of harlequin duck behaviour to noise from low-level military jet over-flights in central Labrador. Environmental Conservation 31(4): 289-298.

Griffith Wildlife Biology. 2022. Least Bell's vireo range expansion surveys in Monterey, San Luis Obispo, Santa Barbara, and Ventura Counties California in 2022. Interim Programmatic

Report Narrative, National Fish and Wildlife Foundation Project# 67287. Prepared for Ventura Audubon Society. 32 pp.

Halfwerk, W., L.J.M. Holleman, C. Lessells, and H. Slabbekoorn. 2011. Negative impact of traffic noise on avian reproductive success. Journal of Applied Ecology 48: 210–219.

Holmgren, M.A., and P.W. Collins. 1999 Final report on the disturbance and habitat associations of six bird species of special concern at Vandenberg Air Force Base, Santa Barbara County, California. Prepared for Vandenberg Air Force Base, 30 CES/CEVPN, Natural Resources, Vandenberg Air Force Base, California. Santa Barbara Museum of Natural History Monographs No. 1, Studies in Biodiversity No. 1. 204 pp.

International Ammunition Technical Guidelines. 2022. Formulae for ammunition management. IATG 01.80. Third edition, UNODA, March 2021 – 43 p.

Johansen, S., O.N. Larsen, J. Christensen-Dalsgaard, L. Seidelin, T. Huulvej, K. Jensen, S.G. Lunneryd, M. Bostrom, and M. Wahlberg. 2016. In-air and underwater hearing in the great cormorant (Phalacrocorax carbo sinensis). Advances in Experimental Medicine Biology 875: 505–512. DOI:10.1007/978-1-4939-2981-8_61

Kaiser, K., D.G. Scofield, M. Alloush, R.M. Jones, S. Marczak, K. Martineau, M.A. Oliva, and P.M. Narins. 2011. When sounds collide: the effect of anthropogenic noise on a breeding assemblage of frogs in Belize, Central America. Behaviour 148: 215–232.

Kaiser, K., J. Devito, C.G. Jones, A. Marentes, R. Perez, L. Umeh, R.M. Weickum, K. McGovern, E.H. Wilson, and W. Saltzman. 2015. Effects of anthropogenic noise on endocrine and reproductive function in White's treefrog, *Litoria caerulea*. Conservation Physiology 3(1): p.cou061-cou061.

KBR. 2024. Falcon 9 and Falcon Heavy noise assessment for flight and test operations at Vandenberg Space Force Base. KBR Technical Note TN 23-04 (revision 2). Prepared for Space Exploration Technologies Corporation. 7 February 2024. 72 pp.

Kleist, N.J., R.P. Guralnick, A. Cruz, C.A. Lowry, and C.D. Francis. 2018. Chronic anthropogenic noise disrupts glucocorticoid signaling and has multiple effects on fitness in an avian community. PNAS 115 (4) E648-E657.

Konishi, M. 1970. Comparative neurophysiological studies of hearing and vocalizations in songbirds. Zeitschrift fur vergleichend Physiologie 66: 257-272.

Kruger, D.J.D., and L.H. Du Preez. 2016. The effect of airplane noise on frogs: a case study on the Critically Endangered Pickersgill's reed frog (*Hyperolius pickersgilli*). Ecological Research 31(3): 393-405.

Kus, B. 2002. Least Bell's Vireo (*Vireo bellii pusillus*). In the Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian-associated Birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/species/riparian/least_bell_vireo.htm.

Lafferty, K.D., C.C. Swift, and R.F. Ambrose. 1999. Extirpation and recolonization in a metapopulation of an endangered fish, the tidewater goby. Conservation Biology 13(6): 1447-1453.

Lehman, P.E. 2020. The birds of Santa Barbara County, California. Revised edition, June 2020. Available at http://www.sbcobirding.com/lehmanbosbc.html

Lengagne, T. 2008. Traffic noise affects communication behaviour in a breeding anuran, *Hyla arborea*. Biological Conservation 141: 2023–2031.

Lewis, E., and P. Narins. 1985. Do Frogs Communicate with Seismic Signals? Science 227(4683): 187-189.

Loredo, I., and D. Van Vuren. 1996. Reproductive ecology of a population of the California tiger salamander. Copeia 1996: 895–901.

ManTech SRS Technologies, Inc. 2007a. Biological Monitoring of Southern Sea Otters, California Brown Pelicans, Western Snowy Plovers, and California Least Terns for the 7 June 2007 Delta II COSMO-1 Launch from Vandenberg Space Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 24 pp.

ManTech SRS Technologies, Inc. 2007b. Biological Monitoring of California Brown Pelicans and Southern Sea Otters for the 14 December 2006 Delta II NROL-21 Launch from Vandenberg Space Force Base, California. SRS Technologies Systems Development Division, Lompoc, California. 21 pp.

ManTech SRS Technologies, Inc. 2008a. Biological Monitoring of Western Snowy Plovers for the 13 March 2008 Atlas V NROL-28 Launch from Vandenberg Space Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 18 pp.

ManTech SRS Technologies, Inc. 2008b. Biological Monitoring of Southern Sea Otters, California Brown Pelicans, Western Snowy Plovers, and California Least Terns for the 20 June 2008 Delta II OSTM Launch from Vandenberg Space Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 29 pp.

ManTech SRS Technologies, Inc. 2008c. Biological Monitoring of Southern Sea Otters and California Brown Pelicans for the 6 September 2008 Delta II GeoEye-1 Launch from Vandenberg Space Force Base, California. Lompoc, California: ManTech SRS Technologies, Inc., Lompoc, California.

ManTech SRS Technologies, Inc. 2009a. Status of the unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) in San Antonio and Cañada Honda creeks, Vandenberg Air Force Base, California. 10 February 2009.

ManTech SRS Technologies, Inc. 2009b. Occurrence of the Amphibian Pathogen, Batrachochytrium dendrobatidis, in Ranids of Vandenberg Air Force Base, California. Prepared for 30 CEV/CEVNN.

ManTech SRS Technologies, Inc. 2009c. Biological Monitoring of Western Snowy Plovers for the 18 October 2009 Atlas V DMSP-18 Launch from Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 18 pp.

ManTech SRS Technologies, Inc. 2009d. Biological Monitoring of Southern Sea Otters and California Brown Pelicans for the 8 October 2009 Delta II Worldview-II Launch from Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 22 pp.

ManTech SRS Technologies, Inc. 2010a. Biological monitoring of western snowy plovers for the 22 April 2010 Minotaur IV HTV-2A Demo launch from Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 16 pp.

ManTech SRS Technologies, Inc. 2010b. Biological monitoring of western snowy plovers for the 20 September 2010 Atlas V NROL-41 launch from Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 17 pp.

ManTech SRS Technologies Inc. 2011. Biological Monitoring of Southern Sea Otters, California Least Terns and Western Snowy Plovers for the 10 June 2011 Delta II Aquarius Launch, Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California.

ManTech SRS Technologies, Inc. 2013. Monitoring of the western snowy plovers for the 28 August 2013 Delta IV Heavy NROL-65 launch from Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 9 pp.

ManTech SRS Technologies, Inc. 2014a. Assessment of California Red-Legged Frog Habitat, Population Status, and Chytrid Fungus Infection on Vandenberg Air Force Base, California. ManTech SRS Technologies, Inc., Lompoc, California. 83 pp.

ManTech SRS Technologies, Inc. 2014b. Baseline Surveys for California Red-Legged Frog, Tidewater Goby, and Southern Steelhead at the 13th Street Bridge on Vandenberg Air Force Base, California. Prepared for 30 CES/CEIEA. June 2014. 44 pp.

ManTech SRS Technologies, Inc. 2015. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Wet Season Surveys 2014. ManTech SRS Technologies, Inc., Lompoc, California. 118 pp.

ManTech SRS Technologies, Inc. 2016a. California Red-Legged Frog Habitat Assessment, Population Status, and Chytrid Fungus Infection in Cañada Honda Creek and San Antonio West Bridge Area on Vandenberg Space Force Base, California. Unpublished report. 51 pp.

ManTech SRS Technologies, Inc. 2016b. Tiger Salamander Surveys at Vandenberg Air Force Base, California 2014-2016. ManTech SRS Technologies, Lompoc, California. 20 pp.

ManTech SRS Technologies, Inc. 2016c. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Wet Season Surveys 2015 – 2016, Wetland Delineations, and Habitat Assessments of Select Pools. ManTech SRS Technologies, Lompoc, California. 138 pp.

ManTech SRS Technologies, Inc. 2017a. Biological Assessment for Launch, Boost-Back and Landing of the Falcon 9 First Stage at SLC-4, Vandenberg Air Force Base, California. ManTech SRS Technologies, Lompoc, California. 65 pp.

ManTech SRS Technologies, Inc. 2017b. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Surveys 2016 – 2017. Prepared for 30 CES/CEIEA. 41 pp.

ManTech SRS Technologies, Inc. 2018a. California red-legged frog habitat assessment, population status, and chytrid fungus infection in Cañada Honda Creek, Cañada del Jolloru, and seasonal pools on Vandenberg Air Force Base, California. Submitted to 30th Civil Engineer Squadron, Environmental Flight, Natural Resources Section (30 CES/CEIEA), Vandenberg Air Force Base, California.

ManTech SRS Technologies, Inc. 2018b. Post-Construction Biological Monitoring for 13th Street Bridge Replacement at Vandenberg Air Force Base, California. Prepared for 30 CES/CEIEA. 26 November 2018. 43 pp.

ManTech SRS Technologies, Inc. 2018c. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Surveys 2017 – 2018. Prepared for 30 CES/CEIEA. 14 pp.

ManTech SRS Technologies, Inc. 2018d. Biological Monitoring of Southern Sea Otters and California Red-legged Frogs for the 7 October 2018 SpaceX Falcon 9 SAOCOM Launch and Landing at Vandenberg Space Force Base, California. Prepared for 30 CES/CEIEA. 27 December 2018. 15 pp.

ManTech SRS Technologies, Inc. 2019. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Surveys 2018 – 2019. Prepared for 30 CES/CEIEA. 15 pp.

ManTech SRS Technologies, Inc. 2020. Environmental DNA survey to detect rare aquatic amphibians on Vandenberg Air Force Base, California. Prepared for 30 CES/CEIEA. 127 pp.

ManTech SRS Technologies, Inc. 2021a. California Red-Legged Frog Habitat Assessment, and Population Status on San Antonio Terrace and Assessment of Select Aquatic Features on Vandenberg Space Force Base, California in 2020. October 2021. 85 pp.

ManTech SRS Technologies, Inc. 2021b. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Surveys 2019 – 2020. Prepared for 30 CES/CEIEA. 22 pp.

ManTech SRS Technologies, Inc. 2021c. Biological Monitoring of Southern Sea Otters and California Red-legged Frogs for the 21 November 2020 SpaceX Falcon 9 Sentinel 6A Mission at Vandenberg Space Force Base, California. January 2021. 12 pp.

ManTech SRS Technologies, Inc. 2022a. 2021 surveys for rare aquatic amphibians on Vandenberg Space Force Base, California using environmental DNA techniques. Prepared for 30 CES/CEIEA. 127 pp.

ManTech SRS Technologies, Inc. 2022b. Assessment of California Red-Legged Frog Population Status and Habitat in Shuman Creek in 2021 on Vandenberg Air Force Base, California. Prepared for 30 CES/CEIEA. 127 pp.

ManTech SRS Technologies, Inc. 2022c. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Surveys 2020 – 2021. Prepared for 30 CES/CEIEA. 32 pp.

ManTech SRS Technologies, Inc. 2022d. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) Surveys 2021 – 2022. Prepared for 30 CES/CEIEA. 18 pp.

ManTech SRS Technologies, Inc. 2022e. Biological Monitoring of California Red-legged Frogs for the 2 February 2022 SpaceX Falcon 9 NROL-87 Mission at Vandenberg Space Force Base, California.

ManTech SRS Technologies, Inc. 2023a. Spring Canyon California Red-Legged Frog Habitat Assessment – 2023, Vandenberg Space Force Base, California. Prepared for 30 CES/CEIEA. 161 pp.

ManTech SRS Technologies, Inc. 2023b. Biological Monitoring of Southern Sea Otters and California Red-legged Frogs for the 16 December 2022 SpaceX SWOT Mission at Vandenberg Space Force Base, California.

ManTech SRS Technologies, Inc. 2023c. California Red-Legged Frog Habitat Assessment and Population Status on Vandenberg Space Force Base, California in 2022. Prepared for 30 CES/CEIEA. 126 pp.

ManTech SRS Technologies, Inc. 2024a. *DRAFT* California Red-legged Frog Monitoring Plan for the Launch, Boost-Back, and Landing of the Falcon 9 at Space Launch Complex 4 at Vandenberg

Space Force Base, California. Prepared for SLD 30, CEIEA, Vandenberg Space Force Base, Ca. 16 December 2024.

ManTech SRS Technologies, Inc. 2024b. Activities Pursuant to Biological Opinion 2017-F-0480 – Launch, Boost-back, and Landing of the Falcon 9 First Stage at Space Launch Complex-4 at Vandenberg Space Force Base, Santa Barbara County, California. 26 pp.

ManTech SRS Technologies, Inc. 2024c. Preliminary Observations from Transporter 11 Video Monitoring of Southern Sea Otters on Vandenberg Space Force Base, California. 19 pp.

ManTech SRS Technologies, Inc. 2024c. Southern Sea Otter – Summary of Video Observations during the SpaceX OneWeb-4 Lauch and Landing at SLC-4, Vandenberg Space Force Base. 2 pp.

Maxwell, A., K.A. Hansen, S.T. Ortiz, O. N. Larsen, U. Siebert, and M. Wahlberg. 2017. In-air hearing of the great cormorant (*Phalacrocorax carbo*). Biology Open 6 (4): 496–502. DOI:10.1242/bio.023879

McClure, C.J.W., H.E. Ware, J. Carlisle, G. Kaltenecker, and J.R. Barber. 2013. An experimental investigation into the effects of traffic noise on distributions of birds: avoiding the phantom road. Proceedings of the Royal Society B: 20132290. http://dx.doi.org/10.1098/rspb.2013.2290.

Meier, J., and R. Thompson. 2009. Lightning Climatology for the WFO Los Angeles/Oxnard, California County Warning Area. National Weather Service Forecast Office, Los Angeles/Oxnard, California.

Mejia, E.C., C.J.W. McClure, and J.R. Barber. 2019. Large-scale manipulation of the acoustic environment can alter the abundance of breeding birds: Evidence from a phantom natural gas field. Journal of Applied Ecology 56:2091–2101.

Mockford, E.J., R.C. and Marshall. 2009. Effects of urban noise on song and response behaviour in great tits. Proceedings of the Royal Society B 276: 2979–2985.

Mooney, T.A., A. Smith, O.N. Larsen, K.A. Hansen, M. Wahlberg, and M.H. Rasmussen. 2019. Field-based hearing measurements of two seabird species. Journal of Experimental Biology 222: 1–7. DOI:DOI:10.1242/jeb.190710

Nafis, G. 2023. A Guide to the Amphibians and Reptiles of California (On-line). Accessed 6 December 2023 at http://www.californiaherps.com/salamanders/pages/a.californiense.html.

National Academies of Sciences, Engineering, and Medicine. 2020. Commercial Space Operations Noise and Sonic Boom Measurements. Washington, DC: The National Academies Press. https://doi.org/10.17226/25834.

Nelson, D.V., H. Klinck, A. Carbaugh-Rutland, C.L. Mathis, A.T. Morzillo, and T.S. Garcia. 2017. Calling at the highway: The spatiotemporal constraint of road noise on Pacific chorus frog communication. Ecology and Evolution 7: 429–440.

Oelze, M.L., W.D. O'Brien, and R.G. Darmody. 2002. Measurement of Attenuation and Speed of Sound in Soils. Soil Science Society of America Journal (66): 788-796.

Oftedal, O.T., K. Ralls. M.T. Tinker, and A. Green. 2007. Nutritional constraints on the southern sea otter in the Monterey Bay National Marine Sanctuary and a comparison to sea otter populations at San Nicolas Island, California and Glacier Bay, Alasska. Joint Final Report to

Monterey Bay National Marine Sanctuary. Monterey Bay National Marine Sanctuary, Monterey, California, USA.

Park, J., and Y. Do. 2022. Wind turbine noise behaviorally and physiologically changes male frogs. Biology 11(4): 516-534.

Parris, K.M., M. Velik-Lord, and J.M.A. North. 2009. Frogs call at a higher pitch in traffic noise. Ecology and Society 14(1): 25. Available at http://www.ecologyandsociety.org/vol14/iss1/art25/.

Partan, S.R., and P. Marler, P. 2005. Issues in the classification of multimodal communication signals. American Naturalist 166(2): 231-245.

Passos, M.F.O., M.V. Beirão, A. Midamegbe, R.H.L. Duarte, R.J. Young, and C.S. de Azevedo. 2020. Impacts of noise pollution on the agonistic interactions of the saffron finch (*Sicalis flaveola* Linnaeus, 1766). Behavioural Processes 180: 104222.

Redondo, I., J. Muriel, C. de Castro Diaz, J.I. Aguirre, D. Gill, and L. Perez-Rodriguez. 2021. Influence of growing up in the city or near an airport on the physiological stress of tree sparrow nestlings (*Passer montanus*). European Journal of Wildlife Research 67: 68.

Riedman, M., and J. Estes. 1990. The sea otter (*Enhydra lutris*): behavior, ecology, and natural history. Washington, D.C.: U.S. Fish and Wildlife Service Biological Report 90(14).

Robinette, D., and R. Ball. 2013. Monitoring of Western Snowy Plovers on South Surf Beach, Vandenberg Space Force Base, Before and After the 29 September 2013 SpaceX Falcon 9 Launch. Point Blue Conservation Science. Vandenberg Field Station. 22 October 2013.

Robinette, D. P., N. Collier, A. Brown, and W. J. Sydeman. 2003. Monitoring and management of the California Least Tern colony at Purisima Point, Vandenberg Air Force Base, 2002. Unpublished Report. Stinson Beach, CA: Point Reyes Bird Observatory.

Robinett, D., and J. Howar. 2010. Monitoring and management of the California Least Tern colony at Purisima Point, Vandenberg Air Force Base, 2009. Petaluma, California: Unpublished Report, PRBO Conservation Science.

Robinette, D.P., and J.K. Miller. 2017a. Monitoring of Western Snowy Plovers on South Surf Beach and California Least Terns at the Sana Ynez River Estuary, Vandenberg Air Force Base, Before and after the 25 June 2017 Falcon 9 Iridium Next 11-20 Launch. Petaluma, California: Point Blue Conservation Science.

Robinette, D.P., and J.K. Miller. 2017b. Monitoring of Western Snowy Plovers on Surf South Beach, Vandenberg Air Force Base, Before and after the 24 August 2017 SpaceX Falcon9 Formosat 5 Launch. Petaluma, California: Point Blue Conservation Science.

Robinette, D.P., and E. Rogan. 2005. Monitoring and management of the California Least Tern colony at Purisima Point, Vandenberg Air Force Base, 2005. Unpublished Report. Stinson Beach, CA: Point Reyes Bird Observatory.

Robinette, D.P., J.K. Miller, and A.J. Howar. 2016. Monitoring and Management of the Endangered California Least Tern and the Threatened Western Snowy Plover at Vandenberg Space Force Base, 2016. Petaluma, California: Point Blue Conservation Science.

Robinette, D., and E. Rice. 2019. Monitoring of California Least Terns and Western Snowy Plovers on Vandenberg Space Force Base during the 12 June 2019 SpaceX Falcon 9 Launch with "Boost-Back". Petaluma, California: Point Blue Conservation Science.

Robinette, D., and E. Rice. 2022a. Monitoring of Western Snowy Plovers on Vandenberg Space Force Base during the 17 April 2022 SpaceX Falcon 9 NROL-85 Launch with "Boost-Back". Petaluma, California: Point Blue Conservation Science.

Robinett, D., and E. Rice. 2022b. Monitoring of California Least Terns and Western Snowy Plovers on Vandenberg Space Force Base during the 18 June 2022 SpaceX Falcon 9 Launch and First Stage Landing at SLC-4. Petaluma, California: Point Blue Conservation Science.

Robinette, D., E. Rice, A. Fortuna, J. Miller, L. Hargett, and J. Howar. 2021. Monitoring and management of the endangered California least tern and the threatened western snowy plover at Vandenberg Space Force Base, 2021. Unpublished Report, Point Blue Conservation Science, Petaluma, CA.

Robinette, D., E. Rice, S. Gautreaux, and J. Hower. 2024a. Monitoring of California Least Terns and Western Snowy Plovers on Vandenberg Space Force Base during 11 SpaceX Falcon 9 Launches in 2023. Petaluma, California: Point Blue Conservation Science.

Robinette, D., E. Rice, S. Gautreaux, and J. Hower. 2024b. Monitoring of California Least Terns and Western Snowy Plovers on Vandenberg Space Force Base during 13 SpaceX Falcon 9 Launches in 2024 – Executive Summary. Petaluma, California: Point Blue Conservation Science.

Robinette, D., E. Rice, J.K. Miller, L.A. Hargett, and J. Hower. 2024c. Monitoring of California Least Terns and Western Snowy Plovers on Vandenberg Space Force Base during 16 SpaceX Falcon 9 Launches in 2024. Petaluma, California: Point Blue Conservation Science.

Robinette, D., E. Rice, J.K. Miller, L.A. Hargett, and J. Hower. 2024d. Monitoring of Western Snowy Plovers and California Least Terns on Vandenberg Space Force Base during 16 SpaceX Falcon 9 Launches in CY2024. Petaluma, California: Point Blue Conservation Science. Point Blue Contribution number 2534.

Rodrıguez-Prieto, I., and E. Fernandez-Juricic. 2005. Effects of direct human disturbance on the endemic Iberian frog *Rana iberica* at individual and population levels. Biological Conservation 123: 1-9.

Rosa, P., and N. Koper. 2022. Impacts of oil well drilling and operating noise on abundance and productivity of grassland songbirds. Journal of Applied Ecology 59:574–584.

Sanger, G.A. 1972. The recent pelagic status of the short-tailed albatross (*Diomedea albatrus*). Biological Conservation 4(3): 186-193.

Schou, C.P.E., A.L. Levengood, and D.A. Potvin. 2021. Limited effects of traffic noise on behavioural responses to conspecific mating calls in the eastern sedge frog *Litoria fallax*. Acta Ethologica 24(3): 217-226.

Seavy, N.E., M.A. Holmgren, M.L. Ball, and G. Geupel. 2012. Quantifying riparian bird habitat with orthophotography interpretation and field surveys: Lessons from Vandenberg Air Force Base, California. Journal of Field Ornithology.

Simmons, D.D., R. Lohr, H. Wotring, M.D. Burton, R.A. Hooper, and R.A. Baird. 2014. Recovery of otoacoustic emissions after high-level noise exposure in the American bullfrog. Journal of Experimental Biollogy 217(9): 1626–1636. doi: 10.1242/jeb.090092.

Southall, B., J. Finneran, C. Reichmuth, P. Nachtigall, D. Ketten, A. Bowles, W. Ellison, D. Nowacek, and P. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 45(2) 125-232.

Southern Sierra Research Station. 2017. Southwestern Willow Flycatcher Protocol Surveys of the Santa Ynez River and San Antonio Creek: 2017 Breeding Season. Prepared for Center for Environmental Management of Military Lands, Colorado State University, Fort Collins, Colorado, and 30 CEA/CEIEA, Vandenberg Air Force Base, California. 23 pp.

SRS Technologies, Inc. 2001. Acoustic Measurements of the 8 September 2001 Atlas IIAS MLV-10 Launch and Quantitative Analysis of Behavioral Responses of Pacific Harbor Seals, Western Snowy Plovers and California Brown Pelicans on Vandenberg Air Force Base, and Selected Pinnipeds on San Miguel Island, California.

SRS Technologies, Inc. 2002. Analysis of Behavioral Responses of California Brown Pelicans and Southern Sea Otters for the 18 October 2001 Delta II Quickbird2 Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force.

SRS Technologies, Inc. 2004. 13th Street Bridge Retrofit Summary of Monitoring Activities August 25, 2003 -February 9, 2004 Vandenberg Air Force Base California.

SRS Technologies, Inc. 2006a. Biological Monitoring of Southern Sea Otters, California Brown Pelicans, and Western Snowy Plovers for the 28 April 2006 Delta II Cloudsat & CALIPSO Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force and the U.S. Fish and Wildlife Service, 11 October 2006.

SRS Technologies, Inc. 2006b. Quantitative Analysis of Behavioral Responses of Western Snowy Plovers and California Brown Pelicans to the 2 December 2003 Atlas IIAS MLV-14 Launch from Vandenberg Air Force Base, California.

SRS Technologies, Inc. 2006c. Results from Water Quality and Beach Layia Monitoring, and Analysis of Behavioral Responses of Western Snowy Plovers to the 19 October 2005 Titan IV B-26 Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force.

SRS Technologies, Inc. 2006d. Analysis of Behavioral Responses of Southern Sea Otters, California Least Terns, and Western Snowy Plovers to the 20 April 2004 Delta II Gravity Probe B Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 12 pp.

SRS Technologies, Inc. 2006e. Analysis of Behavioral Responses of California Brown Pelicans, Western Snowy Plovers and Southern Sea Otters to the 15 July 2004 Delta II AURA Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 13 pp.

SRS Technologies, Inc. 2006f. Analysis of Behavioral Responses of Southern Sea Otters, California Brown Pelicans, and Western Snowy Plovers to the 20 May 2005 Delta II NOAA-N Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 15 pp.

SRS Technologies, Inc. 2006g. Biological Monitoring of Southern Sea Otters, California Brown Pelicans, and Western Snowy Plovers for the 28 April 2006 Delta II Cloudsat & CALIPSO Launch from Vandenberg Space Force Base, California. SRS Technologies technical report submitted to the United States Space Force and the U.S. Fish and Wildlife Service, 11 October 2006. 18 pp.

SRS Technologies, Inc. 2006h. Quantitative analysis of behavioral responses of western snowy plover and California brown pelicans to the 2 December 2003 Atlas IIAS MLV-14 Launch from Vandenberg Air Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 15 pp.

SRS Technologies, Inc. 2006i. Analysis of behavioral responses of California brown pelicans, southern sea otters, and western snowy plovers to the 20 May 2004 Taurus ROCSAT-2 launch from Vandenberg Air Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 18 pp.

SRS Technologies, Inc. 2006j. Analysis of behavioral responses of western snowy plovers to the 14 April 2006 Minotaur COSMIC launch from Vandenberg Air Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 12 pp.

SRS Technologies, Inc. 2006k. Biological monitoring of southern sea otters, California brown pelicans, and western snowy plovers, and water quality and acoustic monitoring for the 27 June 2006 Delta IV NROL-22 launch from Vandenberg Air Force Base, California. SRS Technologies technical report submitted to the United States Space Force. 44 pp.

SRS Technologies, Inc. 2006l. Biological Monitoring of Southern Sea Otters, California Brown Pelicans, Gaviota Tarplant, and El Segundo Blue Butterfly, and Water Quality Monitoring for the 4 November 2006 Delta IV DMSP-17 Launch from Vandenberg Space Force Base, California. SRS Technologies Systems Development Division, Lompoc, California. 40 pp.

Stebbens, W.C. 1983. The Acoustic Sense of Animals. Cambridge, Massachusetts: Harvard University Press.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company.

Stevens, M. 2013. Sensory Ecology, Behaviour, and Evolution. Oxford University Press.

Straam Group. 2025. Vibration Monitoring Report - Falcon 9 Vandenberg Launches. Prepared for Space Exploration Technologies. 7 January 2025.

Strachan, G., M. McAllister, and C.J. Ralph. 1995. Marbled murrelet at-sea and foraging behavior. Chapter 23 *in* Ralph, C. J., Hunt, G.L., Jr., Raphael, M.G., Piatt, J.F. (eds.): Ecology and conservation of the marbled murrelet. USDA Forest Service General Technical Report PSW-152.

Sun, J.W.C., and P.M. Narins. 2005. Anthropogenic sounds differentially affect amphibian call rate. Biological Conservation 121: 419-427.

Suryan, R.M., K.S. Dietrich, E.F. Melvin, G.R. Balogh, F. Sato, and K. Ozaki. 2007. Migratory routes of short-tailed albatross: use of exclusive economic zones of North Pacific Rim countries and spatial overlap with commercial fisheries in Alaska. Biological Conservation 137: 450-460.

Suryan, R., K. Ozaki, and G. Balogh. 2008. Unpublished breeding short-tailed albatross telemetry data.

Swaddle, J.P., and L.C. Page. 2007. High levels of environmental noise erode pair preferences in zebra finches: implications for noise pollution. Animal Behaviour 74: 363–368.

Sweet, S.S., J.P. LaBonte, and M.L. Ball. 2008. Evaluation of potential California tiger salamander (*Ambystoma californiense*) occurrence on Vandenberg Air Force Base: Phase I - wetland evaluations. Cheadle Center for Biodiversity and Ecological Restoration, University of California, Santa Barbara. Prepared for 30 CEV/CEVNN.

Sweet, S.S., J.P. LaBonte, and M.L. Ball. 2010. Evaluation of potential tiger salamander (*Ambystoma* spp.) occurrence on Vandenberg Air Force Base: Phase II – field surveys. Cheadle Center for Biodiversity and Ecological Restoration, University of California, Santa Barbara. Prepared for 30 CES/CEANC.

Swenson, R.O. 1999. The ecology, behavior, and conservation of the tidewater goby, *Eucyclogobius newberryi*. Environmental Biology of Fishes 55: 99-119.

Swift, C.C. 1999. Special-Status Fish Species Survey Report for San Antonio Creek, Vandenberg Air Force Base, California. Prepared for 30 CES/CEVPC, Vandenberg Air Force Base, California. 26 pp.

Swift, C.C., P. Duangsitti, C. Clemente, K. Hasserd, and L. Valle. 1997. Final Report Biology and Distribution of the Tidewater Goby, *Eucyclogobius newberryi*, on Vandenberg Space Force Base, Santa Barbara County, California. Department of Biology Loyola Marymount University, Los Angeles, California. 76 pp.

Swift, C.C., J.L. Nelson, C. Maslow, and T. Stein. 1989. Biology and distribution of the tidewater goby, *Eucyclogobius newberryi* (Pisces: Gobiidae) of California. Natural History Museum of Los Angeles County, No. 404.

Tatarian, P.J. 2008. Movement Patterns of California Red-legged Frogs (*Rana draytonii*) in an Inland California Environment. Herpetological Conservation and Biology 3(2): 155-169.

Tennessen, J.B., S.E. Parks, and T. Langkilde. 2014. Traffic noise causes physiological stress and impairs breeding migration behaviour in frogs. Conservation Physiology 2(1): cou032. Available at https://doi.org/10.1093/conphys/cou032.

Thiessen, G.J. 1958. Threshold of hearing of a ring-billed gull. The Journal of the Acoustical Society of America 30 (11): 1047.

Thometz, N.M., M.M. Staedler, J.A. Tomoleoni, J.L. Bodkin, G.B. Bentall, and M.T. Tinker. 2016. Trade-offs between energy maximization and parental care in a central place forager, the sea otter. Behavioral Ecology 27:552–1566.

Ting, C., J. Garrelick, and A. Bowles. 1997. An analysis of the response of sooty tern eggs to sonic boom overpressures. Prepared for the United States Air Force Research Laboratory. 7 pp.

Trenham, P.C., H.B. Shaffer, W.D. Koenig, and M.R. Stromberg. 2000. Life history demographic variation in the California tiger salamander (*Ambystoma californiense*). Copeia 2000: 365–377.

Troïanowski, M., N. Mondy, A. Dumet, C. Arcanjo, and T. Lengagne. 2017. Effects of traffic noise on tree frog stress levels, immunity, and color signaling. Conservation Biology 31(5): 1132–1140.

U.S. Air Force. 2021. Integrated Natural Resources Management Plan, Vandenberg Air Force Base.

U.S. Fish and Wildlife Service. 1983. Hawaiian dark-rumped petrel and Newell's manx shearwater recovery plan. February 1983. 61 pp.

U.S. Fish and Wildlife Service. 1985a. Revised Unarmored Threespine Stickleback Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 1985b. Recovery Plan for the California Least Tern, *Sterna antillarum brownii*. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 1996. California Condor Recovery Plan, Third Revision. Portland, Oregon: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 1997. Marbled Murrelet Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 1998. Draft Recovery Plan for the Least Bell's Vireo (*Vireo bellii pusillus*). . U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 2002a. Declining Amphibian Population Task Force's code of practice. Available: https://www.fws.gov/southwest/es/NewMexico/documents/SP/Declining _Amphibian_Task_Force_Fieldwork_Code_of_Practice.pdf.

U.S. Fish and Wildlife Service. 1999. Arroyo southwestern toad (*Bufo microscaphus californicus*) recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. vi + 119 pp.

U.S. Fish and Wildlife Service. 2001. Biological Opinion for tbc Evolved Expendable Launch Vehicle Program, Vandenberg Air force Base, Sanla Barbara Connty, California (1-8-99-F-27). Ventura Fish and Wildlife Office, Ventura, California.

U.S. Fish and Wildlife Service. 2002a. Recovery Plan for the California red-legged frog (*Rana aurora draytonii*). Portland, Oregon.

U.S. Fish and Wildlife Service. 2002b. Final Recovery Plan Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup. August 2002. 229 pp.

U.S. Fish and Wildlife Service. 2003. Final Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris nereis*). Portland, Oregon.

U.S. Fish and Wildlife Service. 2005. Recovery Plan for Tidewater Goby (*Eucyclogobius newberry*). Portland, Oregon.

U.S. Fish and Wildlife Service. 2006a. Biological Opinion for the Evolved Expendable Launch Vehicle (EELV) Program, Firebreak and Landscape Maintenance Project, Vandenberg Air Force Base, Santa Barbara County, California (1-8-06-F-18). Ventura Fish and Wildlife Office, Ventura, California.

U.S. Fish and Wildlife Service. 2006b. Reinitiation of Consultation on the Evolved Expendable Launch Vehicle (EELV) Program and Firebreak and Landscape Maintenance Project, Vandenberg Air

Force Base, Santa Barbara County, California (1-8-07-F-1R). Ventura Fish and Wildlife Office, Ventura, California.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). Sacramento, California.

U.S. Fish and Wildlife Service. 2008. Short-tailed Albatross Recovery Plan. Anchorage, AK, 105 pp.

U.S. Fish and Wildlife Service. 2009. Marbled Murrelet (*Brachyramphus marmoratus*) 5-Year Review. Lacy, Washington.

U.S. Fish and Wildlife Service. 2010. Biological Opinion for the Modification and Operation of Space Launch Complex 4 East for the Falcon 9 Space Vehicle Program at Vandenberg Air Force Base, Santa Barbara County, California (8-8-10-F-38). Ventura Fish and Wildlife Office, Ventura, California. 10 December 2010.

U.S. Fish and Wildlife Service. 2011. Reinitiation of the Biological Opinion for the Modification and Operation of Space Launch Complex 4 East for the Falcon 9 Space Vehicle Program at Vandenberg Air Force Base, Santa Barbara County, California (8-8-1 l-F-32R). Ventura Fish and Wildlife Office, Ventura, California. 24 June 2011.

U.S. Fish and Wildlife Service. 2014a. Biological Opinion for In-Flight Abort Test and Improvements to Space Launch Complex 4 West (SLC-4W), Vandenberg Air Force Base, Santa Barbara County, California (8-8-l4-F-41). Ventura Fish and Wildlife Office, Ventura, California. 22 December 2014.

U.S. Fish and Wildlife Service. 2014b. Concurrence letter for Space Launch Complex 4 East, Vandenberg Air Force Base, Santa Barbara County, California. Ventura Fish and Wildlife Office, Ventura, California. 29 August 2014.

U.S. Fish and Wildlife Service. 2014c. 2014 Summer Window Survey Results for Snowy Plovers on the U.S. Pacific Coast.

U.S. Fish and Wildlife Service. 2015a. Concurrence letter for SpaceX Boost-Back Landing Operations, Space Launch Complex 4 West, Vandenberg Air Force Base, Santa Barbara County, California. Ventura Fish and Wildlife Office, Ventura, California. 2 July 2015.

U.S. Fish and Wildlife Service. 2015a. Biological Opinion on the Beach Management Plan and Water Rescue Training at Vandenberg Air Force Base (2014-2018) (8-8-12-F-11R).

U.S. Fish and Wildlife Service. 2015b. Southern Sea Otter (*Enhydra lutris nereis*) 5-Year Review: Summary and Evaluation. Ventura, California: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 2016. Recovery plan for the Santa Barbara County Distinct Population Segment of the California tiger salamander (*Ambystoma californiense*). Ventura, California: U.S. Fish and Wildlife Service, Southwest Region.

U.S. Fish and Wildlife Service. 2017a. Biological Opinion on the Launch, Boost-Back and Landing of the Falcon 9 First Stage at SLC-4 at Vandenberg Air Force Base, Santa Barbara County, California (20 17-F-0480). 12 December 2017.

U.S. Fish and Wildlife Service. 2017b. California Condor Recovery Program. Retrieved from Our Programs Pacific Southwest Region: https://www.fws.gov/cno/es/CalCondor/Condor.cfm

U.S. Fish and Wildlife Service. 2017c. 2016 Summer Window Survey for Snowy Plovers on U.S. Pacific Coast with 2005-2016. Available at https://www.fws.gov/arcata/es/birds/WSP/plover.html.

U.S. Fish and Wildlife Service. 2018. Reinitiation of Programmatic Biological Opinion on Routine Mission Operations and Maintenance Activities, Vandenberg Air Force Base, Santa Barbara County, California, Vandenberg Air Force Base, Santa Barbara County, California (O8EVENOO-201 8-f-0664).

U.S. Fish and Wildlife Service. 2019. Amendment to the Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan. Pacific Region. 13 pp.

U.S. Fish and Wildlife Service. 2020. Short-tailed Albatross (Phoebastria albatrus) 5-Year Review: Summary and Evaluation.

U.S. Fish and Wildlife Service. 2022a. Vandenberg Space Force Base, SpaceX, change in launch number, personal communication (email) from Chris Diel (Ventura Field Office, USFWS) to Samantha Kaisersatt (CEIEA, VSFB). 13 October 2022.

U.S. Fish and Wildlife Service. 2022b. 5-year review. Short Form Summary. Hawaiian petrel (*Pterodroma sandwichensis*). 16 pp.

U.S. Fish and Wildlife Service. 2023a. 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).

U.S. Fish and Wildlife Service. 2024a. Biological Opinion on the Launch, Boost-Back, and Landing of the Falcon 9 First Stage at Space Launch Complex 4 (SLC-4) with project modification to include up to 16 additional launches between October 1 and December 31, 2024, Vandenberg Space Force Base, Santa Barbara County, California. Reference: 2022-0013990-S7-001-R001.

U.S. Fish and Wildlife Service. 2024b. Request to extend BO Coverage for SLC-4 Operations, personal communication (email) from Chris Diel (Ventura Field Office, USFWS) to Tiffany-Whitsitt-Odell (CEIEA, VSFB). 17 December 2024.

U.S. Fish and Wildlife Service. 2024c. Conference Opinion, Department of Defense's 7(a)(1) Conservation Strategy for the Monarch Butterfly (*Danaus plexippus*) for Mission and Sustainment Operations within the Continental United States. USFWS Reference: 2025-0024332. 10 December 2024.

U.S. Fish and Wildlife Service. 2024d. 2024 Snowy Plover Pacific Coast Winter and Breeding Window Survey. Available at: https://www.fws.gov/media/2024-snowy-plover-pacific-coast-winter-and-breeding-window-survey.

U.S. Fish and Wildlife Service. *In Prep*. Draft Conservation Strategy for California red-legged frog. Ventura Field Office.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook Procedures for Conducting Consultation and Conference Activities Under Section 7 of the ESA. U.S. Fish and Wildlife Service and National Marine Fisheries Service.

U. S. Geological Survey. 2006. USGS western pond turtle (*Emys marmorata*) trapping survey protocol for the southcoast ecoregion. U. S. Geological Survey protocol. San Diego, CA. 30 pp.

U.S. Geological Survey. 2025. Available at: https://earthquake.usgs.gov/earthquakes/map/

U.S. Geological Survey Western Ecological Resource Center. 2017. Annual California Sea Otter Census: 2017 Census Summary Shapefile. Retrieved 16 October 2020, from https://www.sciencebase.gov/catalog/item/5601b6dae4b03bc34f5445ec.

U.S. Geological Survey Western Ecological Resource Center. 2018. Annual California Sea Otter Census: 2018 Census Summary Shapefile. Retrieved 16 October 2020, from https://www.sciencebase.gov/catalog/item/5601b6dae4b03bc34f5445ec.

U.S. Geological Survey Western Ecological Resource Center. 2020. Annual California Sea Otter Census: 2019 Census Summary Shapefile. Retrieved 16 October 2020, from https://www.sciencebase.gov/catalog/item/5601b6dae4b03bc34f5445ec.

U.S. Space Force. 2024. Activities Pursuant to Biological Opinion 2017-F-0480 – Launch, Boost-back, and Landing of the Falcon 9 First Stage at Space Launch Complex-4 at Vandenberg Space Force Base, Santa Barbara County, California – 2023 Annual Report. 21 February 2024.

Ventana Wildlife Society. 2017. California Condor #760 aka "Voodoo". Retrieved 28 March 2017, from MYCONDOR.ORG: http://www.mycondor.org/condorprofiles/condor760.html.

Ventre, C.S., Myles, M.M., and I.L. Ver. 2002. Measurements of the Reflection Factor of Flat Ground Surfaces. Prepared for National Aeronautics and Space Administration, Cambridge Massachusetts.

Walthers, A.R., and C.A. Barber. 2020. Traffic noise as a potential stressor to offspring of an urban bird, the European Starling. Journal of Ornithology 161: 459-467.

Washington State Department of Transportation. 2012. Washington State Department of Transportation Biological Assessment Guidance. Olympia, WA: Washington State Department of Transportation.

Wever E.G. 1985. The amphibian ear. Princeton, NJ: Princeton University Press.

Wever, E.G., P.N. Herman, J.A. Simmons, and D.R. Hertzler. 1969. Hearing in the blackfooted penguin (*Spheniscus demersus*), as represented by the cochlear potentials. Proceedings of the National Academy of Sciences 63: 676–680.

Winant, T. 2025. Personal communication from Tom Winant (Straam Group) to John LaBonte (ManTech SRS Technologies, Inc.) and Brian Pownall (SpaceX) regarind interpretation of the Falcon 9 vibration monitoring results at VSFB reported in Straam Group 2025.

Wolfenden, A.D., H. Slabbekoorn, K. Kluk, and S.R. de Kort. 2019. Aircraft sound exposure leads to song frequency decline and elevated aggression in wild chiffchaffs. Journal of Applied Ecology 88:1720–1731.

Yeates, L.C., T.M. Williams, T.L. Fink. 2007. Diving and foraging energetics of the smallest marine mammal, the sea otter (*Enhydra lutris*). The Journal of Experimental Biology 210: 1960-1970.

Yorzinski, J.L., and F.S. Hermann. 2016. Noise pollution has limited effects on nocturnal vigilance in peahens. PeerJ 4:e2525; DOI 10.7717/peerj.2525.

Zollinger, S.A., A. Dorado-Correa, W. Goymann, W. Forstmeier, U. Knief, A.M. Bastidas-Urrutia, and H. Brumm. 2019. Traffic noise exposure depresses plasma corticosterone and delays offspring growth in breeding zebra finches. Conservation Physiology 7(1): coz056; doi:10.1093/conphys/coz056.

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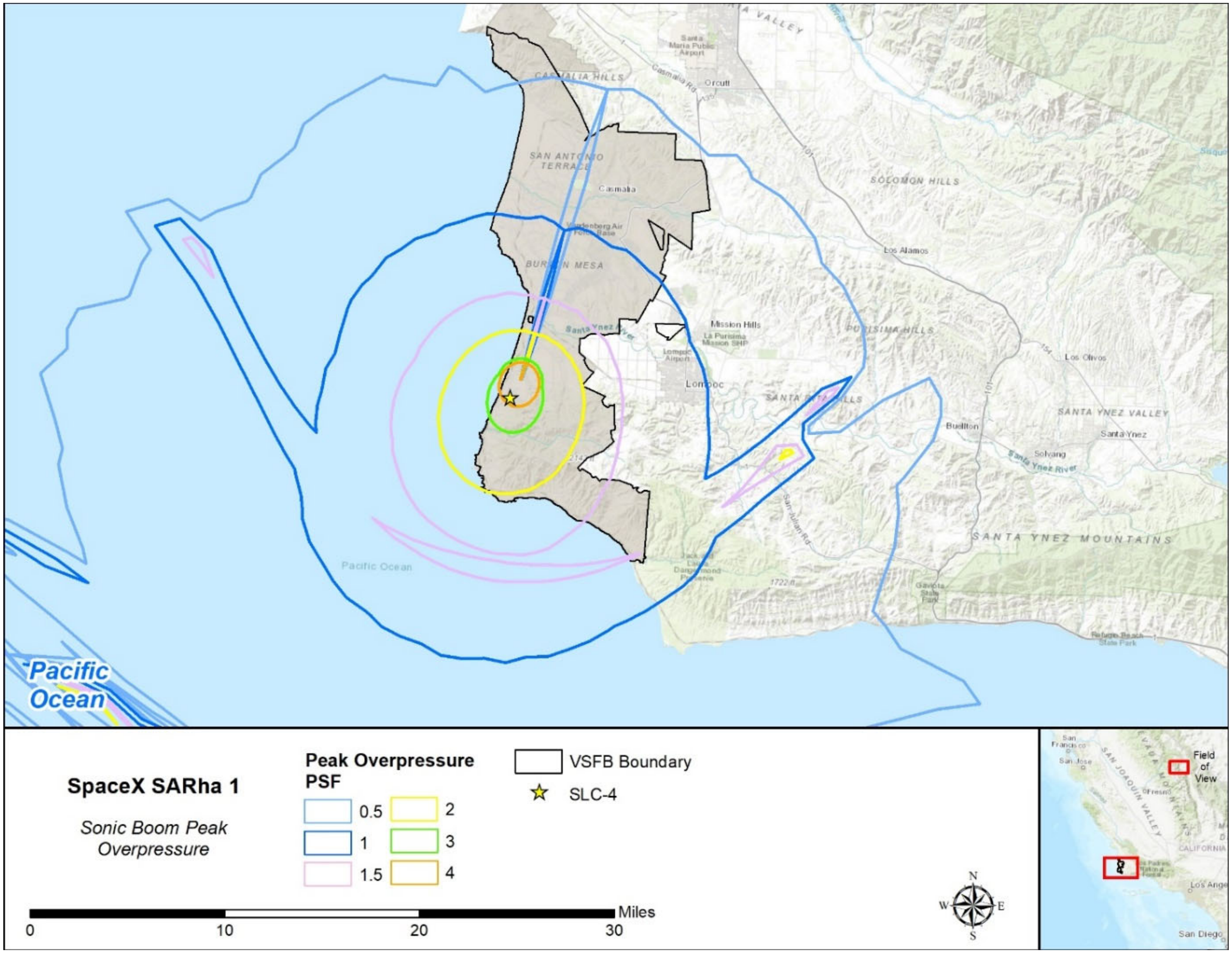
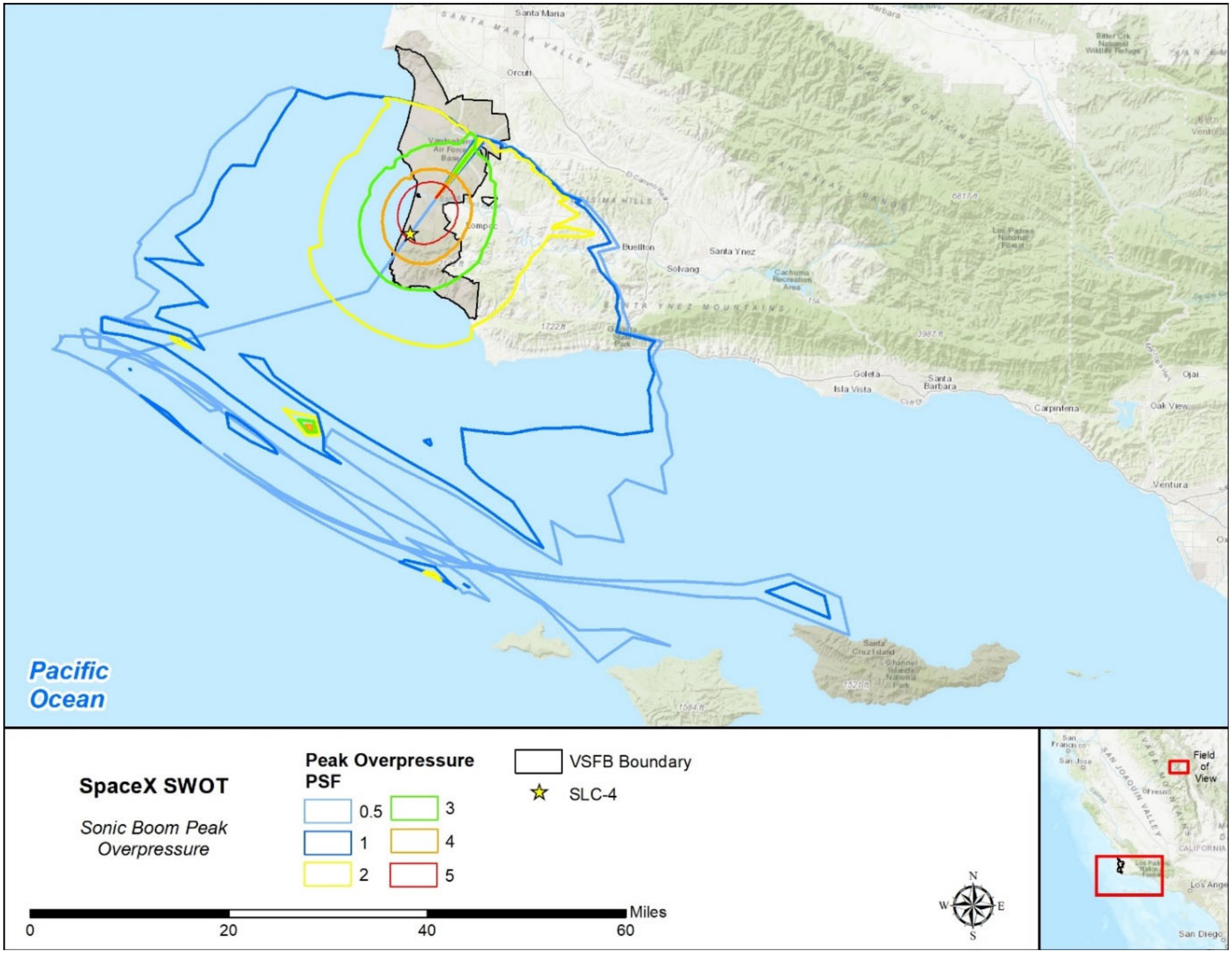
Years of Experience: 29

Appendix A – Examples of Falcon 9 First Stage SLC-4 Landing Sonic Boom Model Results

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Buellton
Santa Ynez
Solvang
Goleta
Isla Vista
Santa Barbara
Carpinteria
Ojai
Oak View
Ventura
Pacific Ocean
SpaceX SWOT
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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VSFB Boundary
SLC-4
Miles
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60
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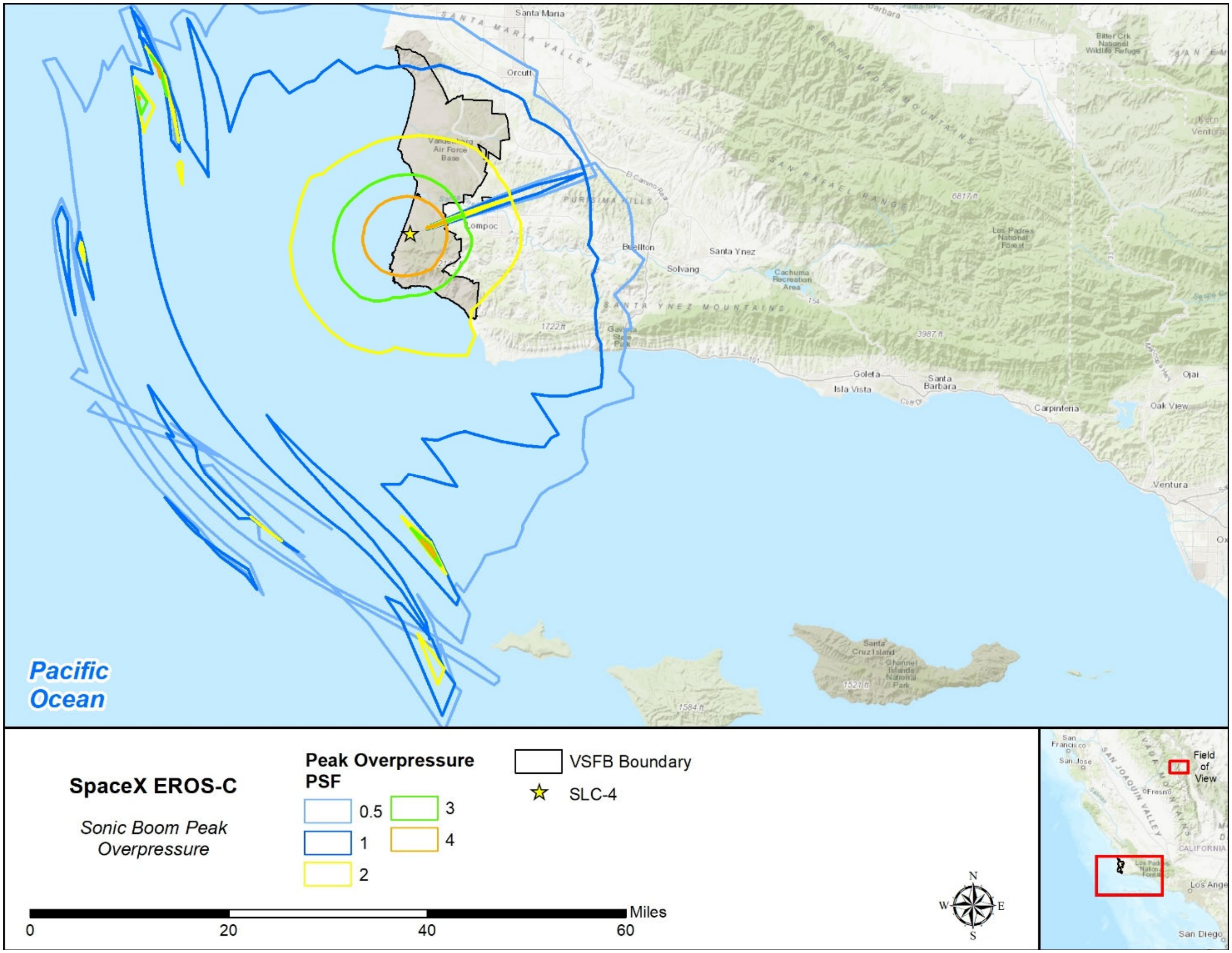
Field of View
San Diego



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Vandenberg Air Force Base
Lompoc
Buellton
Santa Ynez
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Goleta
Isla Vista
Santa Barbara
Carpinteria
Ventura
Ojai
Oak View
SANTA YNEZ MOUNTAINS
SAN RAFAEL RANGE
SPaceX EROS-C
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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VSFB Boundary
SLC-4
Miles
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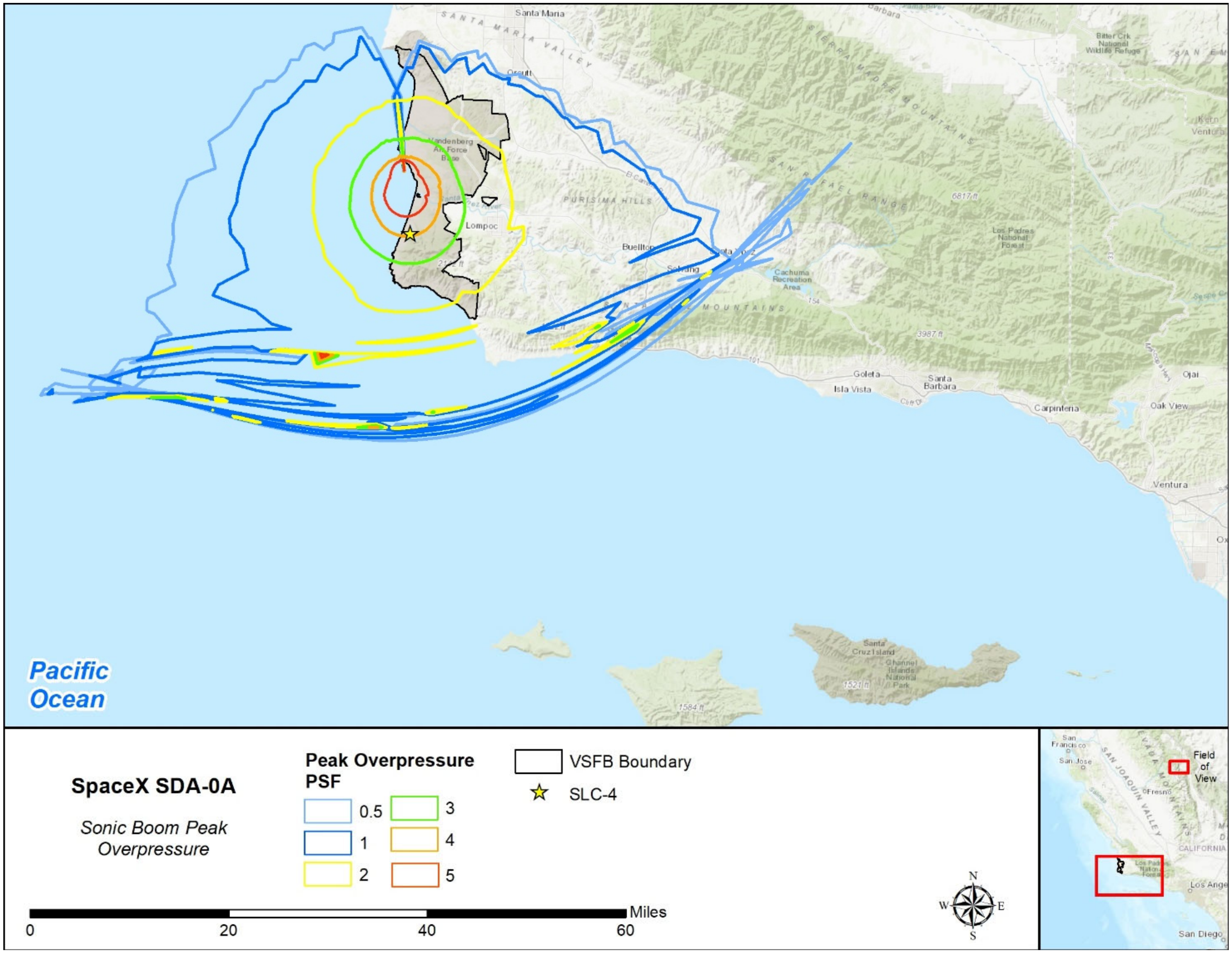
40
60
Field of View



Santa Maria
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Solvang
Goleta
Isla Vista
Santa Barbara
Carpinteria
Ojai
Oak View
Ventura
Pacific Ocean
SpaceX SDA-0A
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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VSFB Boundary
SLC-4
Miles
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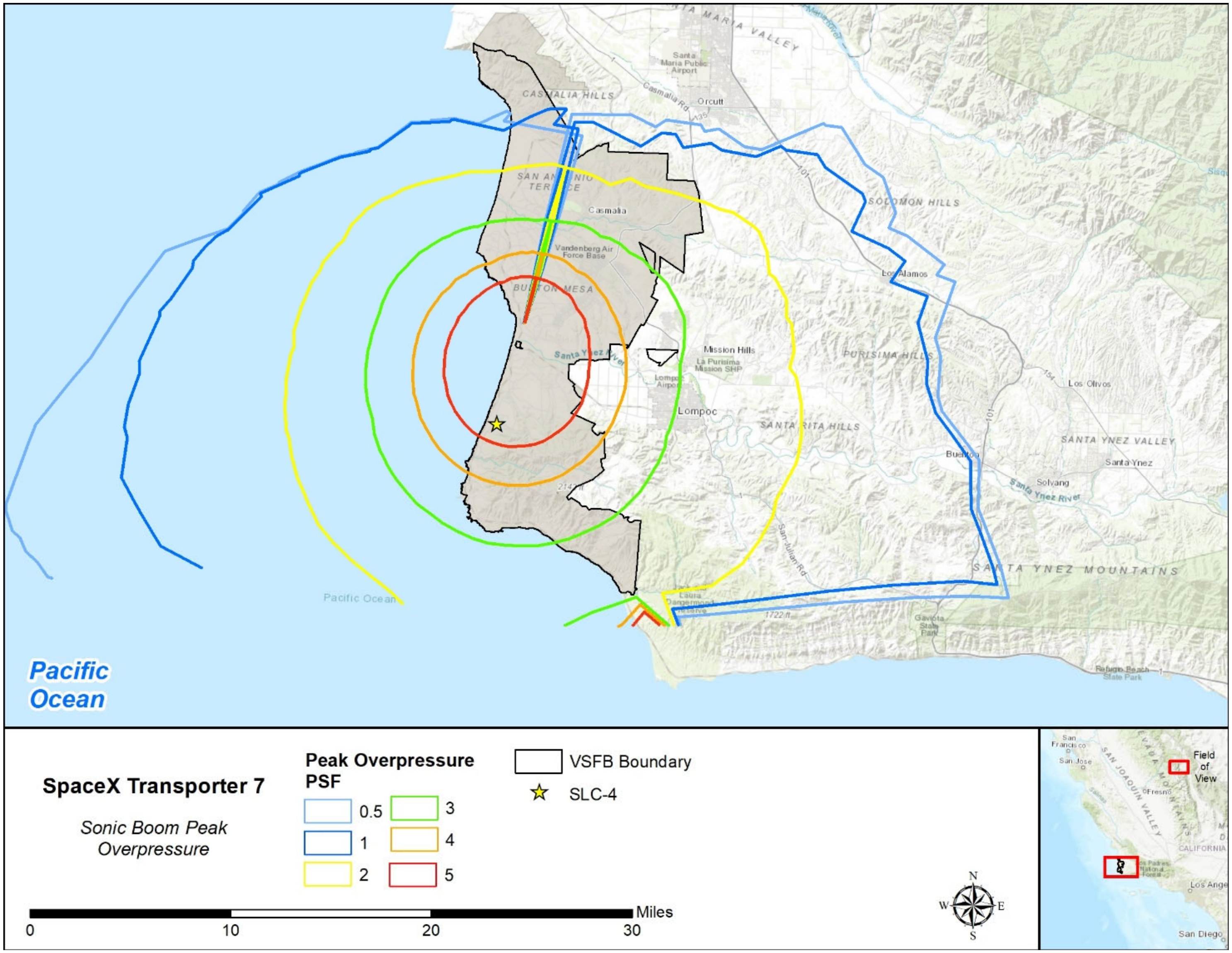
Field of View
San Diego


Pacific Ocean
SpaceX Transporter 7
Sonic Boom Peak Overpressure
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VSFB Boundary
SLC-4
Miles
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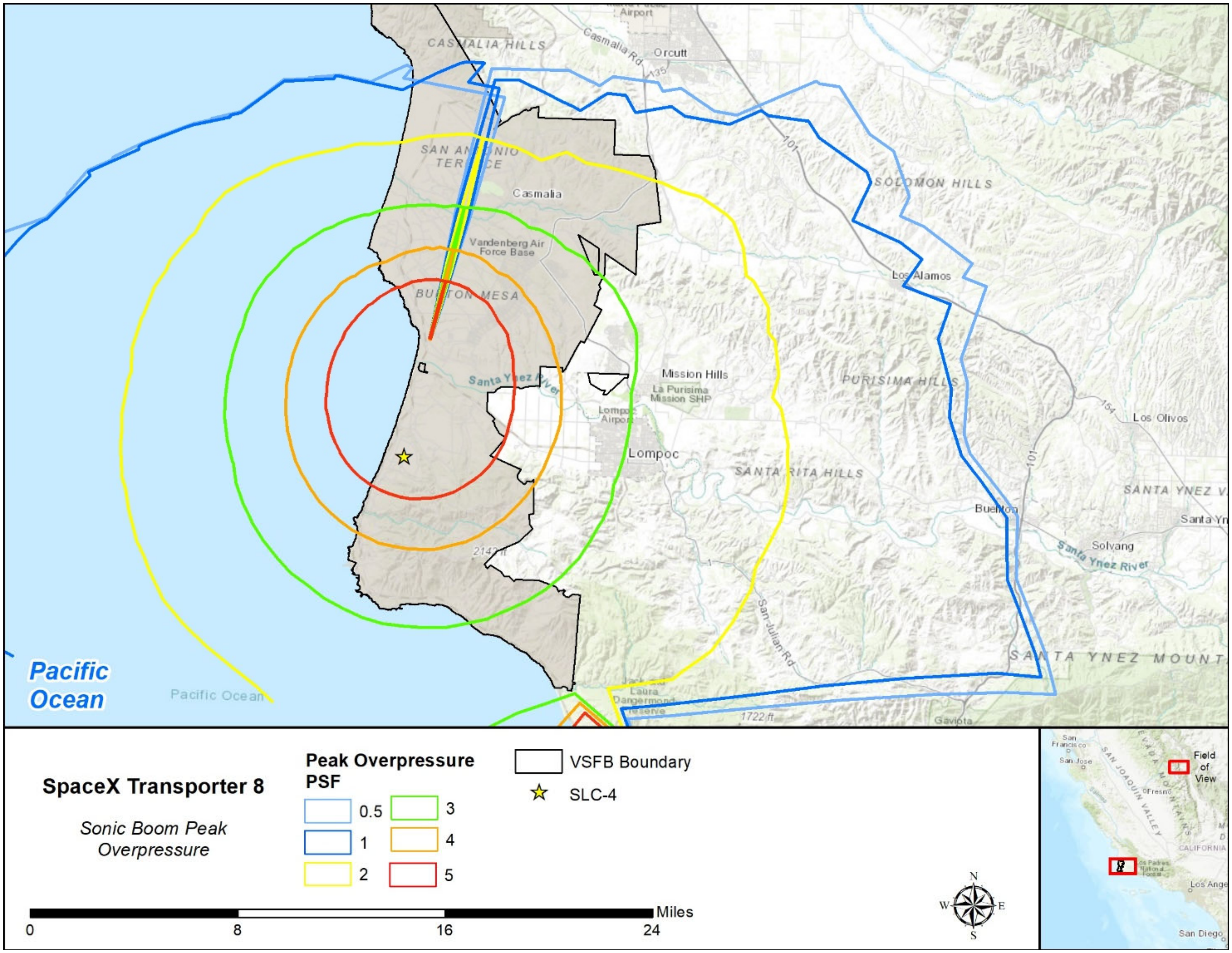
Pacific Ocean
Pacific Ocean
CASMALIA HILLS
Orcutt
SAN ANTONIO TERRACE
Casmalia
Vandenberg Air Force Base
BURTON MESA
SOLOMON HILLS
Los Alamos
Mission Hills
La Purisima Mission SHP
PURISIMA HILLS
Lompoc
SANTA RITA HILLS
Los Olivos
Buellton
Solvang
Santa Ynez River
Gaviota
SpaceX Transporter 8
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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VSFB Boundary
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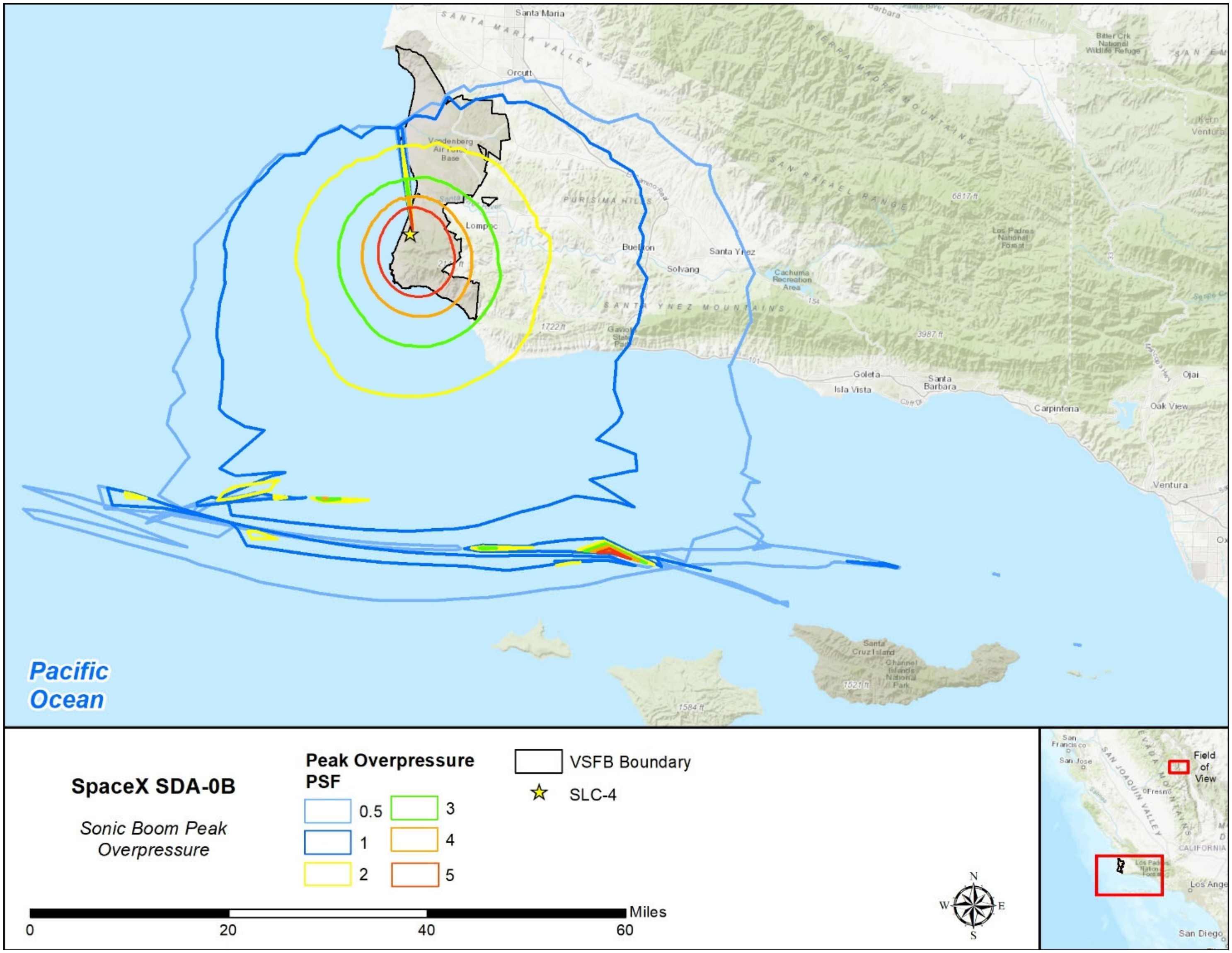
Miles
Field of View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Vandenberg Air Force Base
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Buellton
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Isla Vista
Santa Barbara
Carpinteria
Ojai
Oak View
Ventura
SpaceX SDA-0B
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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SLC-4
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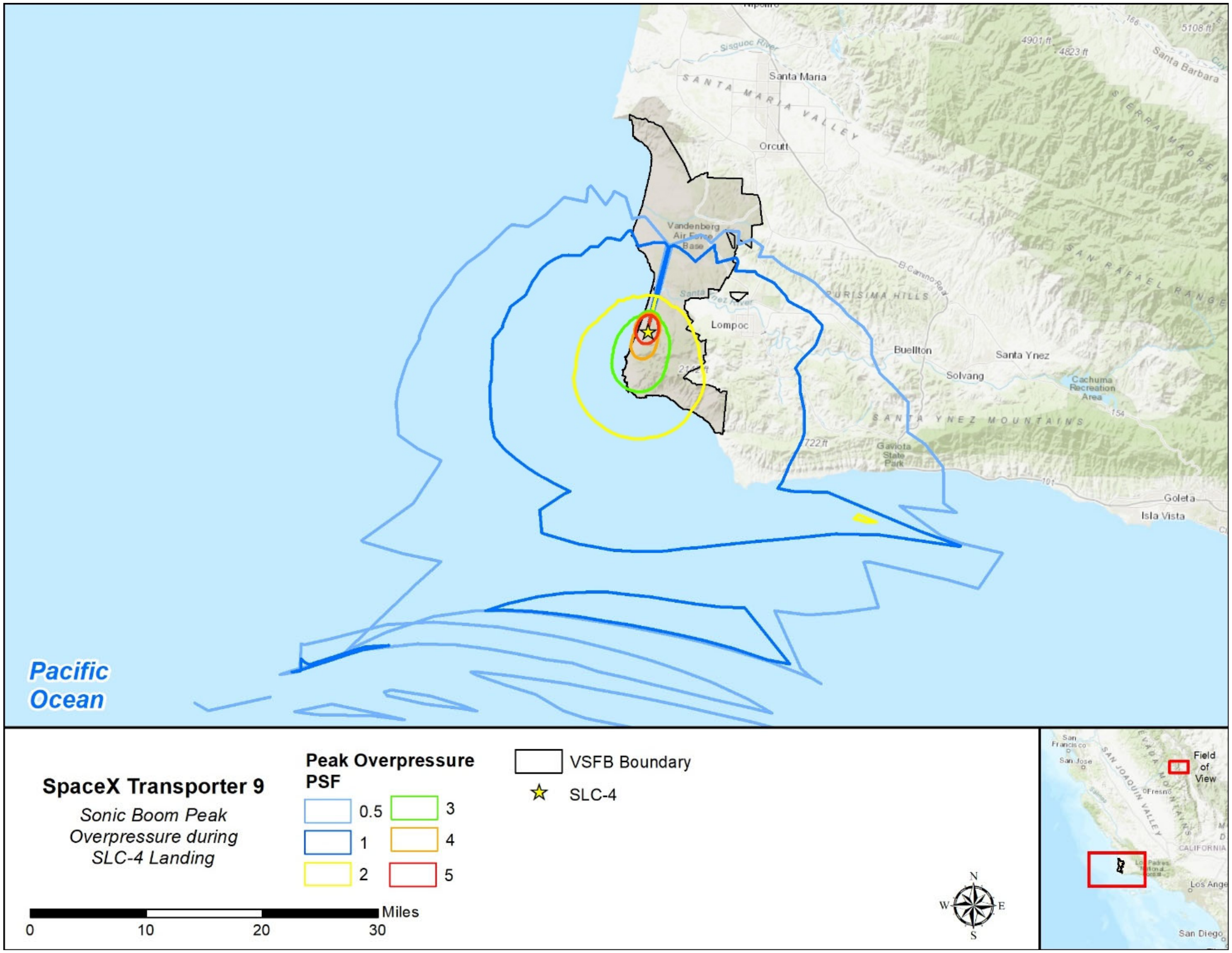
Miles
Field of View
San Diego



Pacific
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Santa Maria
Orcutt
Vandenberg Air Force Base
Lompoc
Buellton
Solvang
Santa Ynez
Goleta
Isla Vista
SPACEX Transporter 9
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
0.5
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VSFB Boundary
SLC-4
Miles
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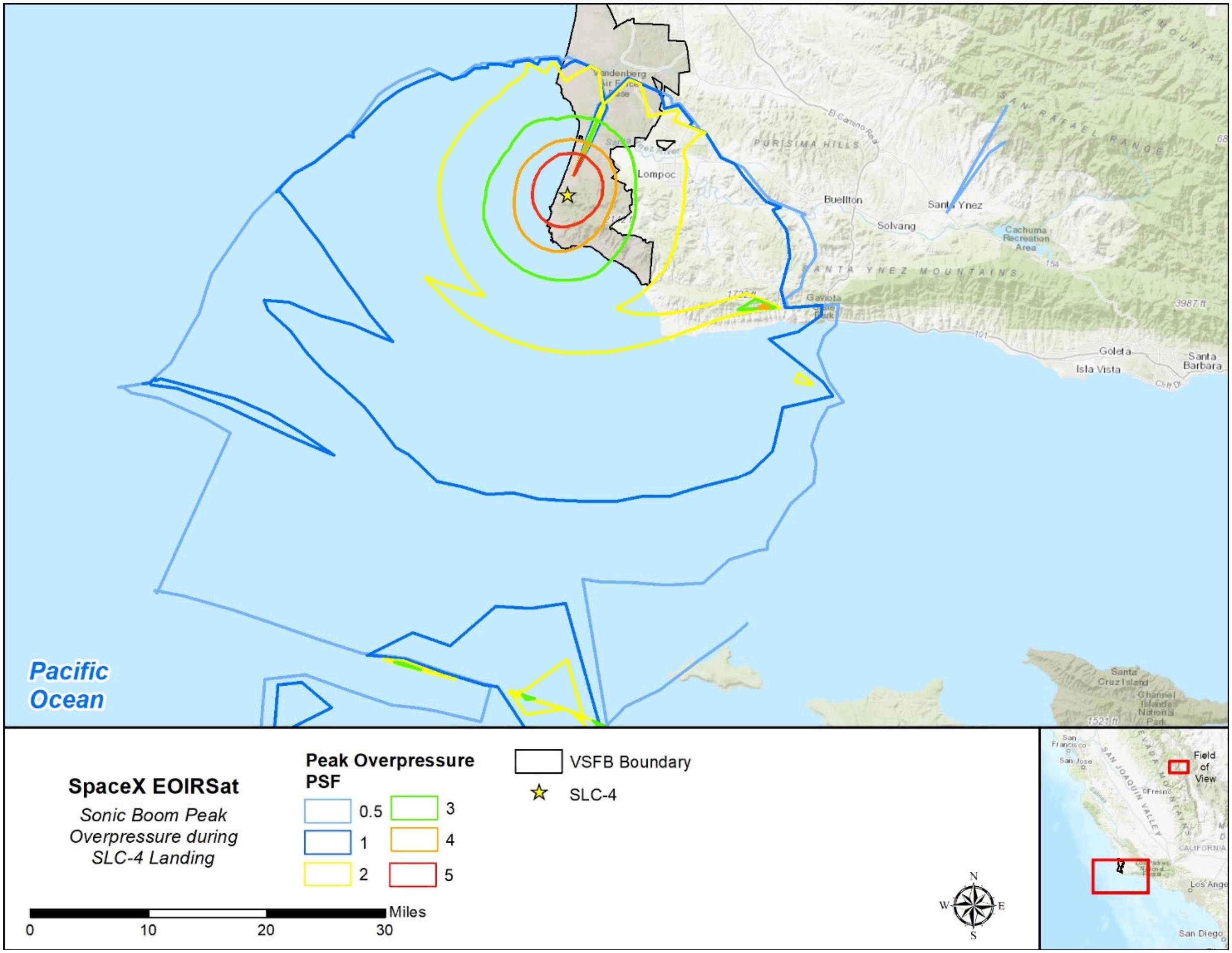
Field of View



Pacific Ocean
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Solvang
Santa Ynez
Goleta
Isla Vista
Santa Barbara
PURISIMA HILLS
SAN RAFAEL RANGE
SANTA YNEZ MOUNTAINS
Cachuma Recreation Area
Santa Cruz Island
Channel Islands National Park
SpaceX EOIRSat
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
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VSFB Boundary
SLC-4
Miles
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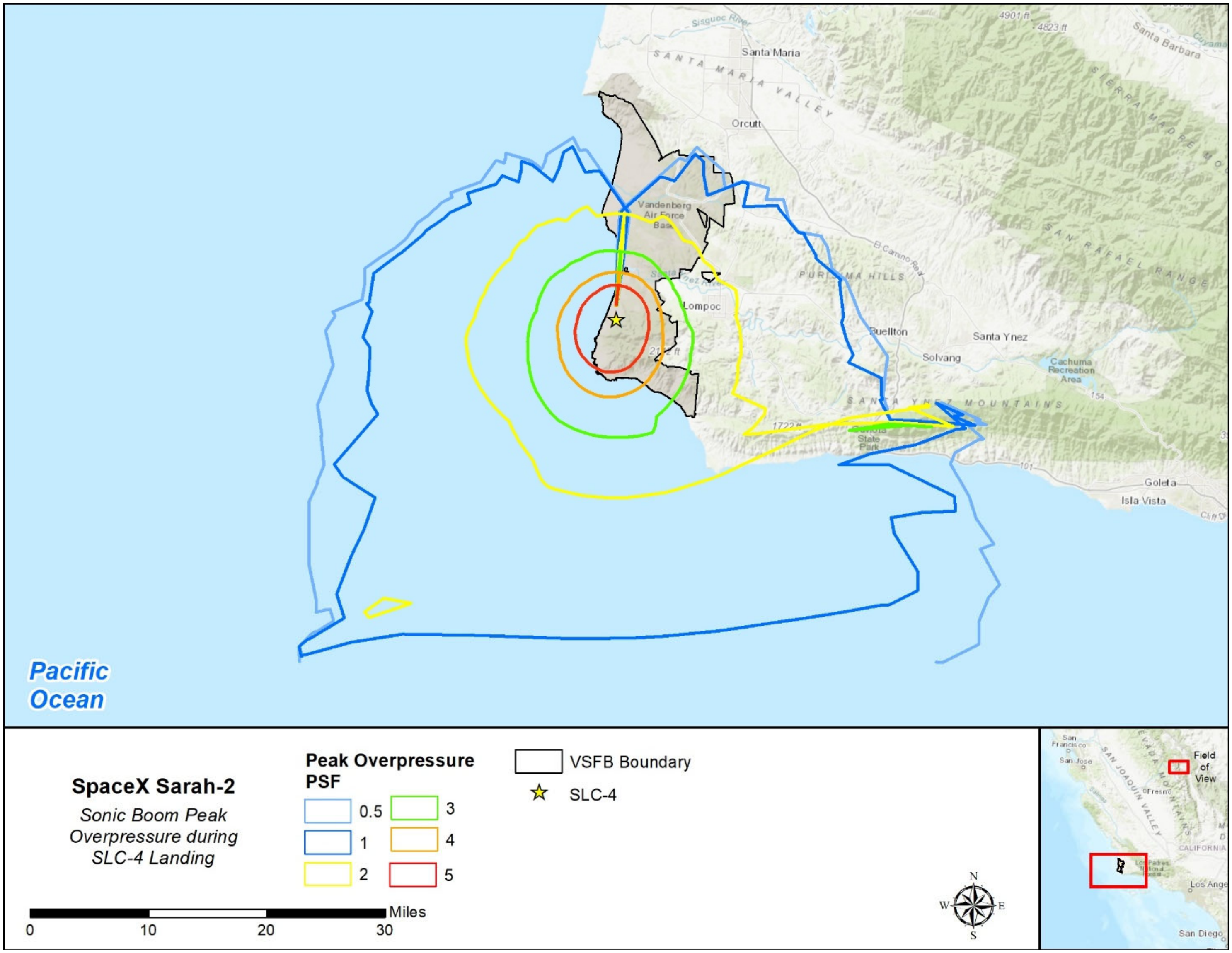
Field of View


Santa Maria
SANTA MARIA VALLEY
Orcutt
Vandenberg Air Force Base
Lompoc
PURISIMA HILLS
Buellton
Santa Ynez
Solvang
Cachuma Recreation Area
SANTA YNEZ MOUNTAINS
SAN RAFAEL RANGE
SIERRA MADRE
Santa Barbara
Goleta
Isla Vista
Pacific Ocean
SpaceX Sarah-2
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
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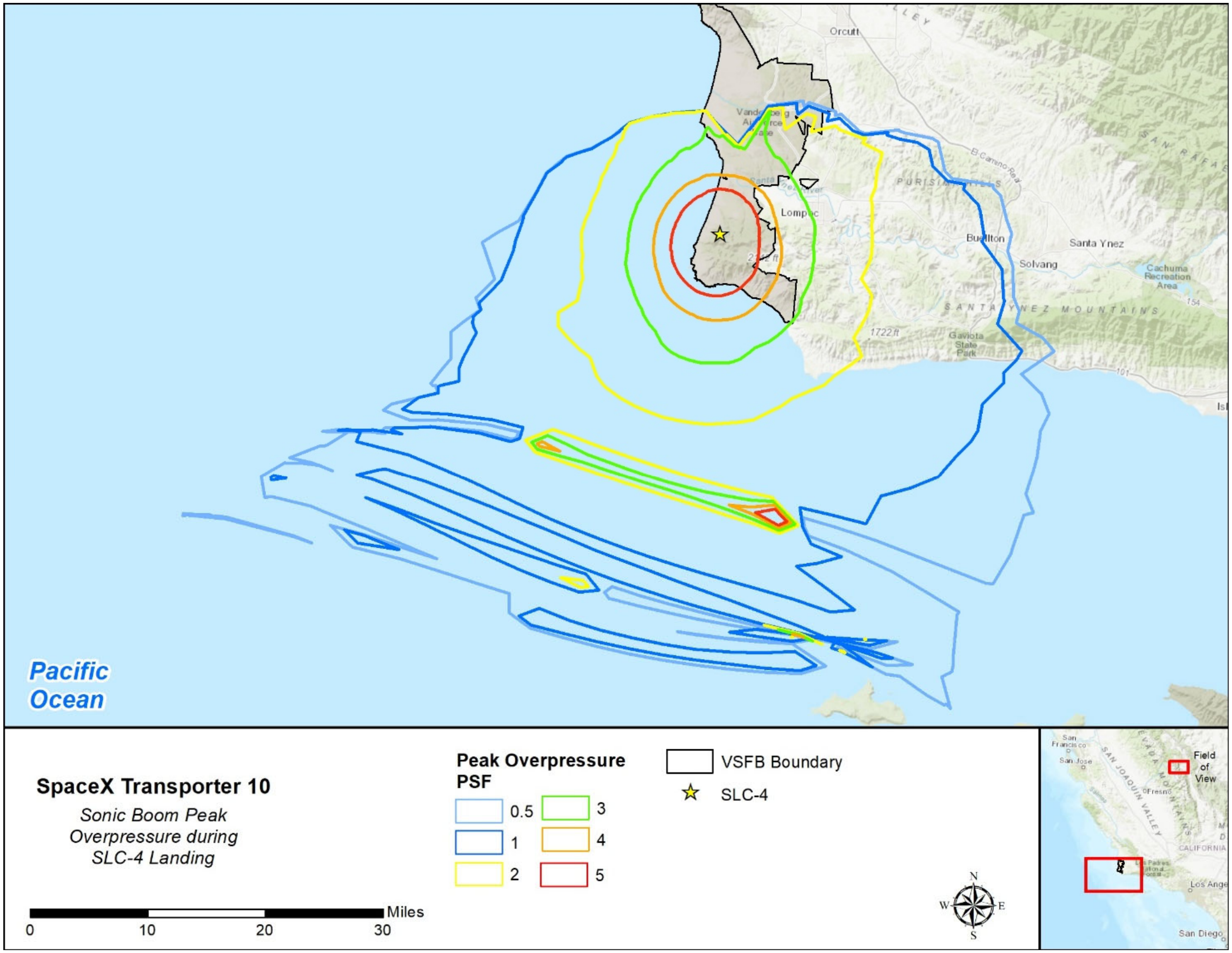
San Francisco
San Jose
Fresno
SAN JOAQUIN VALLEY
CALIFORNIA
Los Angeles
San Diego


Pacific
Ocean
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Sonic Boom Peak
Overpressure during
SLC-4 Landing
Peak Overpressure
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Solvang
Cachuma
Recreation
Area
SANTA YNEZ MOUNTAINS
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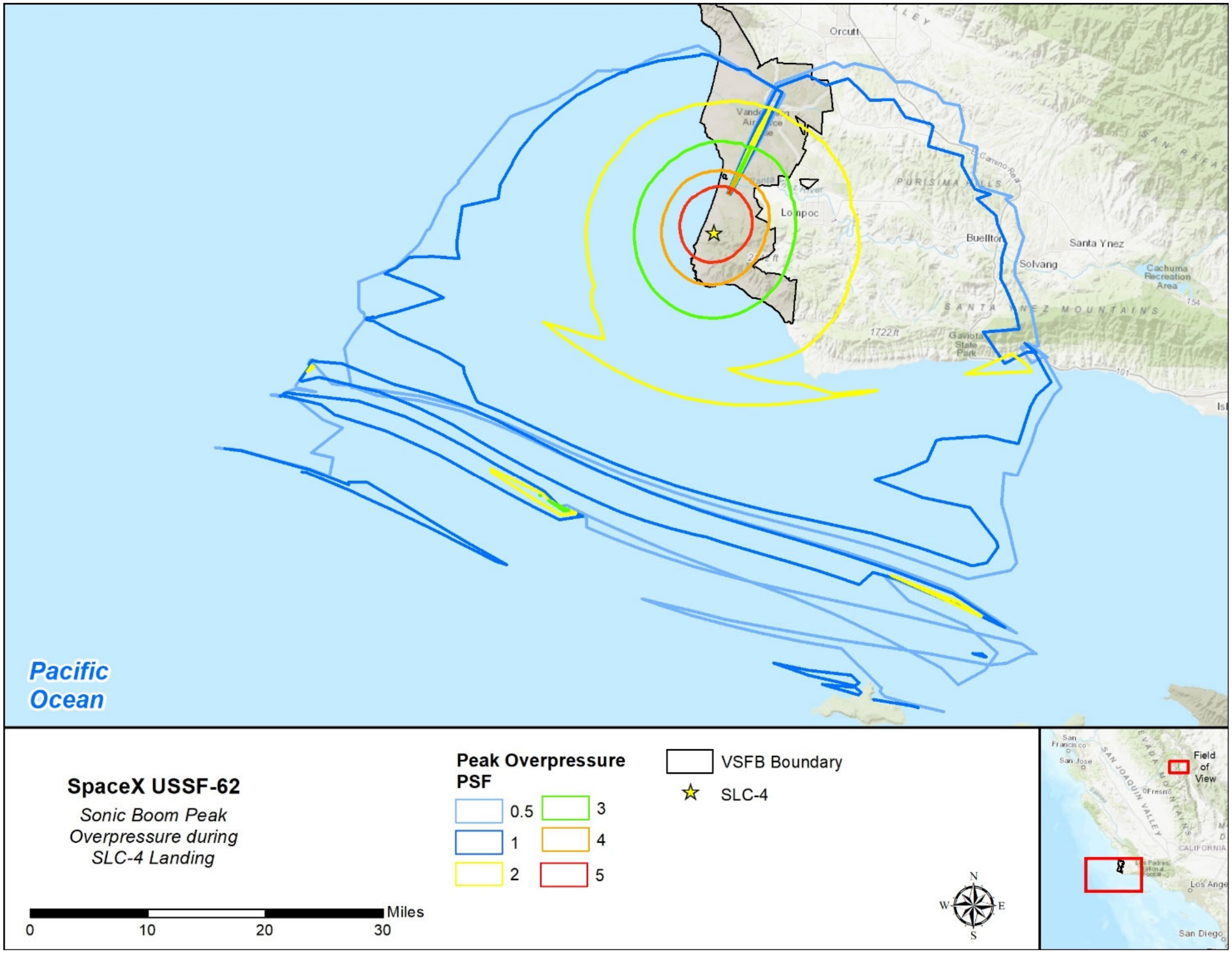
CALIFORNIA
Los Angeles
San Diego



Orcutt
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Buellton
Solvang
Santa Ynez
Cachuma Recreation Area
SANTA YNEZ MOUNTAINS
PURISIMA HILLS
Gaviota State Park
Pacific Ocean
SpaceX USSF-62
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
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VSFB Boundary
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Miles
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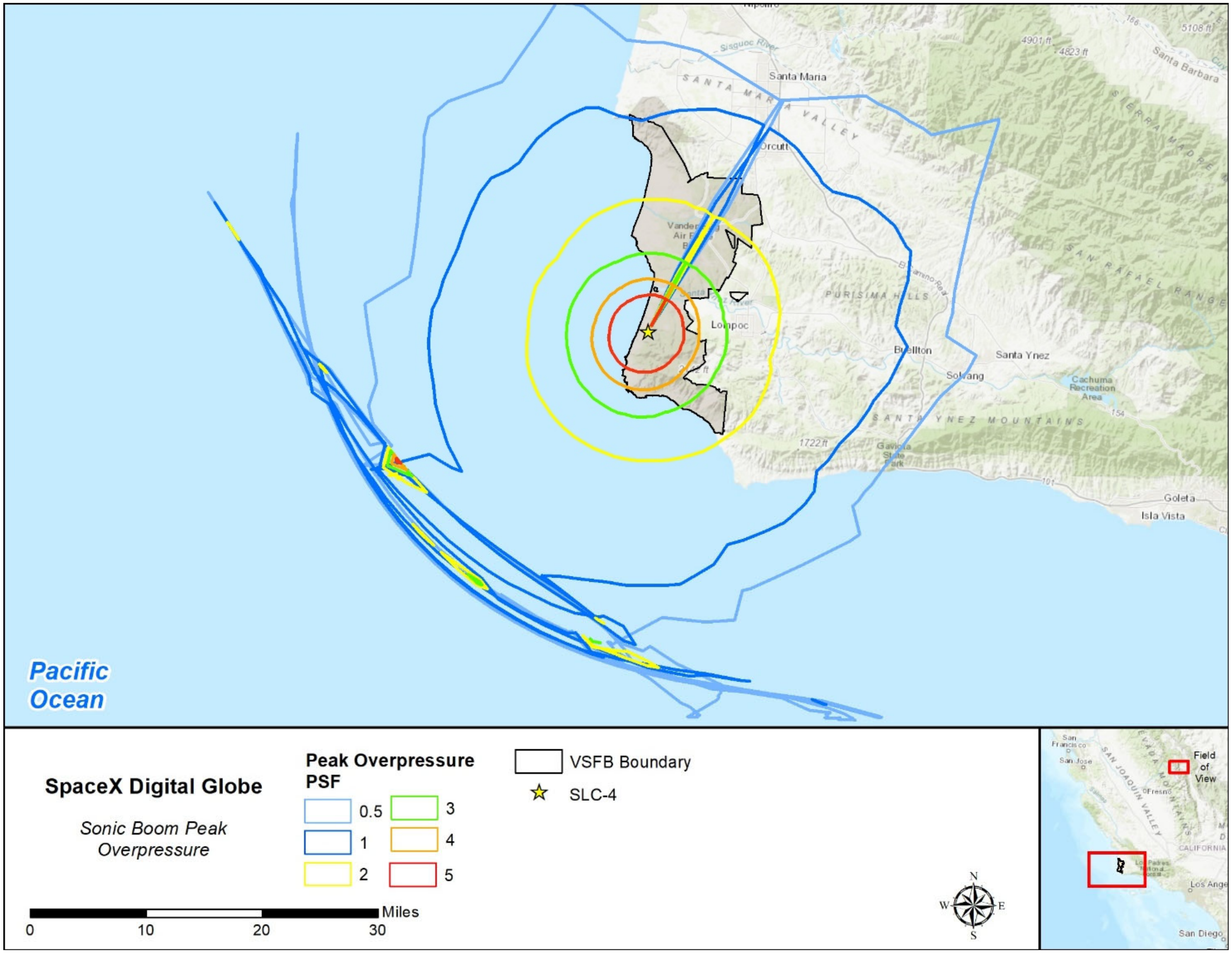
Field of View
San Francisco
San Jose
Fresno
SAN JOAQUIN VALLEY
CALIFORNIA
San Diego


Santa Maria
Orcutt
Lompoc
Buellton
Solvang
Santa Ynez
Goleta
Isla Vista
Pacific Ocean
SpaceX Digital Globe
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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VSFB Boundary
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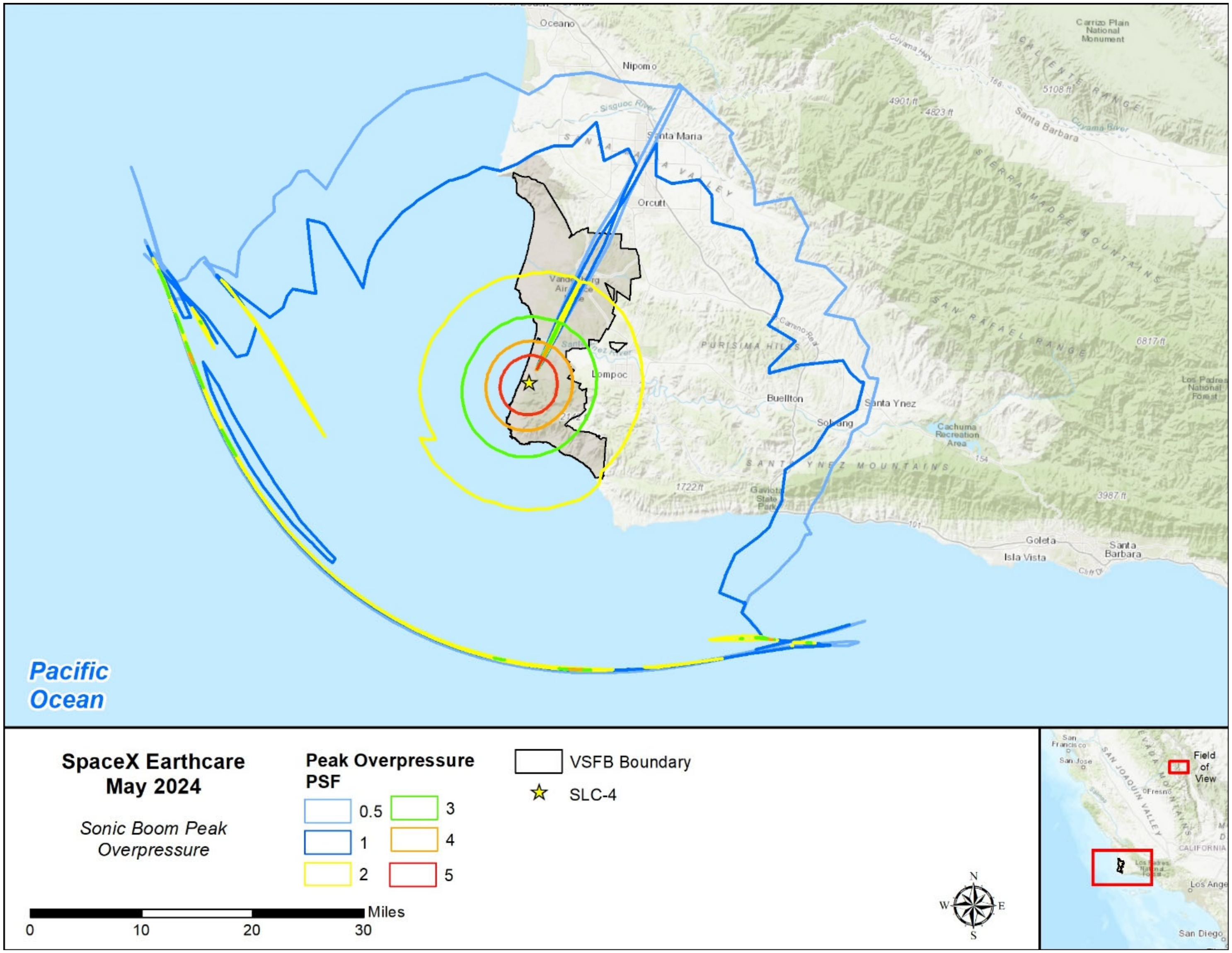
Miles
Field of View



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Isla Vista
Santa Barbara
Carrizo Plain National Monument
SpaceX Earthcare
May 2024
Sonic Boom Peak Overpressure
Peak Overpressure PSF
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VSFB Boundary
SLC-4
Miles
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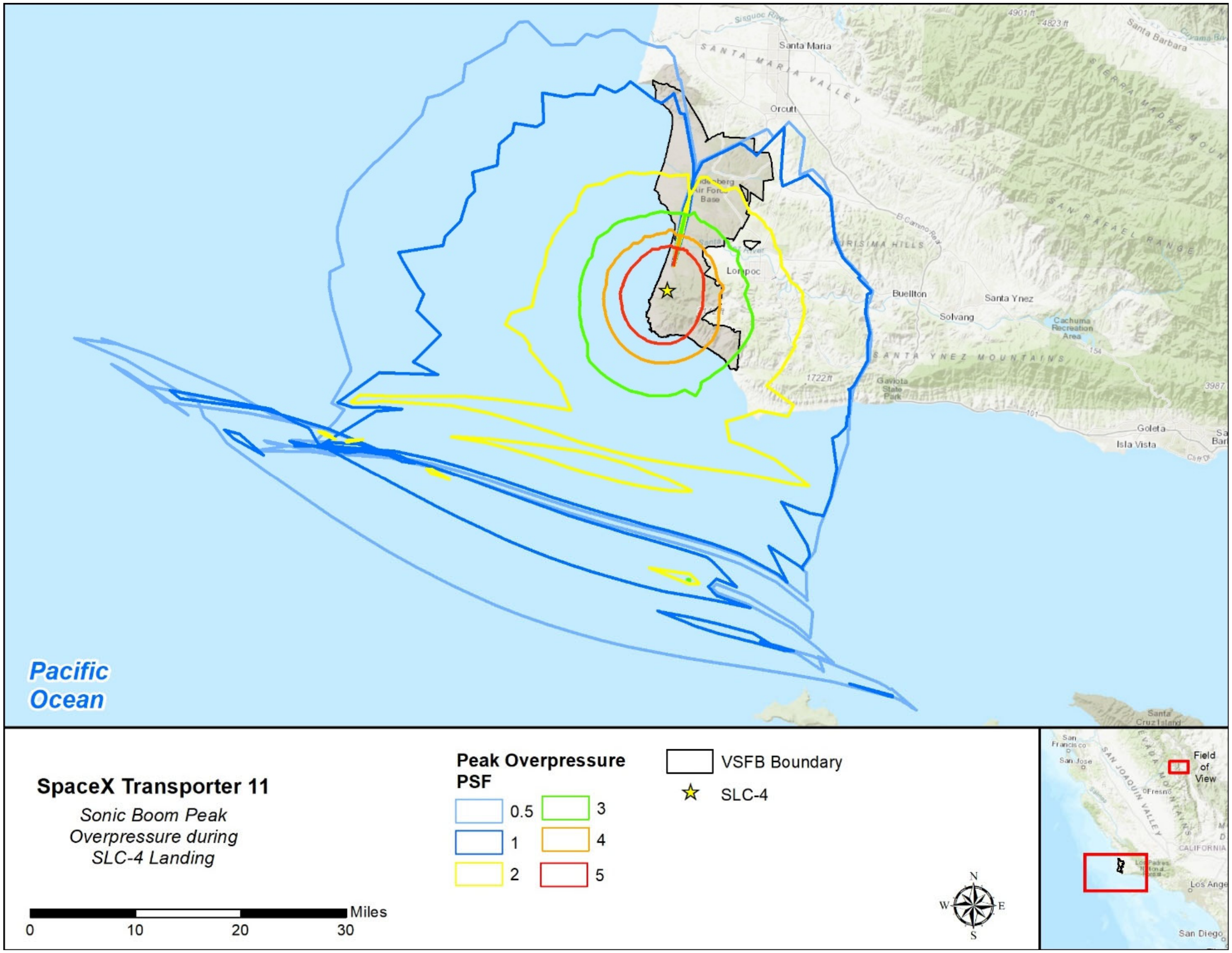
Field of View


Santa Maria
Santa Maria Valley
Orcutt
Lompoc
Buellton
Solvang
Santa Ynez
Santa Ynez Mountains
San Rafael Range
Sierra Madre Mountains
Purisima Hills
Goleta
Isla Vista
Santa Cruz Island
Pacific Ocean
SpaceX Transporter 11
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
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VSFB Boundary
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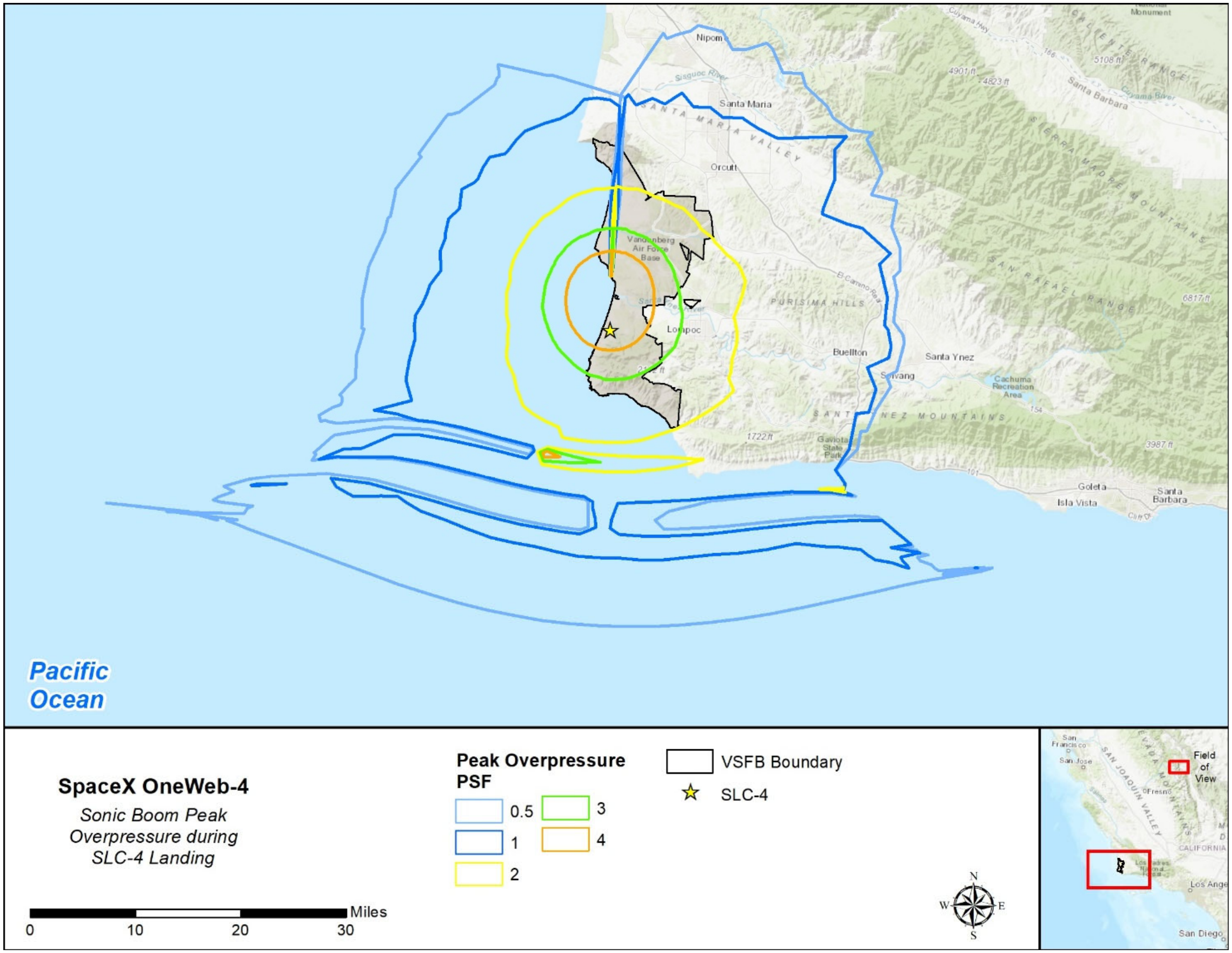
Field of View
San Francisco
San Jose
Fresno
San Joaquin Valley
California
Los Angeles
San Diego


Pacific Ocean
SpaceX OneWeb-4
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
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SLC-4
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Nipomo
Santa Maria
Santa Maria Valley
Orcutt
Vandenberg Air Force Base
Lompoc
Purisima Hills
Buellton
Solvang
Santa Ynez
Cachuma Recreation Area
Santa Ynez Mountains
Gaviota State Park
Goleta
Isla Vista
Santa Barbara
San Rafael Range
Sierra Madre Mountains
Field of View
San Francisco
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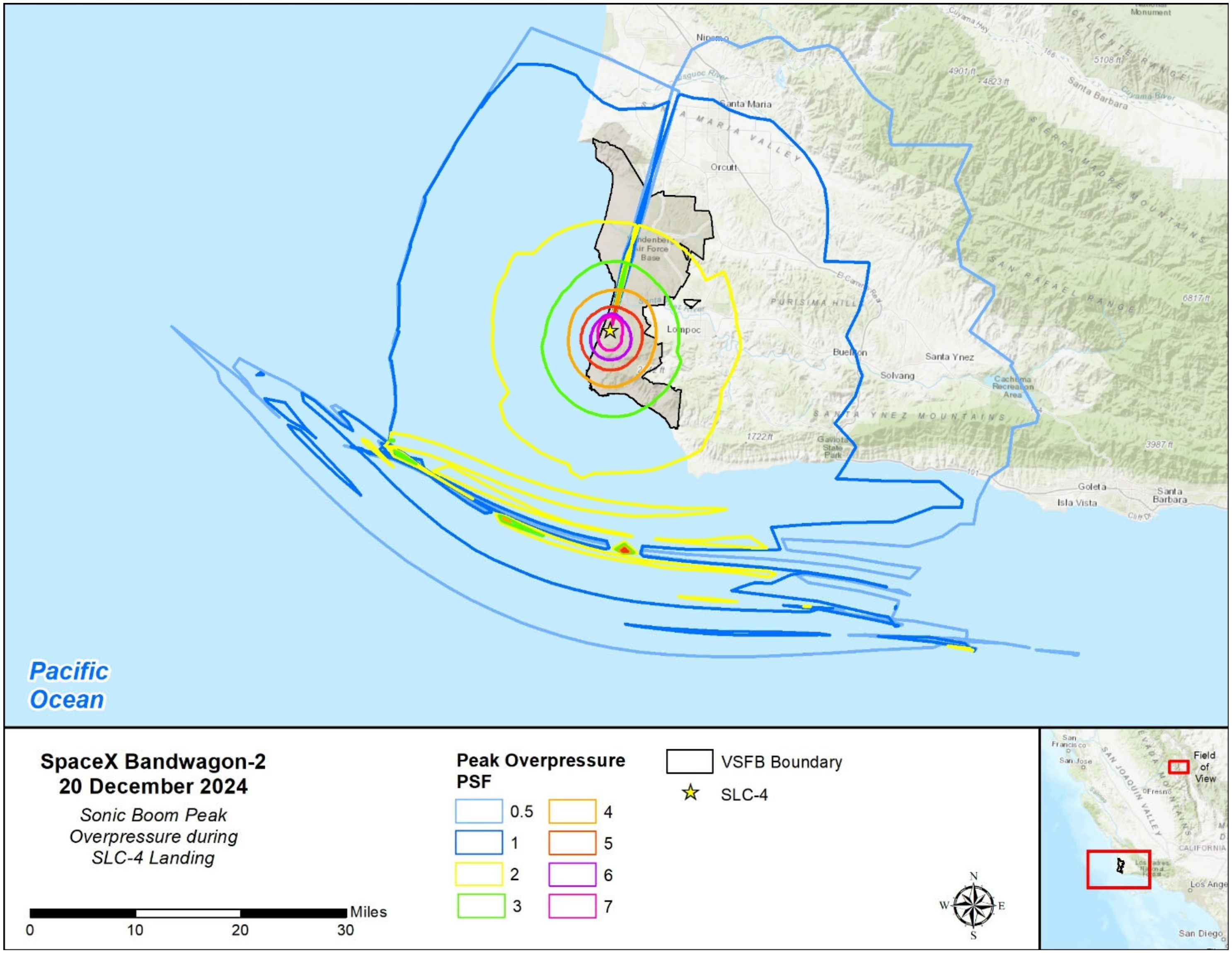
San Joaquin Valley
Fresno
California
Los Angeles
San Diego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Santa Maria
Orcutt
Lompoc
Buellton
Solvang
Santa Ynez
Goleta
Isla Vista
Santa Barbara
PURISIMA HILLS
SANTA YNEZ MOUNTAINS
Pacific Ocean
SpaceX Bandwagon-2
20 December 2024
Sonic Boom Peak Overpressure during SLC-4 Landing
Peak Overpressure PSF
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VSFB Boundary
SLC-4
Miles
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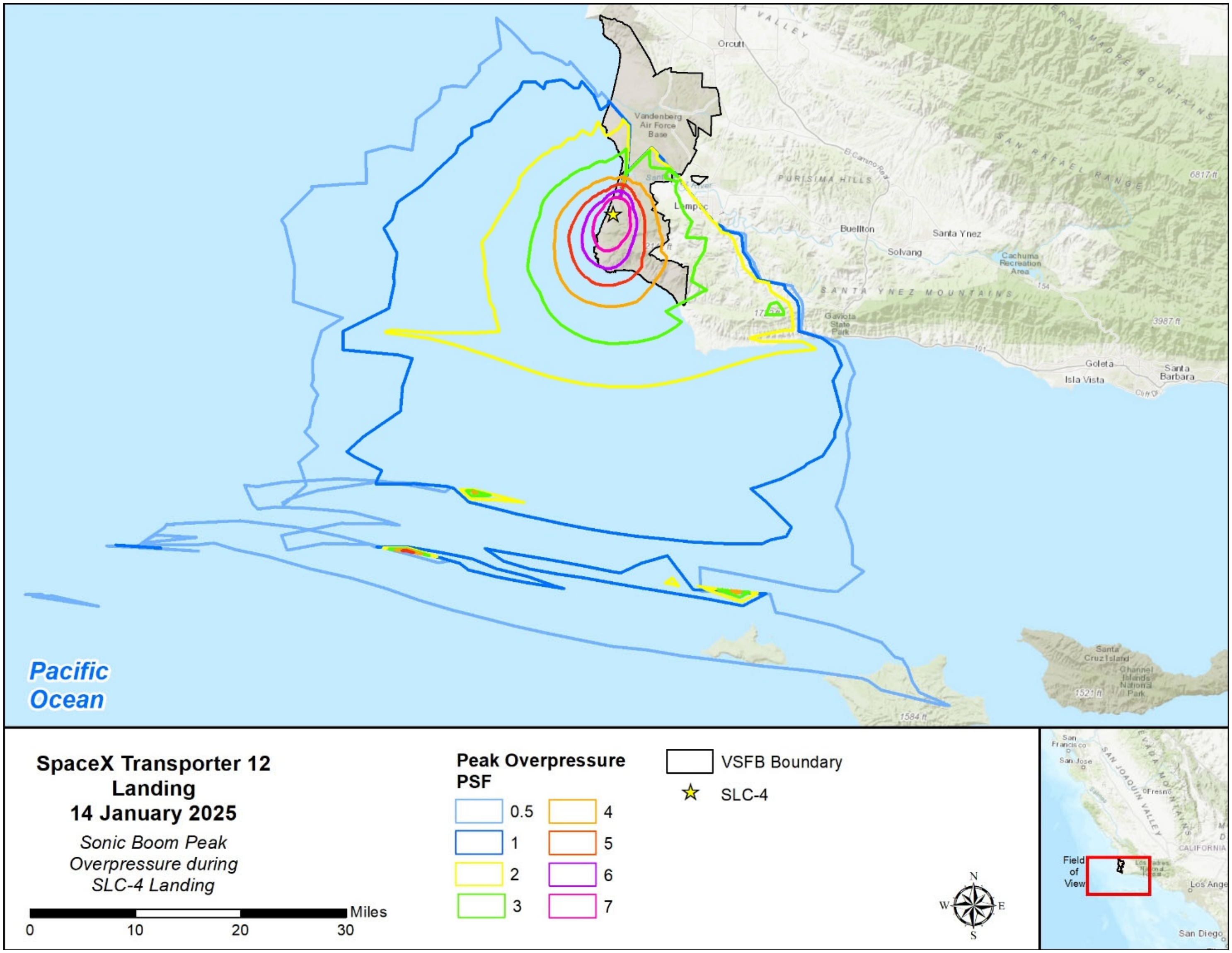
Field of View
San Diego



Orcutt
Vandenberg Air Force Base
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Buellton
Santa Ynez
Solvang
PURISIMA HILLS
SANTA YNEZ MOUNTAINS
SAN RAFAEL RANGE
Cachuma Recreation Area
Gaviota State Park
Goleta
Isla Vista
Santa Barbara
Santa Cruz Island
Channel Islands National Park
Pacific Ocean
SpaceX Transporter 12 Landing
14 January 2025
Sonic Boom Peak Overpressure during SLC-4 Landing
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Peak Overpressure PSF
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CALIFORNIA
Los Angeles
San Diego

Appendix B – Falcon 9 SLC-4 Noise Measurements through 21 January 2025

Date	Mission	Landing Location	Location	Latitude	Longitude	Launch Noise (dB; Lmax)	Modeled Launch Noise (dB; Lmax; RNoise)	Measured Launch Boom (psf)	Modeled Launch Boom (psf; mission-specific model predictions)	Measured Landing Noise (dB Lmax)	Modeled Landing Noise (dB; Lmax; RNoise)	Measured Landing Boom (psf)	Modeled Landing Boom (psf; PCBoom; mission-specific model predictions)
10/7/2018	SAOCOM	SLC-4W	Oil Well Canyon	34.556620	-120.625060					96.66	118	1.780	*
10/7/2018	SAOCOM	SLC-4W	Sudden Ranch	34.557320	-120.603600					99.5	108	0.710	*
12/3/2018	SSO-A	Droneship offshore of VSFB*	Oil Well Canyon	34.556620	-120.625060							0.0075	0.5-2
6/13/2019	Radarsat	SLC-4W	Honda Canyon	34.607531	-120.637075							2.866	1.5
6/13/2019	Radarsat	SLC-4W	Purisima Colony	34.751092	-120.626485							2.660	0.5-1
6/13/2019	Radarsat	SLC-4W	South Surf	34.666335	-120.609818							3.630	1-1.5
11/21/2020	Sentinel 6A	SLC-4W	Honda Canyon	34.607054	-120.632066							5.900	3-4
11/21/2020	Sentinel 6A	SLC-4W	Oil Well Canyon	34.556620	-120.625060							2.350	2-2.5
11/21/2020	Sentinel 6A	SLC-4W	Sudden Ranch	34.557320	-120.603600							1.760	2
9/13/2021	G2-1	Droneship	San Miguel Island: East Judith Cove	34.027127	-120.422979	ND	0	ND	4-6				
2/2/2022	NROL-87	SLC-4W	Honda Canyon	34.607054	-120.632066							2.420	3
2/2/2022	NROL-87	SLC-4W	Oil Well Canyon	34.556620	-120.625060							1.840	1.5-2
4/17/2022	NROL-85	SLC-4W	Oil Well Canyon	34.556620	-120.625060							1.290	1.5-2
4/17/2022	NROL-85	SLC-4W	South Surf	34.666335	-120.609818							1.950	2-3
5/13/2022	G4-13	Droneship	Santa Rosa Island: 1.0 mi East of Cow Canyon	34.020152	-120.115552	ND	0	1.58	0.5-5.0				
6/18/2022	Sarah-1	SLC-4W	Oil Well Canyon	34.556620	-120.625060							1.380	2
6/18/2022	Sarah-1	SLC-4W	Purisima Colony	34.751092	-120.626485							1.123	1-1.5
6/18/2022	Sarah-1	SLC-4W	South Surf	34.666335	-120.609818							2.573	3-4
12/16/2022	SWOT	SLC-4W	Honda Canyon	34.607531	-120.637075							4.700	4-5
12/16/2022	SWOT	SLC-4W	Oil Well Canyon	34.556418	-120.624948							2.540	3
12/16/2022	SWOT	SLC-4W	Sudden Ranch	34.557320	-120.603600							3.400	3
4/14/2023	Transporter 7	SLC-4W	Oil Well Canyon	34.556418	-120.624948	114.41	118			106.76	108	4.220	3-4
4/14/2023	Transporter 7	SLC-4W	South Surf	34.666335	-120.609818	118.82	122			113.77	110	4.270	5
4/27/2023	G3-5	Droneship	Oil Well Canyon	34.556418	-120.624948	110.47	118						
5/10/2023	G2-9	Droneship	Oil Well Canyon	34.556418	-120.624948	114.33	118						
5/10/2023	G2-9	Droneship	South Surf	34.666335	-120.609818	116.07	122						
5/20/2023	Iridium OneWeb	Droneship	Oil Well Canyon	34.556418	-120.624948	107.81	118						
5/20/2023	Iridium OneWeb	Droneship	South Surf	34.666335	-120.609818	110.58	122						
5/30/2023	G2-10	Droneship	Oil Well Canyon	34.556418	-120.624948	109.37	118						
5/30/2023	G2-10	Droneship	Purisima Colony	34.751092	-120.626485	105.57	112						
6/12/2023	Transporter 8	SLC-4W	Oil Well Canyon	34.556418	-120.624948	108.33	118					3.290	3-4
6/12/2023	Transporter 8	SLC-4W	Purisima Colony	34.751092	-120.626485	109.9	112					1.070	3-4
6/12/2023	Transporter 8	SLC-4W	Sudden Ranch	34.557320	-120.603600	108.24	116					2.700	3-4
6/22/2023	G5-7	Droneship	Oil Well Canyon	34.556418	-120.624948	110.24	118						
6/22/2023	G5-7	Droneship	Purisima Colony	34.751092	-120.626485	107.48	112						
6/22/2023	G5-7	Droneship	Santa Rosa Island: Carington Point	34.034970	-120.043351	ND	0	1.09	1.0				
6/22/2023	G5-7	Droneship	South Surf	34.666335	-120.609818	120.91	122						
7/7/2023	G5-13	Droneship	Oil Well Canyon	34.556418	-120.624948	118.16	118						
7/7/2023	G5-13	Droneship	South Surf	34.666335	-120.609818	117.65	122						
7/19/2023	G6-15	Droneship	Oil Well Canyon	34.556418	-120.624948	109.21	118						
7/19/2023	G6-15	Droneship	Purisima Colony	34.751092	-120.626485	96.95	112						
7/19/2023	G6-15	Droneship	South Surf	34.666335	-120.609818	112.83	122						
9/2/2023	sDA-0B	SLC-4W	Oil Well Canyon	34.556418	-120.624948	114.78	118					3.070	5
9/2/2023	sDA-0B	SLC-4W	Sudden Ranch	34.557320	-120.603600	111.88	116					2.430	2-4
11/11/2023	Transporter 9	SLC-4W	Oil Well Canyon	34.556418	-120.624948	124.2	118					3.000	3
11/11/2023	Transporter 9	SLC-4W	Sudden Ranch	34.557320	-120.603600	111.75	116					2.998	3
12/1/2023	EOIRsat	SLC-4W	Oil Well Canyon	34.556418	-120.624948	119.63	118					3.010	4
12/1/2023	EOIRsat	SLC-4W	Sudden Ranch	34.557320	-120.603600	117.91	116					2.900	4
12/24/2023	Sarah-2	SLC-4W	Oil Well Canyon	34.556418	-120.624948	113.79	118					4.170	4-5
12/24/2023	Sarah-2	SLC-4W	Sudden Ranch	34.557320	-120.603600	114.33	116					3.860	4-5
1/14/2024	G7-10	Droneship	Honda Canyon	34.606934	-120.634538	118.85	125						
1/14/2024	G7-10	Droneship	Oil Well Canyon	34.556418	-120.624948	115.11	118						
1/23/2024	G7-11	Droneship	Honda Canyon	34.606934	-120.634538	117.38	125						
1/23/2024	G7-11	Droneship	Oil Well Canyon	34.556418	-120.624948	112.4	118						
1/28/2024	G7-12	Droneship	Honda Canyon	34.606934	-120.634538	117.33	125						
1/28/2024	G7-12	Droneship	Oil Well Canyon	34.556418	-120.624948	115.14	118						
2/9/2024	G7-13	Droneship	Honda Canyon	34.606934	-120.634538	112.56	125						
2/9/2024	G7-13	Droneship	Oil Well Canyon	34.556418	-120.624948	109.89	118						
2/22/2024	G7-15	Droneship	Honda Canyon	34.606934	-120.634538	109.49	125						
2/22/2024	G7-15	Droneship	Oil Well Canyon	34.556418	-120.624948	104.47	118						
3/4/2024	Transporter 10	SLC-4W	Honda Canyon	34.606934	-120.634538	110.7	125			99.18	120	9.860	5
3/4/2024	Transporter 10	SLC-4W	Oil Well Canyon	34.556418	-120.624948	106.04	118			92.88	108	4.010	>5
3/4/2024	Transporter 10	SLC-4W	Sudden Ranch	34.557320	-120.603600	104.93	116			94.87	108	5.570	>5
3/10/2024	G7-17	Droneship	Honda Canyon	34.606934	-120.634538	115.14	125						
3/10/2024	G7-17	Droneship	Oil Well Canyon	34.556418	-120.624948	109.97	118						
4/1/2024	G7-18	Droneship	Honda Canyon	34.606934	-120.634538	116.76	125						
4/1/2024	G7-18	Droneship	Oil Well Canyon	34.556418	-120.624948	114.08	118						
4/6/2024	G8-1	Droneship	Honda Canyon	34.606934	-120.634538	127.940	125						
4/6/2024	G8-1	Droneship	Oil Well Canyon	34.556418	-120.624948	111.36	118						
4/6/2024	G8-1	Droneship	South Surf	34.666335	-120.609818	120.18	122						
4/11/2024	USSF-62	SLC-4W	Oil Well Canyon	34.556418	-120.624948	109.19	118					3.800	4
4/11/2024	USSF-62	SLC-4W	South Surf	34.666335	-120.609818	117.82	122					4.140	>5
4/11/2024	USSF-62	SLC-4W	Sudden Ranch	34.557320	-120.603600	106.08	116					0.920	4
5/2/2024	Digital Globe	SLC-4W	Honda Canyon	34.606934	-120.634538	113.57	125			106.11	120	4.250	5
5/2/2024	Digital Globe	SLC-4W	Oil Well Canyon	34.556418	-120.624948	110.27	118			95.85	108	2.020	3
5/2/2024	Digital Globe	SLC-4W	South Surf	34.666335	-120.609818	117.83	122			106.74	110	3.210	>5
5/2/2024	Digital Globe	SLC-4W	Sudden Ranch	34.557320	-120.603600	101.83	116			96.95	108	1.790	3-4
5/9/2024	G8-2	Droneship	Honda Canyon	34.606934	-120.634538	114.61	125						
5/9/2024	G8-2	Droneship	South Surf	34.666335	-120.609818	119.6	122						
5/14/2024	G8-7	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071	ND		ND	0-0.09				
5/14/2024	G8-7	Droneship	Ventura County: Emma Wood	34.309159	-119.355214	ND		0.334	0-0.99				
5/14/2024	G8-7	Droneship	Ventura County: NBVC Point Mugu	34.110103	-119.092295	ND		ND	0-0.24				
5/14/2024	G8-7	Droneship	Ventura County: Say Road	34.369222	-119.058719	ND		ND	0-0.49				
5/14/2024	G8-7	Droneship	Ventura County: Ventura Harbor	34.245665	-119.267678	ND		0.218	0-1.99				
5/28/2024	EarthCARE	SLC-4W	Honda Canyon	34.606934	-120.634538	114.5	125			107.52	120	5.320	5.25-5.5
5/28/2024	EarthCARE	SLC-4W	South Surf	34.666335	-120.609818	121.96	122			109.66	110	3.920	4-5
5/28/2024	EarthCARE	SLC-4W	Sudden Ranch	34.557320	-120.603600	103.31	116			98.42	108	2.760	3.5
6/8/2024	G8-8	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071	ND						ND	0-0.99
6/8/2024	G8-8	Droneship	Ventura County: Emma Wood	34.309159	-119.355214	ND						ND	0-0.09
6/8/2024	G8-8	Droneship	Ventura County: NBVC Point Mugu	34.110103	-119.092295	ND						ND	0-0.24
6/8/2024	G8-8	Droneship	Ventura County: Say Road	34.369222	-119.058719	ND						ND	0-0.49
6/8/2024	G8-8	Droneship	Ventura County: Ventura Harbor	34.245665	-119.267678	ND						ND	0-1.99
6/18/2024	G9-1	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071	ND						0.287	0-0.49
6/18/2024	G9-1	Droneship	Ventura County: Emma Wood	34.309159	-119.355214	ND						ND	0
6/18/2024	G9-1	Droneship	Ventura County: NBVC Point Mugu	34.110103	-119.092295	ND						ND	0-0.24
6/18/2024	G9-1	Droneship	Ventura County: Say Road	34.369222	-119.058719	ND						ND	0
6/18/2024	G9-1	Droneship	Ventura County: Ventura Harbor	34.245665	-119.267678	ND						0.289	
6/23/2024	G9-2	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071	ND						0.0067	0-0.49
6/23/2024	G9-2	Droneship	Ventura County: Emma Wood	34.309159	-119.355214	ND						0.015	0
6/23/2024	G9-2	Droneship	Ventura County: NBVC Point Mugu	34.110103	-119.092295	ND						0.038	0-0.24
6/23/2024	G9-2	Droneship	Ventura County: Say Road	34.369222	-119.058719	ND						0.013	0
6/23/2024	G9-2	Droneship	Ventura County: Ventura Harbor	34.245665	-119.267678	ND						0.078	0-0.99
6/28/2024	NROL-186	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071	ND						ND	0-1.99
6/28/2024	NROL-186	Droneship	Ventura County: Emma Wood	34.309159	-119.355214	ND						ND	0
6/28/2024	NROL-186	Droneship	Ventura County: NBVC Point Mugu	34.110103	-119.092295	ND						ND	0-0.99
6/28/2024	NROL-186	Droneship	Ventura County: Say Road	34.369222	-119.058719	ND						ND	0
6/28/2024	NROL-186	Droneship	Ventura County: Ventura Harbor	34.245665	-119.267678	ND						ND	0-0.99
7/11/2024	G9-3	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071	ND						ND	0
7/11/2024	G9-3	Droneship	Ventura County: Emma Wood	34.309159	-119.355214	ND						ND	0
7/11/2024	G9-3	Droneship	Ventura County: NBVC Point Mugu	34.110103	-119.092295	ND						ND	0-0.99
7/11/2024	G9-3	Droneship	Ventura County: Say Road	34.369222	-119.058719	ND						ND	0
7/11/2024	G9-3	Droneship	Ventura County: Ventura Harbor	34.245665	-119.267678	ND						ND	0
7/28/2024	G9-4	Droneship	Purisima Colony	34.751092	-120.626485	102.83	112						
7/28/2024	G9-4	Droneship	South Surf	34.666335	-120.609818	119.53	122						
8/16/2024	Transporter 11	SLC-4W	Sudden Ranch	34.557320	-120.603600	112.38	116			97.34	108	2.120	>5
10/19/2024	OneWeb-4	SLC-4W	South Surf	34.665461	-120.612528	116.03	122			108.07	110	3.170	>4
10/19/2024	OneWeb-4	SLC-4W	Sudden Ranch	34.557320	-120.603600	114.68	116			98.24	108	3.130	2.5-2.75
12/13/2024	G11-2	Droneship	SB County: Carpinteria Harbor Seal Sanctuary	34.385520	-119.505688			0.500	0.5-1.99				
12/13/2024	G11-2	Droneship	Ventura County: Emma Wood	34.309159	-119.355214			0.400	0.25-0.99				
12/13/2024	G11-2	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071			0.240	0.10-0.49				
12/13/2024	G11-2	Droneship	Ventura County: Bath Lane	34.264420	-119.273870			ND	0.10-0.49				
12/13/2024	G11-2	Droneship	Ventura County: Arnet Ave	34.283633	-119.223867			0.210	0.10-0.99				
12/17/2024	NROL-149	Droneship	SB County: Carpinteria Buffs Nature Preserve	34.386426	-119.501956			0.180	0.25-0.49				
12/17/2024	NROL-149	Droneship	Ventura County: Emma Wood	34.309159	-119.355214			ND	0.25-0.99				
12/17/2024	NROL-149	Droneship	Ventura County: Bath Lane	34.264420	-119.273870			0.160	0.00-0.49				
12/17/2024	NROL-149	Droneship	Ventura County: Arnet Ave	34.283633	-119.223867			ND	0.00-0.49				
12/17/2024	NROL-149	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071			ND	0.00-0.49				
12/21/2024	Bandwagon-2	SLC-4W	Sudden Ranch	34.557320	-120.603600	110.12	116			98.11	108	2.990	3.8-4.0
12/21/2024	Bandwagon-2	SLC-4W	South Surf	34.665461	-120.612528	119.32	122			106.95	110	3.720	5.0-6.0
12/28/2024	G11-3	Droneship	SB County: Carpinteria Buffs Nature Preserve	34.386426	-119.501956			ND	0.50-1.99				
12/28/2024	G11-3	Droneship	Ventura County: Emma Wood	34.309159	-119.355214			ND	0.25-1.99				
12/28/2024	G11-3	Droneship	Ventura County: Bath Lane	34.264420	-119.273870			0.750	0.00-0.99				
12/28/2024	G11-3	Droneship	Ventura County: Arnet Ave	34.283633	-119.223867			0.570	0.10-0.99				
12/28/2024	G11-3	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071			ND	0.00-0.99				
1/9/2025	NROL-153	Droneship	SB County: Carpinteria Buffs Nature Preserve	34.386426	-119.501956			0.180	0.25-2.49				
1/9/2025	NROL-153	Droneship	Ventura County: Emma Wood	34.309159	-119.355214			ND	0.25-1.99				
1/9/2025	NROL-153	Droneship	Ventura County: Bath Lane	34.264420	-119.273870			0.160	0.10-1.99				
1/9/2025	NROL-153	Droneship	Ventura County: Arnet Ave	34.283633	-119.223867			ND	0.10-0.99				
1/9/2025	NROL-153	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071			ND	0.10-0.49				
1/14/2025	Transporter 12	SLC-4W	Sudden Ranch	34.557320	-120.603600	109.45	116			88.58	108	3.530	5.0-6.0
1/14/2025	Transporter 12	SLC-4W	South Surf	34.665461	-120.612528	112.41	122			ND*	110	4.540	6.0-7.0
1/21/2025	G11-8	Droneship	SB County: Carpinteria Buffs Nature Preserve	34.386426	-119.501956			ND	0.50-0.99				
1/21/2025	G11-8	Droneship	Ventura County: Emma Wood	34.309159	-119.355214			0.450	0.25-0.99				
1/21/2025	G11-8	Droneship	Ventura County: Bath Lane	34.264420	-119.273870			0.240	0.10-0.99				
1/21/2025	G11-8	Droneship	Ventura County: Arnet Ave	34.283633	-119.223867			ND	0.10-0.99				
1/21/2025	G11-8	Droneship	Ventura County: Beverly Drive	34.206605	-119.191071			ND	0.10-0.49				
1/21/2025	G11-8	Droneship	Honda Canyon	34.606934	-120.634538	114.57	125						

IPaC **U.S. Fish & Wildlife Service**

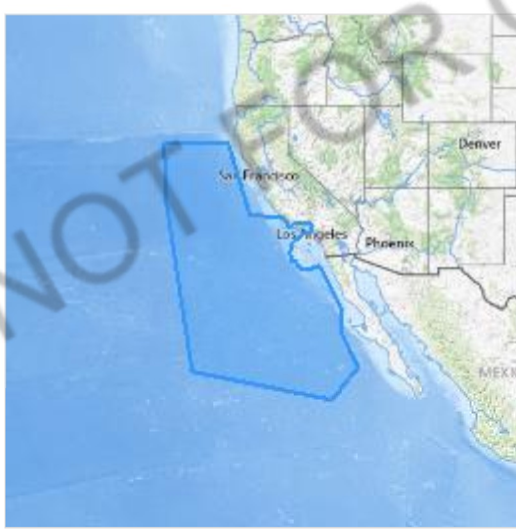
IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

California



Local offices

Arcata Fish And Wildlife Office

(707) 822-7201
(707) 822-8411

1655 Heindon Road
Arcata, CA 95521-4573

Carlsbad Fish And Wildlife Office

(760) 431-9440
(760) 431-5901

2177 Salk Avenue - Suite 250
Carlsbad, CA 92008-7385

Ventura Fish And Wildlife Office

(805) 644-1766
(805) 644-3958
FW8VenturaSection7@FWS.Gov

2493 Portola Road, Suite B
Ventura, CA 93003-7726

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Giant Kangaroo Rat Dipodomys ingens Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6051	Endangered
Southern Sea Otter Enhydra lutris nereis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8560	Threatened Marine mammal

Birds

NAME	STATUS
California Condor Gymnogyps californianus There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8193	Endangered
California Least Tern Sternula antillarum browni Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
California Ridgway"s Rail Rallus obsoletus obsoletus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4240	Endangered
California Spotted Owl Strix occidentalis occidentalis No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7266	Proposed Endangered

Coastal California Gnatcatcher Polioptila californica californica Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8178	Threatened
Hawaiian Petrel Pterodroma sandwichensis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6746	Endangered
Least Bell's Vireo Vireo bellii pusillus Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/5945	Endangered
Light-footed Ridgway"s Rail Rallus obsoletus levipes Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6035	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Short-tailed Albatross Phoebastria (=Diomedea) albatrus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/433	Endangered
Southwestern Willow Flycatcher Empidonax traillii extimus Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/6749	Endangered

Western Snowy Plover Charadrius nivosus nivosus — Threatened

There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/8035

Yellow-billed Cuckoo Coccyzus americanus — Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/3911

Reptiles

NAME	STATUS
Desert Tortoise Gopherus agassizii There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/4481	Threatened
Northwestern Pond Turtle Actinemys marmorata Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1111	Proposed Threatened
Southwestern Pond Turtle Actinemys pallida Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4768	Proposed Threatened

Amphibians

NAME	STATUS
Arroyo (=arroyo Southwestern) Toad Anaxyrus californicus Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/3762	Endangered

California Red-legged Frog Rana draytonii — Threatened
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/2891

California Tiger Salamander Ambystoma californiense — Endangered
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/2076

Foothill Yellow-legged Frog Rana boylii — Endangered
There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/5133

Western Spadefoot Spea hammondii — Proposed Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5425

Fishes

NAME	STATUS
Santa Ana Speckled Dace Rhinichthys gabrielino No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4124	Proposed Threatened
Santa Ana Sucker Catostomus santaanae There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/3785	Threatened
Tidewater Goby Eucyclogobius newberryi Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/57	Endangered

Unarmored Threespine Stickleback Gasterosteus aculeatus williamsoni Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7002	Endangered

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found There is **proposed** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/9743	Proposed Threatened

Crustaceans

NAME	STATUS
Riverside Fairy Shrimp Streptocephalus woottoni Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8148	Endangered
Vernal Pool Fairy Shrimp Branchinecta lynchi Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
Beach Layia Layia carnosa Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6728	Threatened

Braunton's Milk-vetch Astragalus brauntonii — Endangered
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/5674

California Jewelflower Caulanthus californicus — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4599

California Orcutt Grass Orcuttia californica — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4923

Coastal Dunes Milk-vetch Astragalus tener var. titi — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7675

Conejo Dudleya Dudleya abramsii ssp. parva — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4871

Contra Costa Goldfields Lasthenia conjugens — Endangered
Wherever found
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/7058

Gambel's Watercress Rorippa gambellii — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4201

Gaviota Tarplant Deinandra increscens ssp. villosa — Endangered
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/4218

Hoffmann's Rock-cress Arabis hoffmannii — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5909

Hoffmann's Slender-flowered Gilia Gilia tenuiflora ssp. hoffmannii — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/968

Island Barberry Berberis pinnata ssp. insularis — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5197

Island Malacothrix Malacothrix squalida — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/1211

Island Phacelia Phacelia insularis ssp. insularis — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/189

Island Rush-rose Helianthemum greenei — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6338

La Graciosa Thistle Cirsium loncholepis — Endangered
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/6547

Lompoc Yerba Santa Eriodictyon capitatum — Endangered
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/364

Lyon's Pentachaeta Pentachaeta lyonii — Endangered
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/4699

Marcescent Dudleya Dudleya cymosa ssp. marcescens — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7145

Marsh Sandwort Arenaria paludicola — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2229

Nevin's Barberry Berberis nevinii — Endangered
Wherever found
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/8025

Nipomo Mesa Lupine Lupinus nipomensis — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5480

Pismo Clarkia Clarkia speciosa ssp. immaculata — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5936

Salt Marsh Bird's-beak Cordylanthus maritimus ssp. maritimus — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6447

Santa Cruz Island Bush-mallow Malacothamnus fasciculatus var. nesioticus — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6152

Santa Cruz Island Fringepod Thysanocarpus conchuliferus — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7364

Santa Cruz Island Malacothrix Malacothrix indecora — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/3210

Santa Cruz Island Rockcress Sibara filifolia — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7424

Santa Monica Mountains Dudleyea Dudleya cymosa ssp. ovatifolia — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2538

Santa Rosa Island Manzanita Arctostaphylos confertiflora — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/563

Slender-horned Spineflower Dodecahema leptoceras — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4007

Soft-leaved Paintbrush Castilleja mollis — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5312

Southern Mountain Wild-buckwheat Eriogonum kennedyi var. austromontanum Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/7201	Threatened
Spreading Navarretia Navarretia fossalis Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/1334	Threatened
Ventura Marsh Milk-vetch Astragalus pycnostachyus var. lanosissimus Wherever found There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/1160	Endangered
Verity's Dudleya Dudleya verityi Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4342	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Arroyo (=arroyo Southwestern) Toad Anaxyrus californicus https://ecos.fws.gov/ecp/species/3762#crithab	Final
Braunton's Milk-vetch Astragalus brauntonii https://ecos.fws.gov/ecp/species/5674#crithab	Final
California Condor Gymnogyps californianus https://ecos.fws.gov/ecp/species/8193#crithab	Final

California Red-legged Frog Rana draytonii — Final
https://ecos.fws.gov/ecp/species/2891#crithab

California Tiger Salamander Ambystoma californiense — Final
https://ecos.fws.gov/ecp/species/2076#crithab

Coastal California Gnatcatcher Polioptila californica californica — Final
https://ecos.fws.gov/ecp/species/8178#crithab

Conservancy Fairy Shrimp Branchinecta conservatio — Final
For information on why this critical habitat appears for your project, even though Conservancy Fairy Shrimp is not on the list of potentially affected species at this location, contact the local field office.
https://ecos.fws.gov/ecp/species/8246#crithab

Gaviota Tarplant Deinandra increscens ssp. villosa — Final
https://ecos.fws.gov/ecp/species/4218#crithab

La Graciosa Thistle Cirsium loncholepis — Final
https://ecos.fws.gov/ecp/species/6547#crithab

Least Bell's Vireo Vireo bellii pusillus — Final
https://ecos.fws.gov/ecp/species/5945#crithab

Lompoc Yerba Santa Eriodictyon capitatum — Final
https://ecos.fws.gov/ecp/species/364#crithab

Lyon's Pentachaeta Pentachaeta lyonii — Final
https://ecos.fws.gov/ecp/species/4699#crithab

Monarch Butterfly Danaus plexippus — Proposed
https://ecos.fws.gov/ecp/species/9743#crithab

Riverside Fairy Shrimp Streptocephalus woottoni — Final
https://ecos.fws.gov/ecp/species/8148#crithab

Santa Ana Sucker Catostomus santaanae https://ecos.fws.gov/ecp/species/3785#crithab	Final
Southwestern Willow Flycatcher Empidonax traillii extimus https://ecos.fws.gov/ecp/species/6749#crithab	Final
Spreading Navarretia Navarretia fossalis https://ecos.fws.gov/ecp/species/1334#crithab	Final
Tidewater Goby Eucyclogobius newberryi https://ecos.fws.gov/ecp/species/57#crithab	Final
Vandenberg Monkeyflower Diplacus vandenbergensis For information on why this critical habitat appears for your project, even though Vandenberg Monkeyflower is not on the list of potentially affected species at this location, contact the local field office. https://ecos.fws.gov/ecp/species/9079#crithab	Final
Ventura Marsh Milk-vetch Astragalus pycnostachyus var. lanosissimus https://ecos.fws.gov/ecp/species/1160#crithab	Final
Vernal Pool Fairy Shrimp Branchinecta lynchi https://ecos.fws.gov/ecp/species/498#crithab	Final
Western Snowy Plover Charadrius nivosus nivosus https://ecos.fws.gov/ecp/species/8035#crithab	Final

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their nests, should follow appropriate regulations and implement required avoidance and minimization measures, as described in the various links on this page.

The data in this location indicates that no eagles have been observed in this area. This does not mean eagles are not present in your project area, especially if the area is difficult to survey.

Please review the 'Steps to Take When No Results Are Returned' section of the Supplemental Information on Migratory Birds and Eagles document to determine if your project is in a poorly surveyed area. If it is, you may need to rely on other resources to determine if eagles may be present (e.g. your local FWS field office, state surveys, your own surveys).

Additional information can be found using the following links:

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

Bald and Golden Eagle information is not available at this time

Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report

On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

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

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (FWS). The incidental take of migratory birds is the injury or death of birds that results from, but is not the purpose, of an activity. The FWS interprets the MBTA to prohibit incidental take.

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

Additional information can be found using the following links:

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

Migratory bird information is not available at this time

Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as “Vulnerable”. See the FAQ “What are the levels of concern for migratory birds?” for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ “Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds”.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:

The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

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

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Marine mammals

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

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

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

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

The following marine mammals under the responsibility of the U.S. Fish and Wildlife Service are potentially affected by activities in this location:

NAME

Southern Sea Otter Enhydra lutris nereis
https://ecos.fws.gov/ecp/species/8560

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
GUADALUPE-NIPOMO DUNES NATIONAL WILDLIFE REFUGE	2,501.42 acres
HOPPER MOUNTAIN NATIONAL WILDLIFE REFUGE	2,337.32 acres

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

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

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

Wetland information is not available at this time

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

APPENDIX C
National Marine Fisheries Service Consultations

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

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

April 17, 2024

Refer to NMFS No: WCRO-2024-00812

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 the Increase Cadence of Space Launch Vehicle First Stage Recovery Actions and Expanded Landing Areas in the Pacific Ocean

Dear Ms. Kephart,

This letter responds to your March 21, 2024, 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.

This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA and implementing regulations at 50 CFR 402. On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the letter of concurrence would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

We reviewed the Department of Air Force's (DAF) consultation request document and related materials. After a brief exchange in clarification regarding the proposed action and effects determination, and reference to their most recent 2023 consultation, we believe there was adequate consideration and mitigation measures to address the, minimal but present, threat of entanglement, ingestion of debris, strike by falling object, vessel strike, exposure to sonic boom, and other indirect effects. 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 proposed 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://www.fisheries.noaa.gov/resource/tool-app/environmental-consultation-organizer-eco)A complete record of this consultation is on file at NMFS Long Beach, CA office.

Reinitiation of consultation is required and shall be requested by DAF 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 Dan Lawson, NMFS Long Beach, CA office at Dan.Lawson@noaa.gov.

Sincerely,

Dan Lawson
Long Beach Office Branch Chief
Protected Resources Division

bcc: Administrative File: 151422WCR2024PR00078

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL MARINE FISHERIES SERVICE

Letter of Authorization

The U.S. Space Force (USSF), is hereby authorized to take marine mammals incidental to those activities at Vandenberg Space Force Base (VSFB), California, in accordance with 50 CFR 217, Subpart G--Taking Marine Mammals Incidental to U.S. Space Force Launches and Operations at Vandenberg Space Force Base (VSFB), 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 April 10, 2024, through April 9, 2029.

2. This Authorization is valid only for the unintentional taking of the species and stocks of marine mammals identified in Condition 4 incidental to rocket and missile launches and supporting operations originating at VSFB.

3. This Authorization is valid only if USSF or any person(s) operating under its authority implements the mitigation, monitoring, and reporting required pursuant to 50 CFR §§ 217.64 and 217.65 and implements the Terms and Conditions of this Authorization.

4. <u>General Conditions</u>

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

   (b) The incidental take of marine mammals under the activities identified in Condition 2 and 50 CFR § 217.60 of the regulations, by Level B harassment only, is limited to the species and stocks and number of takes shown in Table 1.

Species	**Stock**	**Annual Take by Level B harassment**	**5-Year Total Take by Level B harassment**
Harbor seal	California	11,135	38,591
California sea lion	United States	84,870	281,021
Northern elephant seal	California Breeding	9,438	29,590
Steller sea lion	Eastern	550	1,900
Northern fur seal	California	5,909	18,383
Guadalupe fur seal	Mexico	23	71

(c) 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.

5. Mitigation

USSF, and any persons operating under its authority, must implement the following mitigation measures when conducting the activities identified in Condition 2 of this Authorization.

(a) USSF must provide pupping information to launch proponents at the earliest possible stage in the launch planning process and direct launch proponents to, if practicable, avoid scheduling launches during pupping seasons on VSFB from 1 March to 30 April and on the Northern Channel Islands from 1 June- 31 July. If practicable, rocket launches predicted to produce a sonic boom on the Northern Channel Islands >3 pounds per square foot (psf) from 1 June – 31 July will be scheduled to coincide with tides in excess of +1.0 ft (0.3 m), with an objective to do so at least 50 percent of the time.

(b) For manned flight operations, aircraft must use approved routes for testing and evaluation. Manned aircraft must also remain outside of a 1,000-ft (305 m) buffer around pinniped rookeries and haul-out sites (except in emergencies such as law enforcement response or Search and Rescue operations, and with a reduced, 500-ft (152 m) buffer at Small Haul-out 1).

(c) UAS classes 0-2 must maintain a minimum altitude of 300 ft (91 m) over all known marine mammal haulouts when marine mammals are present, except at take-off and landing. Class 3 must maintain a minimum altitude of 500 ft (152 m), except at take-off and landing. UAS classes 4 and 5 only operate from the VSFB airfield and must maintain a minimum altitude of 1,000 ft (305 m) over marine mammal haulouts except at take-off and landing. USSF must not fly class 4 or 5 UAS below 1,000 ft (305 m) over haulouts.

6. Monitoring

USSF is required to conduct marine mammal and acoustic monitoring as described below:

(a) Monitoring at VSFB and NCI must be conducted by at least one NMFS-approved Protected Species Observer (PSO) trained in marine mammal science. PSOs must have demonstrated proficiency in the identification of all age and sex classes of all marine mammal species that occur at VSFB and on NCI. They must be knowledgeable of approved count methodology and have experience in observing pinniped behavior, especially that due to human disturbances.

(b) In the event that the PSO requirements described in paragraph (a) of this section cannot be met (*e.g.*, access is prohibited due to safety concerns), daylight or nighttime video monitoring must be used in lieu of PSO monitoring. In certain circumstances where the daylight or nighttime video monitoring is also not possible (*e.g.*, USSF is unable to access a monitoring site due to road conditions or human safety concerns), USSF must notify NMFS.

(c) At VSFB, USSF must conduct marine mammal monitoring and take acoustic measurements for all new rockets, for rockets (existing and new) launched from new facilities, and for larger or louder rockets (including those with new launch proponents) than those that have been previously launched from VSFB during their first three launches and for the first three launches from any new facilities during March through July.

i. For launches that occur during the harbor seal pupping season (March 1 through June 30) or when higher numbers of California sea lions are present (June 1 through July 31), monitoring must be conducted. At least one NMFS-approved PSO trained in marine mammal science must conduct the monitoring.

ii. When launch monitoring is required, monitoring must begin at least 72 hours prior to the launch and continue through at least 48 hours after the launch. Monitoring must include multiple surveys each day, with a minimum of four surveys per day.

iii. For launches within the harbor seal pupping season, USSF must conduct a follow-up survey of pups.

iv. For launches that occur during daylight, USSF must make time-lapse video recordings to capture the reactions of pinnipeds to each launch. For launches that occur at night, USSF must employ night video monitoring, when feasible.

v. When possible, PSOs must record: species, number, general behavior, presence and number of pups, age class, gender, and reaction to launch noise, or to natural or other human-caused disturbances. PSOs must also record environmental conditions, including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction.

(d) USSF must conduct sonic boom modeling prior to the first three small or medium rocket launches from new launch proponents or at new launch facilities, and all heavy or super-heavy rocket launches.

(e) USSF must conduct marine mammal monitoring and take acoustic measurements at the NCI if the sonic boom model indicates that pressures from a boom will reach or exceed 7 psf from 1 January through 28 February, 5 psf from 1 March through 31

July, or 7 psf from 1 August through 30 September. No monitoring is required on NCI from 1 October through 31 December.

i. The monitoring site must be selected based upon the model results, prioritizing a significant haulout site on one of the islands where the maximum sound pressures are expected to occur.

ii. USSF must estimate the number of animals on the monitored beach and record their reactions to the launch noise and conduct more focused monitoring on a smaller subset or focal group.

iii. Monitoring must commence at least 72 hours prior to the launch, during the launch and at least 48 hours after the launch, unless no sonic boom is detected by the monitors and/or by the acoustic recording equipment, at which time monitoring may be stopped.

iv. For launches that occur in darkness, USSF must use night vision equipment.

v. Monitoring for each launch must include multiple surveys each day that record, when possible: species, number, general behavior, presence of pups, age class, gender, and reaction to sonic booms or natural or human-caused disturbances.

vi. USSF must collect photo and/or video recordings for daylight launches when feasible, and if the launch occurs in darkness night vision equipment will be used.

vii. USSF must record environmental conditions, including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction.

(f) USSF must continue to test equipment and emerging technologies, including but not limited to night vision cameras, newer models of remote video cameras and other means of remote monitoring at both VSFB and on the NCI.

(g) USSF must evaluate UAS based or space-based technologies that become available for suitability, practicability, and for any advantage that remote sensing may provide to existing monitoring approaches.

(h) USSF must monitor marine mammals during the first three launches of the missiles for the new Ground Based Strategic Defense program during the months of March through July across the 5-year duration of this LOA.

i. When launch monitoring is required, monitoring must include multiple surveys each day, with a minimum of four surveys per day.

ii. When possible, PSOs must record: species, number, general behavior, presence and number of pups, age class, gender, and reaction to launch noise, or to natural or other human-caused disturbances. PSOs must also record environmental conditions, including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction.

(i) USSF must conduct semi-monthly surveys (two surveys per month) to monitor the abundance, distribution, and status of pinnipeds at VSFB. Whenever possible, these surveys will be timed to coincide with the lowest afternoon tides of each month when the greatest numbers of animals are usually hauled out. If a VSFB or area closure precludes monitoring on a given day, USSF must monitor on the next best day.

i. PSOs must gather the following data at each site: species, number, general behavior, presence and number of pups, age class, gender, and any reactions to natural or human-caused disturbances. PSOs must also record environmental conditions, including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction.

7. Reporting

(a) USSF must submit an annual report each year to NMFS Office of Protected Resources and West Coast Region on March 1st of each year that describes all activities and monitoring for the specified activities during that year. This includes launch monitoring information in Condition 7(a)(i) through (iii) for each launch where monitoring is required or conducted. The annual reports must also include a summary of the documented numbers of instances of harassment incidental to the specified activities, including non-launch activities (*e.g.*, takes incidental to aircraft or helicopter operations observed during the semi-monthly surveys). Annual reports must also include the results of the semi-monthly sentinel marine mammal monitoring described in Condition 6(i), results of tests of equipment and emerging technologies described in condition 6(f), and results of evaluation of UAS based or space-based technologies described in condition 6(g).

i. Launch information, including:

1) Date(s) and time(s) of the launch (and sonic boom, if applicable);

2) Number(s), type(s), and location(s) of rockets or missiles launched;

ii. Monitoring program design; and

iii. Results of the launch-specific monitoring program, including:

1) Date(s) and location(s) of marine mammal monitoring;

2) Number of animals observed, by species, on the haulout prior to commencement of the launch or recovery;

3) General behavior and, if possible, age (including presence and number of pups) and sex class of pinnipeds hauled out prior to the launch or recovery;

4) Number of animals, by species, age, and sex class that responded at a level indicative of harassment. Harassment is characterized by:

   A. Movements in response to the source of disturbance, ranging from short withdrawals at least twice the animal's body length to longer retreats over the beach, or if already moving a change of direction of greater than 90 degrees; or

   B. All retreats (flushes) to the water.

5) Number of animals, by species, age, and sex class that entered the water, the length of time the animal(s) remained off the haulout, and any behavioral responses by pinnipeds that were likely in response to the specified activities, including in response to launch noise or a sonic boom;

6) Environmental conditions including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction; and

7) Results of acoustic monitoring, including the following:

   A. Recorded sound levels associated with the launch (in SEL, SPL_{peak}, and SPL_{rms});

   B. Recorded sound levels associated with the sonic boom (if applicable), in psf; and

   C. The estimated distance of the recorder to the launch site and the distance of the closest animals to the launch site.

iv. Results of the semi-monthly sentinel marine mammal monitoring described in Condition 6(i), including:

1) Number of animals observed, by species;

2) General behavior and, if possible, age (including presence and number of pups) and sex class of pinnipeds hauled out;

3) Any reactions to natural or human-caused disturbances;

4) Environmental conditions including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction.

(b) USSF must submit a final, comprehensive 5-year report to NMFS Office of Protected Resources within 90 days of the expiration of this LOA. This report must:

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

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

iii. Assess the cumulative impacts on pinnipeds and other marine mammals from the activities specified in Condition 2.

(c) If the activity identified in Condition 2 likely resulted in the take of marine mammals not identified in Condition 4(b), then the USSF must notify the NMFS Office of Protected Resources and the NMFS West Coast Region stranding coordinator within 24 hours of the discovery of the take.

(d) In the event that personnel involved in the activities discover an injured or dead marine mammal, USSF must report the incident to the Office of Protected Resources (OPR), NMFS (PR.ITP.MonitoringReports@noaa.gov and itp.davis@noaa.gov) and to the West Coast regional stranding network (866-767-6114) as soon as feasible.

The report must include the following information:

i. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

ii. Species identification (if known) or description of the animal(s) involved;

iii. Condition of the animal(s) (including carcass condition if the animal is dead);

iv. Observed behaviors of the animal(s), if alive;

v. If available, photographs or video footage of the animal(s); and

vi. General circumstances under which the animal was discovered.

(e) If real-time monitoring during a launch shows that the activity identified in Condition 2 is reasonably likely to have resulted in the mortality or injury of any marine mammal, USSF must notify NMFS within 24 hours (or next business day). NMFS and USSF must then jointly review the launch procedure and the mitigation requirements and make appropriate changes through the adaptive management process, as necessary and before any subsequent launches of rockets and missiles with similar or greater sound fields and/or sonic boom pressure levels.

8. This Authorization may be modified, suspended or withdrawn if USSF 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.

9. Renewals and Modifications of Letter of Authorization

   (a) A LOA issued under 50 CFR §§ 216.106 and § 217.66 for the activity identified in Condition 2 of this Authorization and 50 CFR § 217.60(a) and (b) shall be modified upon request by USSF, provided that:

      i. The specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for this subpart (excluding changes made pursuant to the adaptive management provision in paragraph (c) of this section); and

      ii. NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

   (b) For LOA modification or renewal requests by the applicant that include changes to the activity or the mitigation, monitoring, or reporting measures (excluding changes made pursuant to the adaptive management provision in paragraph (c) of this section) that do not change the findings made for the regulations or that result in no more than a minor change in the total estimated number of takes (or distribution by species or stock or years), NMFS may publish a notice of proposed changes to the LOA in the *Federal Register*, including the associated analysis of the change, and solicit public comment before issuing the LOA.

   (c) An LOA issued under 50 CFR §§ 216.106 and 217.66 for the activity identified in Condition 2 of this Authorization and 50 CFR § 217.60(a) and (b) may be modified by NMFS under the following circumstances:

      i. After consulting with the USSF regarding the practicability of the modifications, NMFS, through adaptive management, may modify (including adding or removing measures) the existing mitigation, monitoring, or reporting measures if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring.

      ii. Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA include:

         1) Results from the USSF's monitoring from the previous year(s);

2) Results from other marine mammal and/or sound research or studies; or

3) Any information that reveals marine mammals may have been taken in a manner, extent or number not authorized by these regulations or a subsequent LOA.

iii. If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are more than minor, NMFS will publish a notice of the proposed changes to the LOA in the *Federal Register* and solicit public comment.

(d) If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in the regulations and this Authorization, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the *Federal Register* within 30 days of the action.

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For Kimberly Damon-Randall, Director
Office of Protected Resources

Assessment to Determine Applicability of Vandenberg Space Force Base National Marine Fisheries Service Letter of Authorization for Falcon 9 Mainland Booms

2 August 2024

Background

The Department of the Air Force (DAF) contacted the National Marine Fisheries Service (NMFS) regarding mainland acoustic impacts in the Ventura County area as a result of recent SpaceX Falcon missions with easterly trajectories. Since the region of acoustic impact has increased from what was considered in the DAF's application for a Letter of Authorization (LOA; NMFS 2024), the DAF has reassessed acoustic impacts to marine mammals to analyze if the increased impact is covered by the estimated take totals in the LOA or if an amendment is needed. There are two harbor seal haulouts identified on the mainland in the new geographic noise footprint, shown in Figure 1, the Carpinteria Harbor Seal Rookery and the Point Mugu Lagoon haulout.

Our LOA assumes 110 rocket launches from Vandenberg Space Force Base annually. We have assumed 100 Falcon 9 rocket launches in our calculations below to ensure we are account for maximum future potential impact from the easterly trajectories of this rocket.

Potential Noise Impacts

Falcon launches with easterly trajectories may result in sonic booms that impact eastern Santa Barbara, Ventura, and northwestern Los Angeles Counties (Figure 1). Even with identical trajectories, atmospheric conditions create considerable variation in where sonic booms impact and the level at which they impact. To account for this variation, PCBoom can utilize meteorological parameters in the model that affect where and at what level a sonic boom may impact the surface of the earth. In the late 1990's, SRS Technologies, Inc. assembled a series of daily meteorological profiles across 10 years (1984-1994, one per day for 10 years) from radiosonde data for weather balloons released by the VSFB weather squadron. The data include pressure, temperature, wind speed, and wind direction along an elevational profile from ground, every 1,000 feet (ft), to 110,000 ft. Figure 1 depicts the overlaid output from sonic boom modeling software (PCBoom) for four actual SpaceX easterly trajectories, each trajectory run between 29 and 34 times, each run representing 1 of between 29 and 34 randomly selected meteorological profiles that capture potential weather conditions throughout the year (125 model outputs total) overlaid in the image.

We have collected sonic boom overpressure levels in the field for 6 easterly trajectories to determine to what extent the modeled vs actual overpressure levels align (Table 1). Thus far, we have seen that the model predicts higher potential boom levels than actual and thus we are confident that our calculations below are an overestimation.

Table 1. Sonic Boom Data Collection to Date.

Mission	Date	Azimuth	# of Collection Stations	Predicted Boom Level	Actual Boom Level
Starlink 8-7	14 May 2024 18:39Z	144	5	< 0.5 – 2.1 psf	< 0.5 psf
Starlink 8-8	8 June 2024 12:58Z	144	5	< 0.5 – 2.1 psf	0 psf
Starlink 9-1	19 June 2024, 03:40Z	144	15	< 0.5-1.0 psf	< 1.0 psf
Starlink 9-2	24 June 2024, 03:47Z	144	20	< 0.5-1.0 psf	< 0.5 psf
NROL-186	29 June 2024, 03:14Z	155	20	< 1.0-1.99 psf	< 0.1 psf
Starlink 9-3	12 July 2024, 02:39Z	144	15	< 1.0-1.99 psf	<0.5 psf

In addition to sonic boom, rocket engine noise is expected in these areas, but at very low levels. RNOISE was used to model engine noise during Falcon 9 launch from SLC-4. The modeled 90 decibel (dB) unweighted peak sound pressure level (SPL) extends to approximately 7.4 miles southeast of SLC-4 (Figure 2). Santa Barbara is estimated to receive 60 dB unweighted SPL due to rocket engine noise (Figure 2). Additionally, acoustic monitoring in Ventura County for five SpaceX missions with easterly trajectories, engine noise has been below ambient noise levels and thus could not be measured.

NMFS In-Air Acoustic Thresholds

Pinnipeds are categorized into two functional hearing groups based on their generalized hearing sensitivities: (1) otariids and (2) phocids. Within these hearing groups, there is one phocid, the Pacific harbor seal, that hauls out in the area that may experience noise as a result of Falcon launches in Ventura County. NMFS has established thresholds for in-air impulsive noise for Level B harassment (i.e., behavioral disruption and temporary threshold shift [TTS] in hearing sensitivity) and for Level A harassment (permanent threshold shifts [PTS] in hearing sensitivity) based on species' audiograms and the results of studies measuring threshold shifts and behavioral responses (Table 2; NMFS 2021). For all pinnipeds the Level B harassment threshold for behavioral disruption is a sound exposure level (SEL) of 100 decibels (dB).

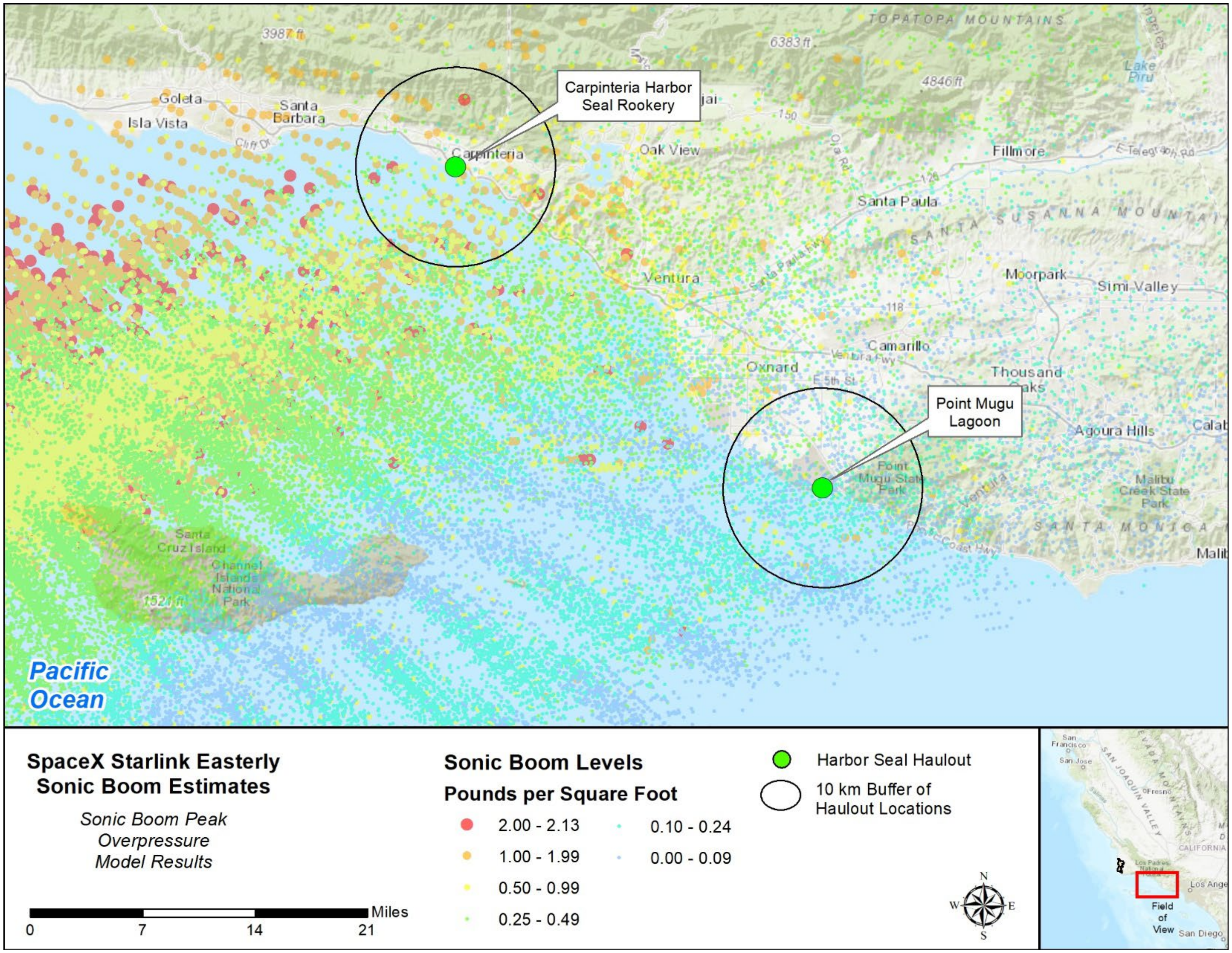

Figure 1. Sonic boom model results for easterly SpaceX Starlink trajectories showing range of possible boom impact areas and levels, depending on meteorological conditions, and mainland harbor seal haulouts (Note: the image is intended to show the array of potential sonic booms; no single launch would result in impacts across the entire areas depicted nor at the specific levels depicted).

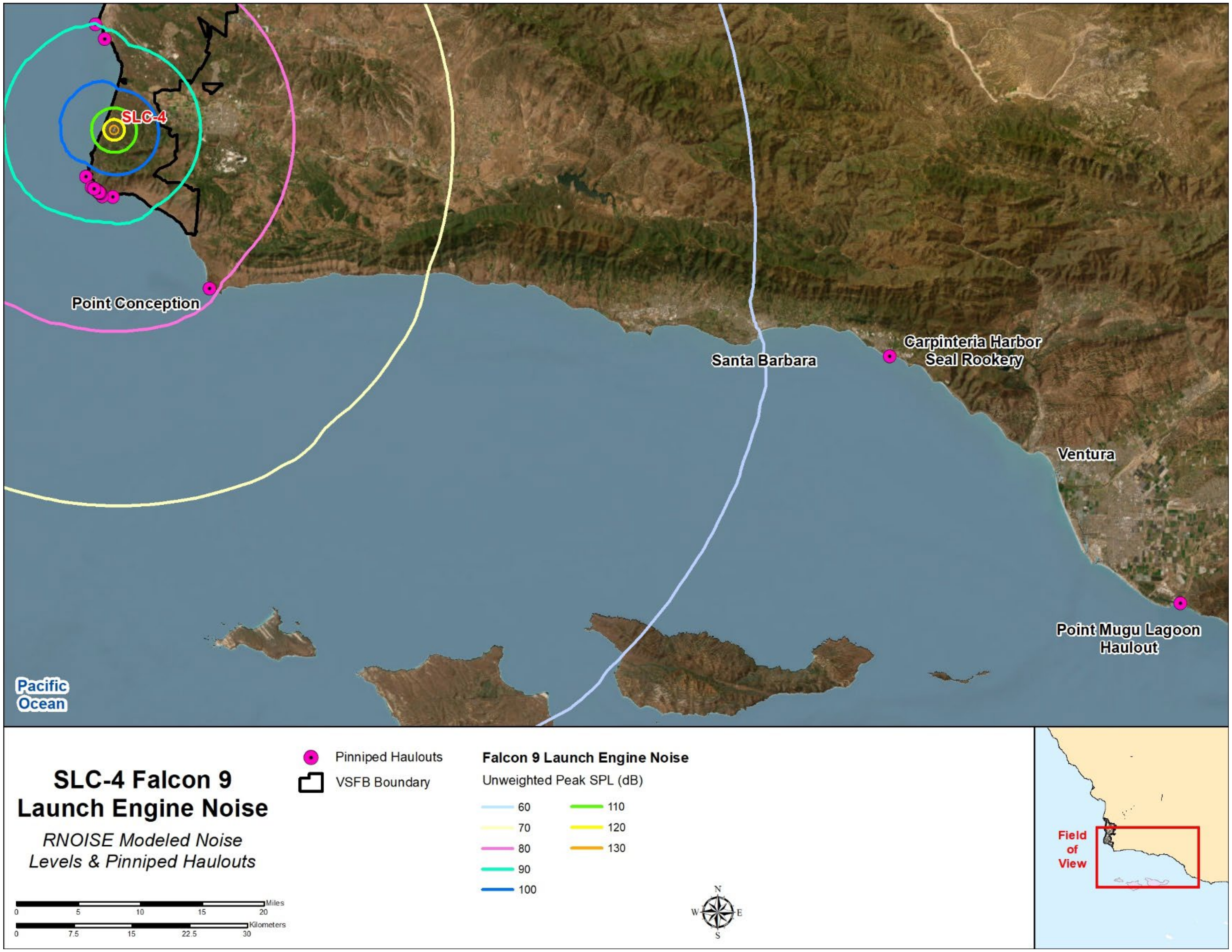

Figure 2. Modeled rocket engine noise for Falcon 9 launch from SLC-4 using RNOISE.

NMFS has also established thresholds for in-air non-impulsive noise for Level B harassment (behavioral disruption) for pinnipeds Table 3 (NMFS 2021). For harbor seals, the Level B harassment threshold (behavioral disruption) for non-impulsive noise is 90 dB root mean square (dB_{rms}). The dB_{rms} is the average dB of a noise over a period of time; therefore, substituting dB peak SPL is a conservative approach to applying the threshold for Level B harassment. NMFS has not established thresholds for Level A harassment resulting from PTS or Level B harassment resulting from TTS. However, according to Southall et al. (2019), the most recent study available, the lower limit for TTS as a result of in-air non-impulsive noise for phocids is 134 dB SEL, and the lower limit for PTS is 154 dB SEL (Table 4).

Table 2. Thresholds for in-air impulsive sound effects on pinnipeds.

Hearing Group	MMPA Level B Exposure		MMPA Level A Exposure
	Behavioral - SEL (unweighted)	TTS - Peak SPL (unweighted; re 20 μPa)	PTS - Peak SPL (unweighted; re 20 μPa)
Otariids	100 dB re 20 μPa^2 sec	170 dB (132.1 psf)	176 dB (263.6 psf)
Phocids		155 dB (23.5 psf)	161 dB (46.9 psf)

Source: NMFS 2021

SEL = sound exposure level; SPL = sound pressure level; dB = decibels; dB re 20 μPa = decibels related to 20 micropascals; dB re 20 μPa^2sec = decibels related to 20 micropascals squared seconds

Table 3. National Marine Fisheries Service current in-air acoustic thresholds for pinnipeds for non-impulsive noise.

Criterion	Criterion Definition	NMFS Threshold
Level A	PTS (injury)	None established
Level B	TTS	None established
Level B	Behavioral disruption for harbor seals	90 dB_{rms}
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB_{rms}

Source: NMFS 2021

Table 4. In-air acoustic thresholds for TTS and PTS for pinnipeds and non-impulsive noise.

Group	Criterion Definition	Threshold
Otariids	PTS in hearing sensitivity (physical injury)	177 dB SEL
	TTS in hearing sensitivity	157 dB SEL
Phocids	PTS in hearing sensitivity (physical injury)	154 dB SEL
	TTS in hearing sensitivity	134 dB SEL

Source: Southall et al. 2019

Analysis of Noise Impacts in the Ventura County Area

The DAF applied the NMFS thresholds as the best available science to estimate level of take resulting from in-air impulsive and non-impulsive noise for harbor seals in Ventura County. During missions with easterly trajectories, the received engine noise levels (non-impulsive noise) would be substantially less than 90 dB_{rms}, the NMFS threshold for behavioral disturbance for harbor seals (Table 3). As discussed above, the modeled 90 dB peak SPL extends to approximately 7.4 miles southeast of SLC-4 (Figure 2). Additionally, acoustic monitoring in Ventura County for five SpaceX missions with easterly trajectories, engine noise has been below ambient noise levels and thus could not be measured. Therefore, engine noise is substantially below NMFS thresholds for behavioral disruption of harbor seals and thus no takes are anticipated at either the Carpinteria Harbor Seal Rookery or the Point Mugu Lagoon haulout.

To analyze the potential for take due to sonic boom (impulsive noise), the sonic boom model outputs were compared to harbor seal haulout locations, depicted in Figure 1. Approximately 39% of missions with easterly trajectories are predicted to impact the Carpinteria Harbor Seal Rookery. To estimate the potential levels of these sonic booms, a frequency distribution of potential sonic boom levels was constructed by overlaying a 10-km buffer of the rookery onto the PCBoom model output described above and as depicted in Figure 1. Of the sonic booms predicted to impact within 10 km of the rookery, 88% of the boom levels were predicted to be less than 1.0 psf, and 98% were predicted to be less than 2.0 psf (Figure 2). The highest predicted level was 3.7 psf.

For the Point Mugu Lagoon haulout, approximately 93% of missions with easterly trajectories are predicted to impact the site. However, 99.8% of the boom levels were predicted to be less than 1.0 psf, and 100% were predicted to be less than 1.5 psf (Figure 3). The highest predicted level was 1.6 psf.

Since PCBoom does not generate estimates of noise levels in SEL, recordings of sonic booms from VSFB were used to compare sonic boom psf levels to corresponding SEL values. During the SpaceX Sarah-1 mission, a 2.57 psf sonic boom was recorded on VSFB which corresponded to a measured level of 113.5 dB SEL. For the SpaceX Transporter 8 mission, a 1.07 psf sonic boom was recorded on VSFB which had a measured level of 102.3 dB SEL. Therefore, sonic booms of approximately 1 psf are expected to generally correspond to the NMFS threshold of 100 dB SEL for behavioral disruption for harbor seals (Table 2). This is supported by over two decades of pinniped monitoring by the DAF on the Northern Channel Islands and Vandenberg Space Force Base (VSFB) during sonic booms caused by numerous launches. The DAF has observed that there are generally no significant behavioral disruptions caused to pinnipeds by sonic booms less than 1 psf.

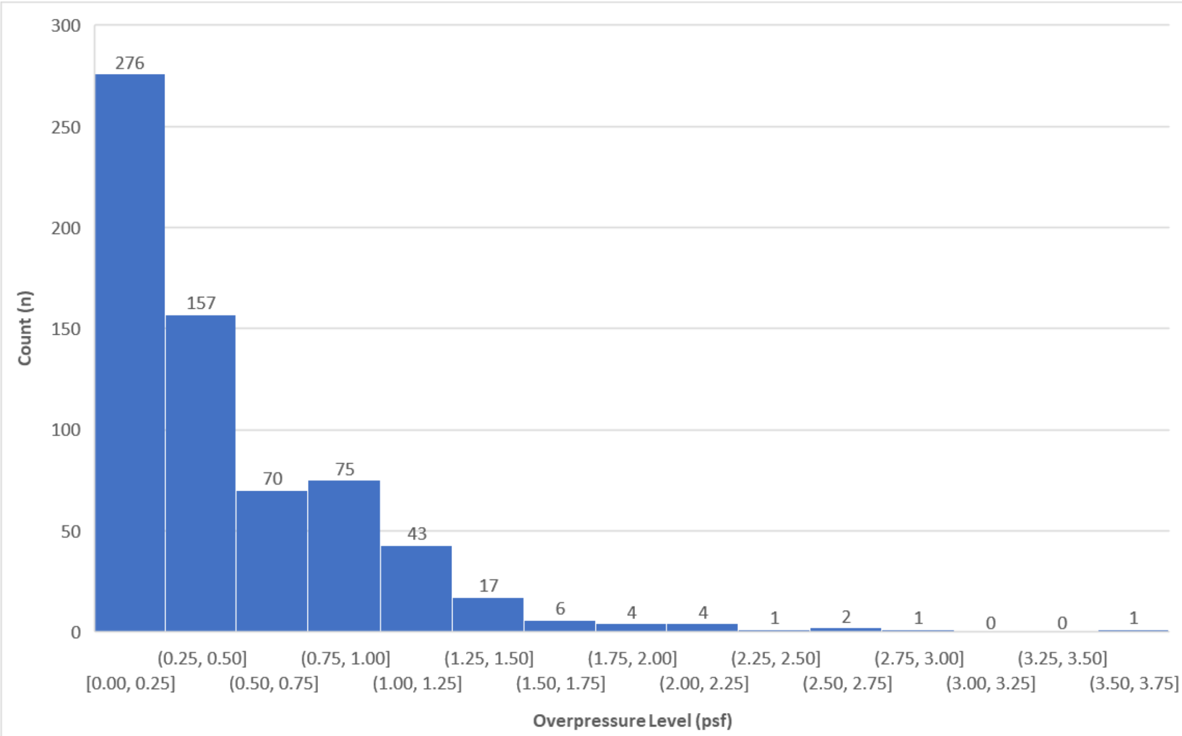

Figure 3. Distribution of PCBoom sonic boom modeling results within 10 km of the Carpinteria Harbor Seal Rookery, as shown in Figure 1.

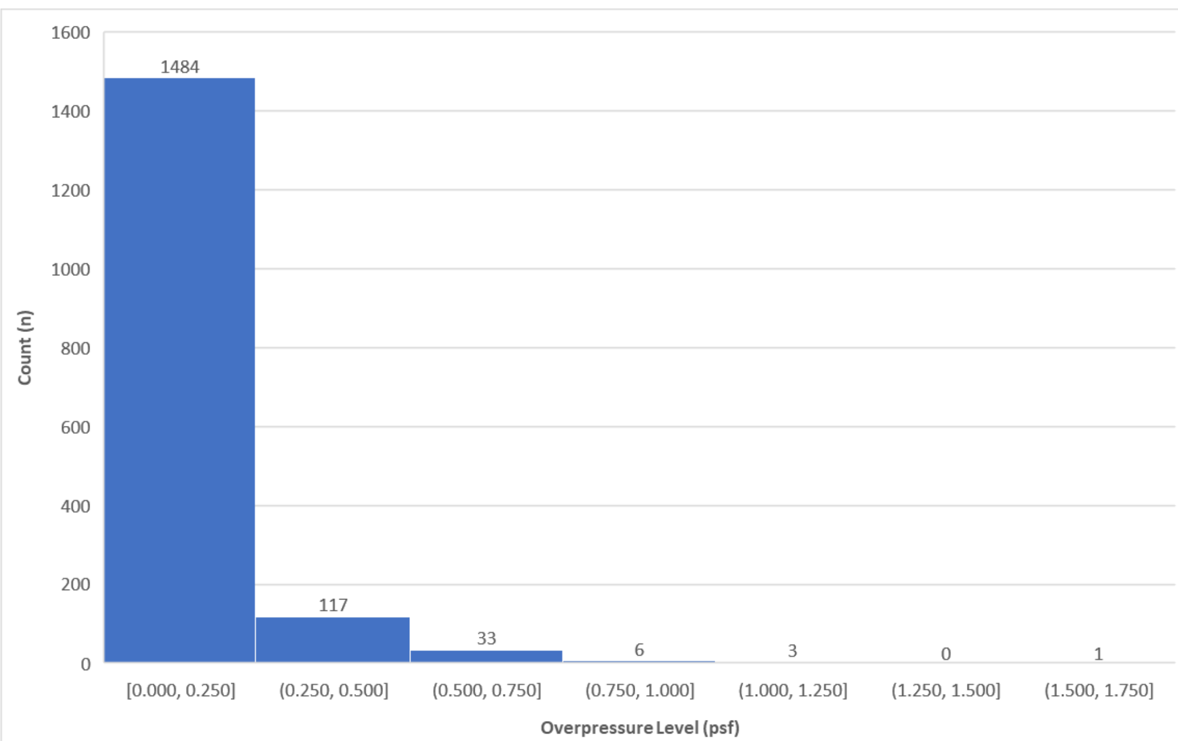

Figure 4. Distribution of PCBoom sonic boom modeling results within 10 km of the Point Mugu Lagoon haulout, as shown in Figure 1.

Therefore, applying NMFS thresholds for behavioral disruption caused by impulsive noise and VSFB pinniped monitoring results, we expect launches with easterly trajectories to result in sonic booms that would be at or above 1 psf for 22% of these missions at the Carpinteria Harbor Seal Rookery and less than 1% of missions at the Point Mugu Lagoon haulout. From 2019 through 2023 (excluding 2020 when counts did not occur due to Covid 19), the average number of adults present at the Carpinteria Harbor Seal Rookery from January through May was 132, with a high of 230 in May 2019 (Carpinteria Seal Watch 2024). The average highest number of pups recorded during this time period was 60 per year, with a high of 68 in 2019 (Carpinteria Seal Watch 2024). We estimate that approximately 80% of future Falcon 9 missions would have easterly trajectories and that 22% of these missions would create a sonic boom greater than 1 psf. Therefore, conservatively, an estimated 2,323 adult Pacific harbor seal takes would occur annually at this location. Based on 100 launches per year: 100 missions/year x 80% of missions with easterly trajectories x 22% x 132 (average number recorded over a 5-year period) = 2,323 takes.

For pups, present from January through May, conservatively an estimated 440 takes would occur each year. Based on 100 missions per year x 80% of missions with easterly trajectories, divided by 12 to get monthly average x 5 for the five-month pup season (Jan-May) x 22% x 60 (average highest number of pups recorded each year) = 440 takes. We used the average highest number of pups (vice average number) because of the short duration they are considered pups prior to weaning.

At the Point Mugu Lagoon haulout, we conservatively assume 1% of missions with easterly trajectories would cause a sonic boom of 1 psf or greater to impact this location. From 2019 through 2023, the average number of adults present at the Point Mugu Lagoon haulout was 104, with a high of 372 in December 2022 (NBVC Point Mugu 2024). The average highest number of pups recorded during this time period was 65 per year, with a high of 72 in 2021 (NBVC Point Mugu 2024). An estimated 83 adult Pacific harbor seals would be taken annually at this location. Based on 100 launches per year: 100 missions/year x 80% of missions with easterly trajectories x 1% x 104 (average number recorded over a 5-year period) = 83 takes.

For pups, present from January through May, an estimated 22 would be taken each year. Based on 100 missions per year x 80% of missions with easterly trajectories, divided by 12 to get monthly average x 5 for the five-month pup season (Jan-May) x 1% x 65 (average highest number of pups recorded each year) = 22 takes. We used the average highest number of pups (vice average number) because of the short duration they are considered pups prior to weaning.

Based on decades of monitoring harbor seal reactions to launch noise, we would expect all or some proportion of the seals to react to sonic booms of 1 psf or greater by moving off the haulout into the water. However, monitoring data shows that these responses are short-lived and animals begin to return to the haulout within minutes, typically returning to pre-launch numbers usually within 10 to 20 minutes and show no signs of lasting behavioral impacts in the days following the launch.

Permitted Annual Take by Level B harassment

VSFB's LOA permits a total of 11,135 Pacific harbor seals to be incidentally taken by Level B harassment annually due to launch activities (NMFS 2024). Although this total did not include estimates of take at haulouts on the south coast of eastern Santa Barbara, Ventura, and northwestern Los Angeles Counties, any increase in annual take by Level B harassment of Pacific harbor seals (estimated to be 2,868per year total) would be offset by a reduction in take on San Miguel Island. This is because as the trajectory of the Falcon 9 and resultant sonic boom moves more to the east and approaches 140 to 145 degrees the sonic boom no longer overlaps San Miguel Island, where there are large numbers of Pacific harbor seals and other pinnipeds. This is illustrated in Figures 5 and 6 below. It is therefore unnecessary to increase the number of permitted takes by Level B harassment of Pacific harbor seals under the LOA, despite the change in geographic area of potential impacts.

References

Carpinteria Seal Watch. 2024. Carpinteria Seal Watch Numbers. Available at: https://carpinteriasealwatch.org/about/. Accessed on 2 July 2024.

National Marine Fisheries Service. 2021. ESA Section 7 Consultation Tools for Marine Mammals on the West Coast. Available online: <https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west>. Accessed on 12 January 2024.

National Marine Fisheries Service. 2024. Letter of Authorization. 9 April 2024.

Naval Base Ventura County Point Mugu. 2024. Pinniped Count Data. Provided by Martin Ruane, Natural Resource Manager, Environmental Division, Naval Base Ventura County.

Southall, B. L., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, D. P. Nowacek, and P. L. Tyack. 2019. Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. Aquatic Mammals 45(2): 125–232.

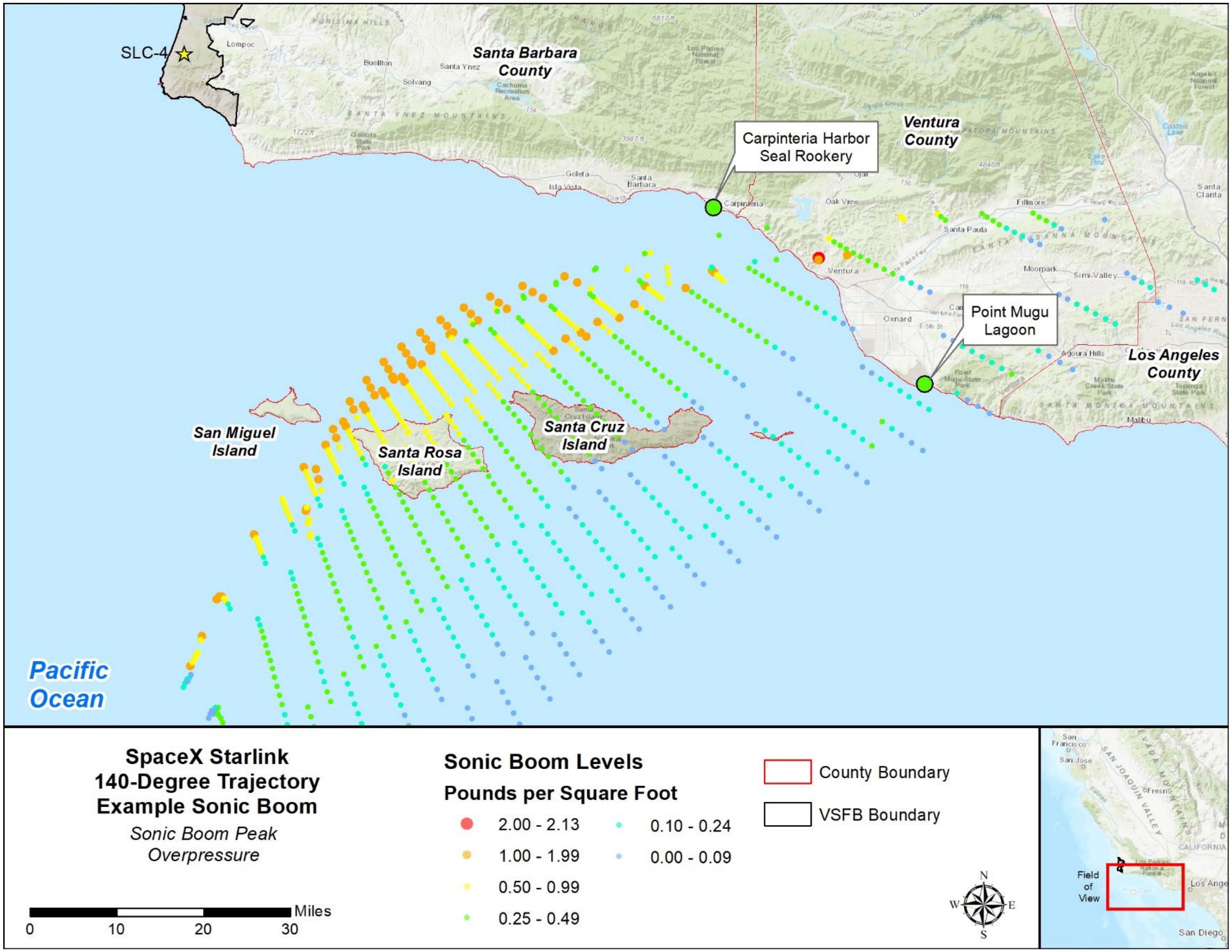

Figure 5. Falcon 9 sonic boom footprint during 140-degree trajectory overlapping mainland California, but not overlapping San Miguel Island.

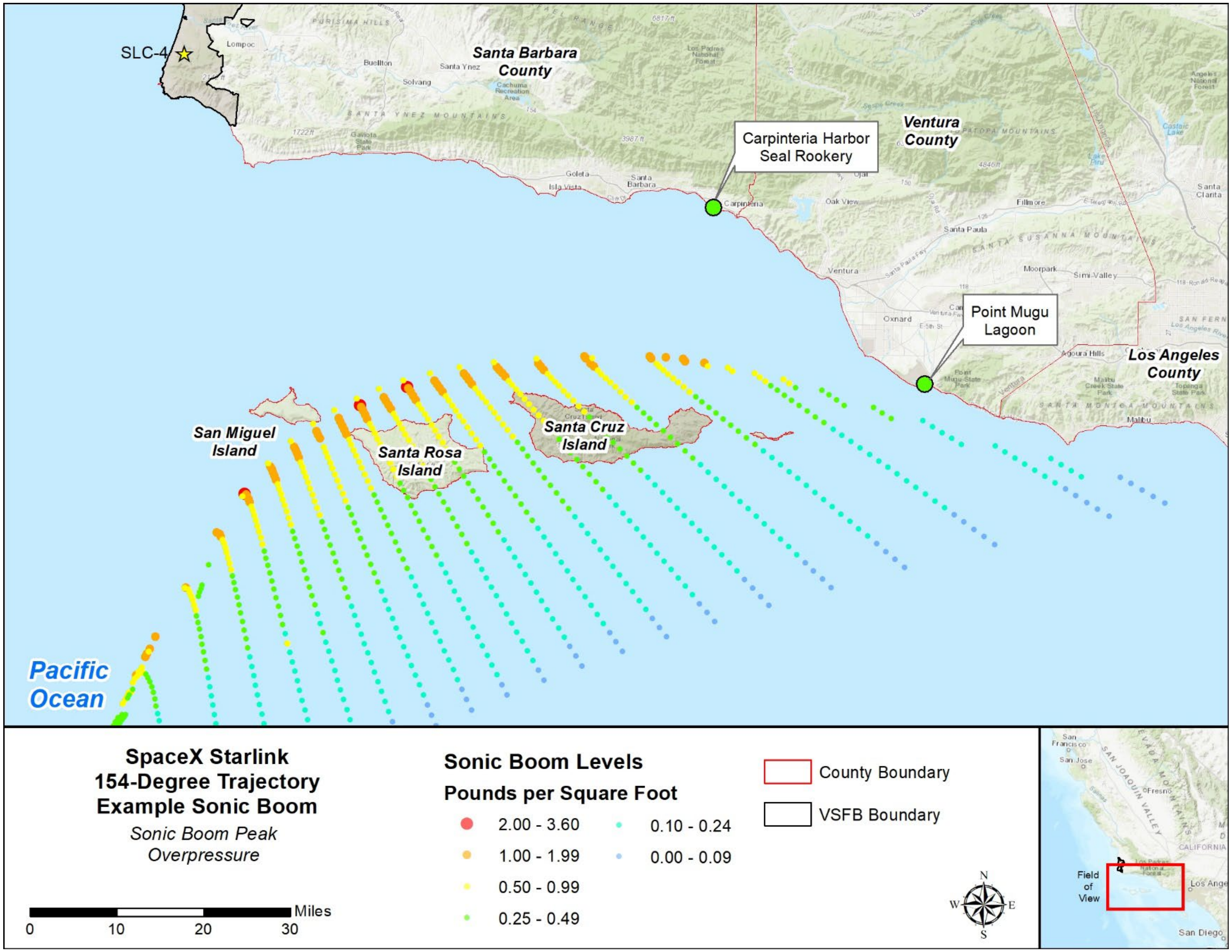

Figure 6. Falcon 9 sonic boom footprint during 154-degree trajectory not overlapping mainland California, some overlap with San Miguel Island.

From:	Leah Davis - NOAA Federal
To:	WHITSITT-ODELL, TIFFANY A CIV USSF SSC 30 CES/CEIEA
Cc:	KAISERSATT, SAMANTHA O CIV USSF SSC 30 CES/CEIEA
Subject:	Re: [Non-DoD Source] Re: Southeasterly Trajectories Maps and Information
Date:	Tuesday, January 7, 2025 8:35:56 AM

Hi Tiffany,

Following NMFS' review and resolution of NMFS' questions on the Ventura Marine Mammal LOA Analysis, NMFS concurs with VSFB's conclusion that any marine mammal take from these activities is not likely to exceed the number of authorized takes in the April 2024 LOA. Therefore, we agree that modifying the LOA is not warranted at this time. In the event of incidental take of marine mammals that exceeds that analyzed in the analysis referenced above, VSFB should contact our office immediately to provide notification and to work through the necessary steps to ensure MMPA compliance moving forward, which could include submitting a request for a modified ITA. It is our practice to support the continuation of ongoing activities, contingent upon implementation of agreed-upon avoidance measures, while we act on any such request.

Kindly,
Leah

On Fri, Aug 2, 2024 at 3:40 PM WHITSITT-ODELL, TIFFANY A CIV USSF SSC 30 CES/CEIEA <tiffany.whitsitt-odell@spaceforce.mil> wrote:

> Good Afternoon Leah –
>
> Please find attached our analysis depicting impacts to harbor seals due to some of our easterly launch trajectories creating sonic booms on the mainland of Santa Barbara/Ventura/Los Angeles Counties. Based on the decades of launch specific monitoring we have completed, and past coordination with your agency, we are assuming the impacts to these individuals will be commensurate with what we have seen at other haul outs.
>
> We welcome any questions you may have and a determination if you agree that the shift in noise impacts and potential take is covered under the existing 2024 LOA.
>
> v/r,
>
> Tiffany
>
> *Tiffany Whitsitt-Odell*
>
> Natural Resources, NH-3, 30 CES/CEIEA

1028 Iceland Ave B#11146
COMM: 805-606-4198/276-4198

Tiffany.Whitsitt-Odell@spaceforce.mil

(she, her, hers)

From: Leah Davis - NOAA Federal <leah.davis@noaa.gov>
Sent: Wednesday, June 26, 2024 5:16 AM
To: EVANS, RHYS M CIV USSF SSC 30 CES/CEIEA <rhys.evans@spaceforce.mil>
Cc: KAISERSATT, SAMANTHA O CIV USSF SSC 30 CES/CEIEA <samantha.kaisersatt@spaceforce.mil>; WHITSITT-ODELL, TIFFANY A CIV USSF SSC 30 CES/CEIEA <tiffany.whitsitt-odell@spaceforce.mil>
Subject: Re: [Non-DoD Source] Re: Southeasterly Trajectories Maps and Information

Thanks, Rhys. I will keep an eye out for more from Tiffany and/or Samantha. Enjoy your retirement if we don't email again before then!

On Tue, Jun 25, 2024 at 7:17 PM EVANS, RHYS M CIV USSF SSC 30 CES/CEIEA <rhys.evans@spaceforce.mil> wrote:

> Thank you! We are working on a response, which you will likely receive from Tiffany and/or Samantha…
>
> I'll tell you INFORMALLY that our acoustics expert from Brigham Young University told me this morning that while they recorded booms in many locations last week, he unofficially categorized them as "minor" but it will take longer to ascertain actual PSF levels and variability between locations (but they had something like 26 recorders deployed). Yes, we acknowledge that even "minor" booms may impact pinnipeds…   But more to follow!
>
> Rhys
>
> ---
>
> **From:** Leah Davis - NOAA Federal <leah.davis@noaa.gov>
> **Sent:** Tuesday, June 25, 2024 1:45 PM
> **To:** EVANS, RHYS M CIV USSF SSC 30 CES/CEIEA <rhys.evans@spaceforce.mil>
> **Cc:** KAISERSATT, SAMANTHA O CIV USSF SSC 30 CES/CEIEA

<samantha.kaisersatt@spaceforce.mil>; WHITSITT-ODELL, TIFFANY A CIV USSF SSC 30 CES/CEIEA <tiffany.whitsitt-odell@spaceforce.mil>
Subject: [Non-DoD Source] Re: Southeasterly Trajectories Maps and Information

Hi Rhys,

Thanks again for providing this information. Following up from my conversation with Jolie, it is up to Vandenberg personnel to assess whether Vandenberg may be at risk of violating their authorization and needs additional MMPA coverage. If you would like to write an assessment with a determination for us to review, we would be happy to do so. (Of note, a relative comparison of impacts from the launches to impacts from other stressors (e.g., dogs) should not be included as part of an assessment.)

While additional monitoring is not a requirement, I think if I were you, I would conduct some pinniped monitoring on the mainland (perhaps at the site you reference above, for example) to observe whether responses that were not anticipated in the analysis may be occurring, in order to help support your determination.

I hope that helps!

Leah

On Fri, Jun 21, 2024 at 2:46 PM Leah Davis - NOAA Federal <leah.davis@noaa.gov> wrote:

> Thanks, Rhys, received. I will review, check in with Jolie, and then follow up.
>
> Have a great weekend,
>
> Leah
>
> On Thu, Jun 20, 2024 at 4:58 PM EVANS, RHYS M CIV USSF SSC 30 CES/CEIEA <rhys.evans@spaceforce.mil> wrote:
>
>> Hello again, Leah.

I’ve attached a brief, preliminary analysis (well, it’s 8 pages, but 6 pages of figures) of sonic booms on the mainland. There will be more to come, specifically when we receive analysis of the 21 (I wrote 18 in the last e-mail) recorders that were deployed for the 18 June launch and are planned to be deployed again for a launch scheduled 28 June.

I would like to ask if there are any specific sites that concern you? We’re of course “quite” aware of many comments on Facebook (etc.) over noise impacts to pinnipeds hauled-out at Carpenteria State Beach, but I would “argue” that those seals – and sometimes sea lions – are harassed by unleashed dogs about 18 times more than rockets…

The next part of this discussion should be about if we need to amend our LOA to include potential effects of mainland booms or if NMFS can consider including the mainland without a formal amendment?

Thanks!   rhys

--

Leah Davis (she/her)

Biologist, Permits and Conservation Division

Office of Protected Resources | NOAA Fisheries
(301) 427- 8431
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Biological Assessment for

Increase Cadence of Space Launch Vehicle First Stage Recovery Actions and Expanded Landing Areas in the Pacific Ocean at Vandenberg Space Force Base, California

21 March 2024

Prepared for

Space Launch Delta 30, Installation Management Flight Environmental Assets
1028 Iceland Avenue, Bldg. 11146
Vandenberg Space Force Base, California 93437

Prepared by

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

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ACRONYMS AND ABBREVIATIONS

BA	Biological Assessment
C.F.R.	Code of Federal Regulations
DAF	Department of the Air Force
DPS	Distinct Population Segment
EPM	Environmental Protection Measure
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
°F	degrees Fahrenheit
FE	federally endangered
ft	foot or feet
FT	federally threatened
LOC	Letter of Concurrence
mi	mile(s)
NCI	Northern Channel Islands
NLAA	not likely to adversely affect
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
psf	pounds per square foot
SLC	Space Launch Complex
USFWS	United States Fish and Wildlife Service
VSFB	Vandenberg Space Force Base

1 Introduction

1.1 Background & Consultation History

The purpose of this Biological Assessment (BA) is to address the effects of the addition of Falcon Heavy at Vandenberg Space Force Base (VSFB), increasing Falcon 9 and Falcon Heavy launch, and first stage and booster recoveries to 100 times per year, and expanding the first stage/booster and fairing recovery area in the Pacific Ocean on species listed under the Endangered Species Act (ESA) and designated critical habitat under the jurisdiction of the National Marine Fisheries Service (NMFS). Although the current action also includes the modification and future use of existing Space Launch Complex 6 (SLC-6), there is no impact from that portion of the action on NMFS' resources.

Only those species and designated critical habitat that may be affected by the Proposed Action are discussed in this BA. Consistent with the NMFS requirements for ESA Section 7 analyses, the spatial and temporal overlap of activities with the presence of listed species is assessed in this BA. The definitions used by the Department of the Air Force (DAF) in making the determination of effect under Section 7 of the ESA are based on the United States Fish and Wildlife Service (USFWS) and NMFS Endangered Species Consultation Handbook (USFWS & NMFS 1998). The DAF is the lead agency for the purposes of this BA. The DAF and the project proponents have utilized the best available scientific and commercial data in the preparation of this BA.

The DAF previously completed informal Section 7 consultation with NMFS, which concurred potential impacts were *not likely to adversely affect* the ESA-listed species managed by NMFS, detailed in Table 1.1-1, through a Letter of Concurrence (LOC), issued on 20 January 2023 (hereafter "2023 LOC"; NMFS 2023). The Proposed Change has not modified the action in a manner that would result in different types of stressors or levels of stressors that were not considered in the 2023 LOC; nor would the Proposed Change affect the ESA-listed species previously consulted on or critical habitat in a manner or to an extent not previously considered. The addition of Falcon Heavy to VSFB would not result in new stressors that were not considered in the 2023 LOC. The DAF would not increase the number of first stage/booster landings at VSFB; however, would increase the number of downrange first stage/booster landings on droneships in the Pacific Ocean. This increase would not change the types or levels of stressors to ESA-listed species in the Pacific Ocean (discussed in Section 4). The proposed recovery area is larger than analyzed in the 2023 LOC and overlaps the range of the federally threatened Central North Pacific Distinct Population Segment (DPS) of the green sea turtle (*Chelonia mydas*), which was not included in the NMFS 2023 LOC. All other species, DPSs, and Evolutionary Significant Units (ESUs) considered in the prior BA (30th Space Wing 2022) and 2023 LOC remain the same.

Table 1.1-1. NMFS concurrence on effect determinations for species, DPSs, and ESUs covered under LOC 20 January 2023.

Common Name	Distinct Population Segment or Evolutionarily Significant Units	ESA Status	Effect Determination
Steelhead	Southern California Coast	FE	NLAA
Chinook salmon	4 ESUs[1]	FT	NLAA
Coho salmon	2 ESUs[2]~~[3]~~	FT	NLAA
Green sturgeon	Southern	FT	NLAA
Oceanic whitetip shark	-	FT	NLAA
Scalloped hammerhead shark	Eastern Pacific	FE	NLAA
Green sea turtle	East Pacific	FT	NLAA
Leatherback sea turtle	-	FE	NLAA
Olive ridley sea turtle	Mexico Pacific coast	FE	NLAA
Hawksbill sea turtle	-	FE	NLAA
Loggerhead turtle	North Pacific	FE	NLAA
Blue whale	-	FE	NLAA
Fin whale	-	FE	NLAA
Gray whale	Western North Pacific	FE	NLAA
Humpback whale	Mexico	FT	NLAA
	Central America	FE	
Humpback whale critical habitat	Mexico/Central America DPS	-	NLAA
Killer whale	Southern Resident	FE	NLAA
Sei whale	-	FE	NLAA
Sperm whale	-	FE	NLAA
Guadalupe fur seal	-	FT	NLAA

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

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

FE = federally endangered; FT = federally threatened; NLAA = not likely to adversely affect.

2 Description of the Action and the Action Area

2.1 Action Area

The action area is defined in 50 Code of Federal Regulations (C.F.R.) § 402.02 as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." In general, the action area includes the portions of the Pacific Ocean where launch, reentry, and recovery activities are anticipated (Figure 2.1-1). These activities occur in the marine environment in deep waters between approximately 46-400 nautical miles (nm) off Rockport, California at the northern limit, 575 nm off of southern Mexico at the southern limit, and 490 nm east of Hawaii at the western limit (Figure 1.1-1). No recovery activities would occur within 12 nm of islands. The only component of the Proposed Action that occurs less than 12 nm from the U.S. are marine vessels transiting to and from a port in support of first stage and fairing recovery activities. These nearshore vessel transit areas in the action area include marine waters that lead to the Port of Long Beach and the VSFB Harbor.

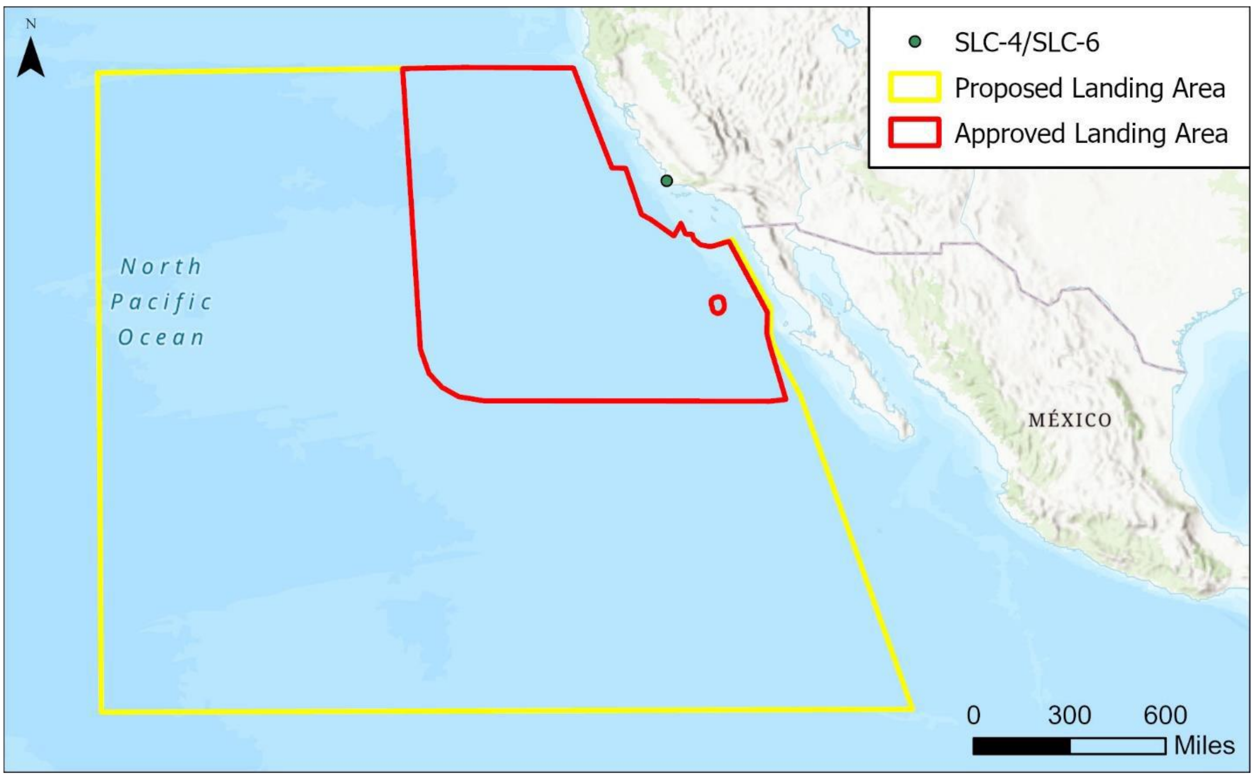

Figure 2.1-1. Proposed landing area. (Note: at this scale, SLC-4 and SLC-6 are in practically the same location)

2.2 Proposed Action

The Proposed Action will maintain the annual number of space launch activities from VSFB at 110 launches per year, as analyzed in the 2023 LOC. The DAF also proposes to increase the annual number of first stage recoveries from 36 per year, as approved in the 2023 LOC, to 100 either downrange on a droneship or at landing zones at VSFB, but not more than 36 per year at landing zones at VSFB, and expand potential downrange droneship landing and fairing recovery locations in the Pacific Ocean to accommodate new trajectories and the addition of Falcon Heavy (Figure 2.1-2). Launches and recovery operations would continue to occur day or night, at any time during the year.

2.2.1 Launch Operations

Launch operations would be performed in the same manner as analyzed in the 2023 LOC. Space launch vehicles (commonly termed rockets) at VSFB place a payload into space by vertical launch. For expendable launch vehicles, the first stage and fairing would fall into the Pacific Ocean after stage separation and sink to the ocean floor. The fairing consists of two halves which separate, allowing the deployment of the payload at the desired orbit. First stage boosters and fairings are composed of heavy-duty metal components but may also include some carbon composite components that may float for several days (10 days maximum) before becoming waterlogged and sinking. Both expendable and reusable rockets at VSFB use liquid oxygen and either kerosene or alcohol as propellants. Current and reasonably foreseeable launch vehicles at VSFB are listed in Table 2.2-1.

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

Launch Vehicle	Operator	Type	Launch Site
Alpha	Firefly	Expendable	SLC-2
Daytona-E	Phantom	Expendable	SLC-5/SLC-8
Falcon 9	SpaceX	Reusable/Expendable	SLC-4/SLC-6
Falcon Heavy	SpaceX	Reusable/Expendable	SLC-6
Laguna-E	Phantom	Expendable	SLC-5
Minotaur IV/Peacekeeper	Northrop Grumman	Expendable	SLC-8
New Glenn	Blue Origin	Expendable	SLC-9
RSL	ABL	Expendable	LF-576E
Terran 1	Relativity	Expendable	SLC-11
Vulcan	ULA	Expendable	SLC-3

As analyzed previously, launches may occur from any launch facility on VSFB. Engine noise produced during launches would primarily impact VSFB and the surrounding area. During ascent, a sonic boom (overpressure of impulsive sound) with a peak generated over a relatively small area, typically between 3.0 to 5.0 pounds per square foot (psf), but potentially as high as 8.0 psf, would be generated. Depending on the launch trajectory, the sonic boom may or may not impact the surface of the earth. When sonic booms do impact the earth's surface, they primarily impact the Pacific Ocean, but may overlap the Northern Channel Islands (NCI). The levels and anticipated impact locations of sonic booms would not change from those previously analyzed in the 2023 LOC.

2.2.2 First Stage/Booster Recovery Operations

The Proposed Action would continue to conduct boost-back and landing of first stage/boosters downrange in the Pacific Ocean on a droneship within the proposed landing area (Figure 2.1-1) or at a landing complex on VSFB. Currently the only active landing complex on VSFB is at Space Launch Complex (SLC) 4; however, SpaceX will develop a second landing zone near SLC-6. The annual number of first stage/booster recoveries would increase from 36 (as analyzed in the 2023

LOC) to 100; however, the annual number of first stage/booster landings at landing complexes on VSFB would not increase from 36, which was analyzed in the 2023 LOC.

After the first stage engine cutoff and separation from the second stage, a subset of the first stage engines restart to conduct a reentry burn. Once the first stage is in position and approaching its landing target, the engines are cut off. A final burn is performed to slow the first stage to a velocity of zero for landing on the droneship or at VSFB. During descent, the first stage will produce engine noise and sonic booms. Engine noise during downrange droneship landing operations would only impact open ocean and would not impact mainland or islands. As analyzed in the 2023 LOC, engine noise produced during landing operations at VSFB would primarily impact areas on VSFB. Landing engine noise follows launch and associated launch engine noise by approximately 5 to 7 minutes and typically occurs slightly before the sonic boom impacts land. During descent, when a first stage/booster is supersonic, a sonic boom (overpressure of high-energy impulsive sound) would be generated, as analyzed in the 2023 LOC. Overpressure levels for the Falcon Heavy booster landings at SLC-6 would be similar to those for Falcon 9 first stage landings, except higher overpressure levels are expected centered on the landing pad, due to the vehicle transitioning from supersonic to subsonic at a lower altitude (Figure 2.2-1). While Figure 2.2-1 shows two sonic boom footprints, each for one Falcon Heavy booster landing, each recovery operation may involve two nearly simultaneous booster landings at SLC-6, such that multiple booms are expected to occur at nearly the same time from both vehicles. (Figure 2.2-3). During landing events at VSFB or in offshore areas near VSFB, sonic booms may continue to impact the NCI at the same levels and geographic locations as analyzed in the 2023 LOC.

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

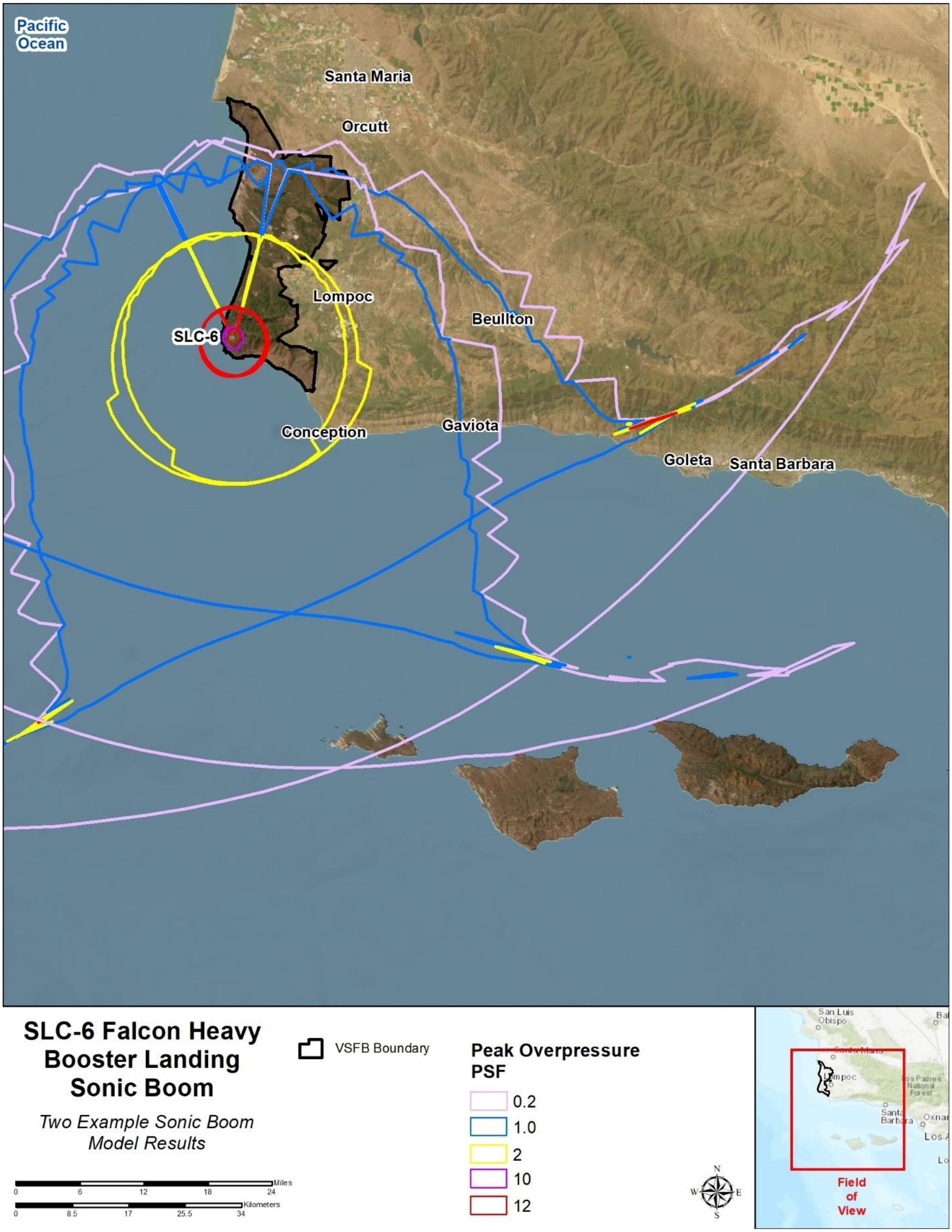

Figure 2.2-1. Examples of two sonic boom model results for Falcon Heavy boost landing at SLC-6.

2.2.3 Fairing Recovery Operations

Fairing recovery operations would increase from 36 to up to 100 per year. Up to 200 parachutes and 200 parafoils would land in the ocean annually. All parachutes and parafoils are meant to be recovered and they have been recovered during the majority of operations, but it is possible that some of the parafoils would not be recovered due to sea or weather conditions at the time of recovery. Parafoils are made of nylon and are expected to sink at a rate of approximately 1,000 feet (ft) in 145.5 minutes (NMFS 2022). Recovery of the parachute assembly would be attempted if the recovery team can get a visual fix on the splashdown location. Because the parachute assembly is deployed at a high altitude, it is difficult to locate. In addition, based on the size of the assembly and the density of the material, the parachute assembly would saturate and begin to sink upon impact. This would make recovering the parachute assembly difficult and unlikely. Parachutes are made of nylon and Kevlar and are expected to sink at a rate of approximately 1,000 ft in 46 minutes (NMFS 2022).

The fairing and parafoil would be recovered by a salvage ship stationed in the Proposed Landing Area near the anticipated splashdown site, but no closer than 12 nm offshore (Figure 2.1-1). The salvage ship would be able to locate the fairing using GPS data from mission control and strobe lights on the fairing data recorders. Upon locating the fairing, a rigid hulled inflatable boat would be launched. Crew members would hook rig lines to the fairing and connect a buoy to the parafoil. Then the crew would release the parafoil riser lines and secure the canopy by placing it into a storage drum. If sea or weather conditions are poor, recovery of the fairing and parafoil may be unsuccessful.

2.2.4 Environmental Protection Measures

The DAF will continue to ensure the following Environmental Protection Measures (EPMs) are implemented to reduce the risk of injury or mortality of ESA-listed species:

- The DAF will ensure that all personnel associated with vessel support operations are instructed about marine species and any critical habitat protected under the ESA that could be present in the proposed landing area. Personnel will be advised of the civil and criminal penalties for harming, harassing, or killing ESA-listed species.
- Support vessels will maintain a minimum distance of 150 ft from sea turtles and a minimum distance of 300 ft from all other ESA-listed species. If the distance ever becomes less, the vessel will reduce speed and shift the engine to neutral. Engines would not be re-engaged until the animal(s) are clear of the area.
- Support vessels will maintain an average speed of 10 knots or less.
- Support vessels will attempt to remain parallel to an ESA-listed species' course when sighted while the watercraft is underway (e.g., bow-riding) and avoid excessive speed or abrupt changes in direction until the animal(s) has left the area.
- The DAF will immediately report any collision(s), injuries, or mortalities to ESA-listed species to the appropriate NMFS contact.

3 Description of the Species

The list of ESA-listed endangered and threatened species that may be affected by the Proposed Change were obtained from the NMFS endangered species web sites, species experts, and a review of available literature. Table 1.1-1 lists the ESA-listed species under NMFS jurisdiction that may be affected by the Proposed Change that were previously analyzed in the 2023 LOC. The Proposed Change has not modified the action in a manner that would result in different types of stressors or levels of stressors that were not considered in the 2023 LOC; nor would the Proposed Change affect ESA-listed species or critical habitat in a manner or to an extent not previously considered. The proposed recovery area is larger than analyzed in the 2023 LOC and overlaps the range of the federally threatened Central North Pacific DPS of the green sea turtle which was not included in the 2023 LOC. All other species, DPSs, and ESUs considered in the prior BA and 2023 LOC remain the same. As a result, a description is only provided for the Central North Pacific DPS of the green sea turtle.

3.1 Green Sea Turtle (*Chelonia mydas*)

3.1.1 Distribution

The green sea turtle is found in tropical and subtropical coastal and open ocean waters, between 30° North and 30° South. Green sea turtles are widely distributed in the subtropical coastal waters of southern Baja California, Mexico, and Central America (Cliffton et al. 1995; NMFS and USFWS 1998). The range of the Central North Pacific DPS includes the Hawaiian Archipelago and Johnston Atoll, bound by 41° North 169° East in the northwest corner, 41° North 143° West in the northeast, 9° North 125° West in southeast, and 9° North 175° West in the southwest. Balazs et al. (2015) estimated the total nester abundance at 4,000 females, with 96 percent of nesting occurring at one atoll at the French Frigate Shoals.

3.1.2 Critical Habitat

Critical habitat has not been designated in the Action Area.

4 Analysis of Effects of the Proposed Action

As discussed in the prior BA and analyzed in the 2023 LOC, acoustic impacts as a result of the Proposed Action are limited to in-air noise as a result of sonic boom or rocket engine noise. Exceptionally little sound is transmitted between the air-water interface; thus, in-air sound would not have a significant effect on submerged animals (Godin 2008). Therefore, increasing the number of downrange droneship recoveries to 100, and thus the number of noise events on the open ocean, would have no effect on ESA-listed fish species.

In addition, cetaceans and sea turtles spend most of their time (>90% for most species) entirely submerged below the surface. When at the surface, their bodies are almost entirely below the water's surface, with only the blowhole or turtle's head exposed briefly to allow breathing. This minimizes in-air noise exposure, both natural and anthropogenic, essentially 100 percent of the time because their ears are nearly always below the water's surface. As a result, increasing the number of downrange droneship recoveries to 100 per year, and thus the number of noise events on the open ocean, will not have an effect on ESA-listed sea turtles or cetacean species.

Similarly, when at-sea, pinnipeds spend varying amounts of time underwater and the potential for disruption from in-air noise within the limited area of potential exposure during the brief moment of the sonic boom or engine noise is extremely unlikely for animals that are at sea. As a result, increasing the number of downrange droneship recoveries to 100 per year, and thus the number of noise events on the open ocean, would have no effect on ESA-listed Guadalupe fur seals that are at-sea.

The proposed increase in the number of weather balloons and fairing recovery operations would not change the effects analysis in the prior BA and 2023 LOC. Unrecovered parafoils, parachutes, and weather balloons could potentially become entangled with ESA-listed species, causing injury or death. While these materials may pose a risk of entanglement, the likelihood of entanglement is extremely small because: (1) the encounter rate for these expended materials is low, (2) there is restricted overlap with susceptible species, and (3) the physical characteristics of the expended materials reduce entanglement risk to ESA-listed species compared to abandoned fishing gear. For example, latex weather balloons burst after reaching its elastic limit at an altitude of 12 to 19 miles (mi). The temperature at this altitude range can reach negative 40 Fahrenheit (^{o}F) and even colder. Under these conditions of extreme elongation and low temperature, the balloon undergoes "brittle fracture" where the rubber shatters along grain boundaries of crystallized segments. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989). The balloon fragments would be positively buoyant, float on the surface, and begin to photo-oxidize due to UV light exposure. In addition, unrecovered parafoils and parachutes would sink quickly through the water column, at 7 ft and 22 ft per minute, respectively, and settle (NMFS 2022). These activities would typically occur far offshore in deep waters where they are not expected to be encountered by ESA-listed species potentially affected by the Proposed Action. Entanglement with parachutes, unrecovered parafoils, or weather balloons therefore remains extremely unlikely and therefore the risk of entanglement is very low, as analyzed in the prior BA and 2023 LOC.

Similarly, the risk of ingestion of expended materials remains very low and discountable, as analyzed in the prior BA and 2023 LOC. Pieces of weather balloons, parachutes, or parafoils may pose an ingestion stressor to ESA-listed species. Parachutes and parafoils would sink rapidly (discussed above) and settle on the ocean floor, typically far from shore at depths greater than the ESA-listed species are expected to occur and where ultraviolet light would not penetrate. Because the degradation of these materials would be very slow and the presence of the ESA-listed species at these depths is unlikely the risk of ingestion of parachute or parafoil materials by ESA-listed species would remain very low and discountable. As discussed above, weather balloons would undergo "brittle fracture", and shatter into pieces approximately the size of a quarter (Burchette 1989). These pieces would become dispersed over a broad area as they fall to the surface of the ocean. The balloon fragments would be positively buoyant, float on the surface, and degrade over approximately 6 weeks as they photo-oxidize due to UV light exposure (Burchette 1989). After several weeks, the pieces of latex would be smaller and become neutrally buoyant (Ye and Andrady 1991; Lobelle and Cunliffe 2011). Because of the small amount of latex material expended, the dispersion of fragments as they descend to the ocean, and their limited amount of time on the surface, and low densities of ESA-listed species in the action area, the risk of ingestion of weather balloon material remains very low and discountable, as analyzed in the prior BA and 2023 LOC.

The proposed recovery area is larger than analyzed in the 2023 LOC and overlaps the range of the federally threatened Central North Pacific DPS of the green sea turtle, which was not included in the NMFS 2023 LOC and is therefore analyzed below. The potential effects to all other species, DPSs, and ESUs considered in the prior BA and 2023 LOC remain the same.

4.1 Direct and Indirect Effects on the Central North Pacific Green Sea Turtle DPS

This section evaluates how, and to what degree, the activities described in Chapter 2 potentially impact the ESA-listed Central North Pacific DPS of the green sea turtle. The stressors and effects are the same as were determined in the prior BA and 2023 LOC since green sea turtles of the Central North Pacific DPS are physically, behaviorally, and functionally essentially the same as the green sea turtle DPSs analyzed in the prior BA. The stressors considered are:

- Physical disturbance and impacts by fallen objects
- Entanglement
- Ingestion
- Ship Strike
- Indirect Effects
- Cumulative Effects

The DAF has identified no interrelated or interdependent projects that would impact the Central North Pacific DPS of the green sea turtle within the Action Area.

4.1.1 Physical Disturbance and Impacts by Fallen Objects

If a fairing or radiosonde struck a green sea turtle, it could result in injury or death. Once within the water column, disturbance or strike from an item falling through the water is possible, but its velocity would be greatly reduced (reducing the potential for serious injury) and the falling object could potentially be avoided by marine species once detected. A low possibility exists that a green sea turtle would be at or just under the surface in the impact area at the time of splashdown, but population-level impacts would not occur. In addition, green sea turtles occur in very low densities throughout the proposed landing area (U.S. Department of the Navy 2017), therefore, the probability of a strike would be very unlikely and discountable.

Therefore, the DAF has determined physical disturbance and potential strike as a result of the Proposed Change would be discountable and may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle.

4.1.1 Entanglement

Unrecovered parafoils, parachutes, and weather balloons can potentially become entangled with green sea turtles, causing injury or death. While individual turtles could encounter expended materials that may pose a risk of entanglement, the likelihood of entanglement is extremely small because: (1) the encounter rate for these expended materials is low, (2) there is restricted overlap with susceptible turtles, and (3) the physical characteristics of the expended materials reduce entanglement risk to green sea turtles compared to abandoned fishing gear. For example, latex weather balloons burst after reaching its elastic limit at an altitude of 12 to 19 mi. The temperature at this altitude range can reach negative 40 ^{o}F and even colder. Under these conditions of extreme elongation and low temperature, the balloon undergoes "brittle fracture" where the rubber shatters along grain boundaries of crystallized segments. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989). The balloon fragments would be positively buoyant, float on the surface, and begin to photo-oxidize due to UV light exposure. In addition, unrecovered parafoils and parachutes would sink quickly through the water column, at 7 ft and 22 ft per minute, respectively, and settle (NMFS 2022). These activities will typically occur far offshore in deep waters where they are not expected to be encountered by green sea turtles potentially affected by the Proposed Action. Entanglement with parachutes, unrecovered parafoils, or weather balloons is therefore extremely unlikely and therefore the risk of entanglement is very low.

As a result, the DAF has determined that entanglement stressors introduced into the marine environment as a result of the Proposed Action may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle species because the potential impacts are discountable.

4.1.2 Ingestion Stressors

Pieces of weather balloons, parachutes, or parafoils may pose an ingestion stressor to green sea turtles. Ingestion of expended materials by turtles could occur at or just below the surface, in the water column, or at the seafloor depending on the size and buoyancy of the expended object and the feeding behavior of the turtle. Floating material is more likely to be eaten by a turtle that is feeding at or just under the water's surface.

Parachutes and parafoils are made of nylon and Kevlar and thus do not degrade quickly. Photooxidation would break down nylon, however, the parachutes and parafoils would sink rapidly (discussed above) and settle on the ocean floor, typically far from shore at depths greater than the green sea turtles discussed herein are expected to occur and where ultraviolet light would not penetrate. Because the degradation of these materials would be very slow and the presence of the green sea turtle species at these depths is unlikely the risk of ingestion of parachute or parafoil materials by green sea turtle would be very low and discountable.

Weather balloons would burst at an altitude of 12 to 19 mi where temperatures can reach negative 40 ^{o}F and even colder. As discussed above, the balloon would undergo "brittle fracture", and shatter into pieces approximately the size of a quarter (Burchette 1989). These pieces would become dispersed over a broad area as they fall to the surface of the ocean. The balloon fragments would be positively buoyant, float on the surface, and degrade over approximately 6 weeks as they photo-oxidize due to UV light exposure (Burchette 1989). After several weeks, the pieces of latex would be smaller and become neutrally buoyant (Ye and Andrady 1991; Lobelle and Cunliffe 2011). Because of the small amount of latex material expended, the dispersion of fragments as they descend to the ocean, and their limited amount of time on the surface, and low densities of green sea turtle in the action area, the risk of ingestion of weather balloon material is very low and discountable.

Therefore, the DAF has determined that ingestion stressors introduced into the marine environment as a result of the Proposed Action may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle because the potential impacts are discountable.

4.1.3 Ship Strike

Support vessels which would be used during first stage and fairing recover activities have the potential to strike green sea turtles that are at or near the surface of the water. Any of the sea turtles found in the action area can occur at or near the surface in open ocean, whether feeding or periodically surfacing to breathe. However, green sea turtles spend a majority of their time submerged (Hochscheid et al. 1999; Rice & Balazs 2008). Green sea turtles forage along the sea floor and are more likely to forage nearshore shallow environments (Hochscheid et al. 1999; Rice & Balazs 2008), outside of the proposed landing area. Green sea turtles occur in low densities in the action area and are widespread and scattered at sea. Therefore, ship strikes of green sea turtles would be very unlikely. Additionally, the probability of a strike would be further reduced by implementation of the EPMs, discussed in Section 2.2.4. As a result, the DAF has determined that strike stressors as a result of the Proposed Action may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle because the potential impacts are discountable.

4.1.4 Indirect Effects

Indirect effects (secondary stressors) on green sea turtles would mainly be associated with the occurrence and availability of prey species and impacts on habitat. For example, the impact of expended materials on the ocean surface might cause injury or induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity of the activity. The abundance of prey species could be diminished for a brief period of time before being repopulated by animals from adjacent waters. Secondary impacts such as these would be temporary, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts under the Proposed Action would not result in a decrease in the quantity or quality of prey species populations or sea turtle habitats in the Action Area.

Therefore, the DAF has determined that indirect effects of the Proposed Action may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle because the potential impacts are insignificant.

4.2 Cumulative Effects on the Central North Pacific Green Sea Turtle DPS

Cumulative effects on green sea turtle species are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the Action Area (50 C.F.R. Section 402.02). For the purposes of this BA and cumulative effects analysis for the Central North Pacific DPS of the green sea turtle, the DAF identified broad categories of activities including commercial fishing and harvest, maritime traffic and vessel strikes, coastal land development, ocean pollution, ocean noise, and offshore energy development. Any impacts that might occur could be additive to behavioral disturbance, injury and mortality associated with other actions within the Action Area. Therefore, this section evaluates risks posed by non-federal activities in the Action Area that could result in cumulative adverse effects on sea turtles.

Based on the listing status of the Central North Pacific DPS of the green sea turtle within the Action Area, there is a clear indication that the current aggregate impacts of past human activities are significant for green sea turtles. Bycatch, vessel strikes, coastal land development, and ocean pollution are the leading causes of mortality and population decline for green sea turtles. Paoching and illegal harvest of eggs within nesting areas are also impactful. Any incidence of injury and mortality that might occur under the Proposed Action, though unlikely and would affect a relatively small number of individuals, could be additive to injury and mortality associated with other actions in the region of influence.

As discussed above, the Central North Pacific DPS of the green sea turtle could be affected by physical disturbance, strike stressors, entanglement stressors, and ingestion stressors. Some stressors could also result in injury or mortality to a relatively small number of individuals but the likelihood of these effects is discountable. It is anticipated that the Proposed Action may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle within the Action Area. Effects from the Proposed Action to green sea turtle food sources would be insignificant. Likewise, the stressors under the Proposed Action generally would not overlap other stressors in space and time as they occur as dispersed, infrequent, and isolated events that do not last for extended periods.

It is possible that the response of a previously stressed animal to impacts associated with the Proposed Action could be more severe than the response of an unstressed animal, or impacts from the Proposed Action could make an individual more susceptible to other stressors. Likewise, the Proposed Action could contribute incremental stressors to individuals, which would both compound effects on a given individual already experiencing stress which may further stress populations in significant decline. Although the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on the Central North Pacific DPS of the green sea turtle in the Action Area, the Proposed Action is not likely to incrementally contribute to declines in populations of the Central North Pacific DPS of the green sea turtle within the Action Area.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on the Central North Pacific DPS of the green sea turtle in the Action Area. The Proposed Action could contribute incremental stressors to individuals, which may further stress populations in significant decline. However, the incremental stressors anticipated from the Proposed Action would be insignificant in light of the relative contribution from the Proposed Action in comparison to other actions and because the Proposed Action generally will not overlap in space and time with other stressors. Therefore, it is anticipated that the Proposed Action may affect, but is not likely to adversely affect the Central North Pacific DPS of the green sea turtle within the Action Area.

5 Conclusion

The DAF proposes to add Falcon Heavy, increase first stage and booster recoveries to 100 times per year, and expand the first stage/booster and fairing recovery area in the Pacific Ocean. The Proposed Change would not modify the action in a manner that would result in different types of stressors or levels of stressors that were not considered in the 2023 LOC; nor would the Proposed Change affect the ESA-listed species previously consulted on or critical habitat in a manner or to an extent not previously considered. The proposed recovery area is larger than analyzed in the 2023 LOC and overlaps the range of the federally threatened Central North Pacific DPS of the green sea turtle, which was not included in the NMFS 2023 LOC. All other species, DPSs, and ESUs considered in the prior BA and 2023 LOC remain the same. After reviewing the Proposed Change, including the EPMs (Section 2.2.4), the DAF has determined that the Proposed Change *may affect, but is not likely to adversely affect* the Central North Pacific DPS of the green sea turtle.

6 Literature Cited

30th Space Wing. 2022. Biological Assessment of Launch Cadence Increase at Vandenberg Space Force Base, California, and Offshore Landing Locations to Support Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service. Prepared by ManTech SRS Technologies, Inc. for 30th Space Wing, Installation Management Flight, Vandenberg Space Force Base, California. 16 December 2022.

Balazs, G.H., K.S. Van Houtan, S.A. Hargrove, S.M. Brunson, and S.K.K., Murakawa. 2015. A Review of the Demographic Features of Hawaiian Green Turtles (*Chelonia mydas*). Chelonian Conservation and Biologiy 14(2): 119-129.

Burchette, D.K. 1989. A Study of the Effect of Balloon Releases on the Environment. Latex Rubber Institute of Malaysia: Environmental Committee of the National Association of Balloon Artists.

Cliffton, K., D.O. Cornejo, and R.S. Felger. 1995. Sea turtles of the Pacific coast of Mexico. In K. A. Bjorndal (Ed.), Biology and Conservation of Sea Turtles (Revised ed., pp. 199-209). Washington, DC: Smithsonian Institution Press.

Godin, O. 2008. Sound transmission through water–air interfaces: new insights into an old problem. Contemporary Physics 49(2): 105-123.

Hochscheid, S., B.J. Godley, A.C. Broderick, and R.P. Wilson. 1999. Reptilian diving: highly variable dive patters in the green turtle *Chelonia mydas*. Marine Ecology Progress Series 185: 101-112.

Lobelle, D., and M. Cunliffe. 2011. Early microbial biofilm formation on marine plastic debris. Marine Pollution Bulletin 62(1): 197–200.

National Marine Fisheries Service. 2022. Programmatic Concurrence Letter for Launch and Reentry Vehicle Operations in the Marine Environment and Starship/Super Heavy Launch Vehicle Operations at SpaceX's Boca Chica Launch Site, Cameron County, TX. Office of Protected Resources, Silver Spring, MD.

National Marine Fisheries Service. 2023. Endangered Species Act Section 7(a)(2) Concurrence Letter for increasing number of launches at the Vandenberg Space Force Base. Reference No: WCRO-2023-00002. 20 January 2023.

Rice, M.R., and G.H. Balazs. 2008. Diving behavior of the Hawaiian green turtle (*Chelonia mydas*) during oceanic migrations. Journal of Experimental Marine Biology and Ecology 356(1-2): 121-127.

U.S. Department of the Navy. 2017. U.S. Navy Marine Species Density Database Phase III for the Hawaii-Southern California Training and Testing Study Area (Naval Facilities Engineering Command Pacific Technical Report). Pearl Harbor, HI: Naval Facilities Engineering Command Pacific.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook Procedures for Conducting Consultation and Conference Activities Under Section 7 of the ESA. U.S. Fish and Wildlife Service and National Marine Fisheries Service.

Ye, S., and A.L. Andrady. 1991. Fouling of floating plastic debris under Biscayne Bay exposure conditions. Marine Pollution Bulletin 22(12): 608–613.

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APPENDIX E
Public Participation

Public Scoping Summary – Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base

The following is a summary of public involvement and stakeholder outreach activities conducted by the United States (U.S.) Department of the Air Force (DAF), in cooperation with the Federal Aviation Administration (FAA) and the U.S. Coast Guard (USCG) during the public scoping period of the Environmental Impact Statement (EIS) for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base, California. Outreach and involvement efforts were conducted in accordance with the National Environmental Policy Act (NEPA). The DAF is the lead agency for the preparation of the EIS and the FAA and U.S. Coast Guard are cooperating agencies.

E.1 Public Scoping Period

The public scoping period began 13 December 2024, which commenced the timeframe the public could submit scoping comments. Open house public scoping meetings were held on 14, 15, and 16 January 2025. The 45-day public scoping period closed on 27 January 2025.

The purpose of public involvement and outreach during the public scoping period was to (1) notify and inform stakeholders and the public about the Proposed Action and the intent to prepare an EIS; and (2) provide the opportunity for stakeholders and the public to submit comments on the scope of the EIS, potential alternatives, environmental concerns, issues that should be addressed in the EIS, and the project's potential to affect historic properties pursuant to Section 106 of the National Historic Preservation Act.

E.1.1 Public Scoping Notification

The DAF prepared materials to notify the public about the project and upcoming public involvement opportunities. All public notices included information about the intent to prepare an EIS, the Proposed Action, the purpose of the open house public scoping meetings and scoping meeting details, how to submit public comments, and the project website address.

E.1.1.1 Federal Register Notice

A Notice of Intent to prepare an EIS was published in the *Federal Register* 13 December 2024, announcing the start of the 45-day comment period, public scoping meeting dates and locations, and project website address. The *Federal Register* notice is shown in Figure E-1.

Figure E-1: Federal Register Notice

100986 **Federal Register** / Vol. 89, No. 240 / Friday, December 13, 2024 / Notices

Honolulu, HI
Contracting Activity: DEPT OF THE ARMY, 0413 AQ HQ
Service Type: Recycling Service
Mandatory for: US Army, US Army Garrison Hawaii, Wheeler Army Airfield, Schofield Barracks, 742 Santos Dumont Avenue, Oahu, HI
Authorized Source of Supply: Goodwill Contract Services of Hawaii, Inc., Honolulu, HI
Contracting Activity: DEPT OF THE ARMY, 0413 AQ HQ
Service Type: Grounds Maintenance
Mandatory for: Constitution Gardens, Washington, DC
Authorized Source of Supply: Melwood Horticultural Training Center, Inc., Upper Marlboro, MD
Contracting Activity: OFFICE OF POLICY, MANAGEMENT, AND BUDGET, NBC ACQUISITION SERVICES DIVISION
Service Type: Administrative Service
Mandatory for: National Park Service: 12795 W Alameda Parkway, Lakewood, CO
Authorized Source of Supply: Bayaud Enterprises, Inc., Denver, CO
Contracting Activity: OFFICE OF POLICY, MANAGEMENT, AND BUDGET, NBC ACQUISITION SERVICES DIVISION

Michael R. Jurkowski,
Director, Business Operations.

[FR Doc. 2024–29425 Filed 12–12–24; 8:45 am]

BILLING CODE 6353–01–P

CONSUMER PRODUCT SAFETY COMMISSION

Sunshine Act Meeting

TIME AND DATE: Wednesday, December 18, 2024—10:00 a.m.

PLACE: 4330 East West Highway, Bethesda, Maryland 20814.

STATUS: Closed Commission Meeting.

MATTER TO BE CONSIDERED: Briefing matter.

CONTACT PERSON FOR MORE INFORMATION: Alberta E. Mills, Office of the Secretary, U.S. Consumer Product Safety Commission, 4330 East West Highway, Bethesda, MD 20814, 301–504–7479 (Office) or 240–863–8938 (Cell).

Dated: December 11, 2024.

Alberta E. Mills,
Commission Secretary.

[FR Doc. 2024–29561 Filed 12–11–24; 4:15 pm]

BILLING CODE 6355–01–P

DEPARTMENT OF DEFENSE

Department of the Air Force

Notice of Intent To Prepare an Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base

AGENCY: Department of the Air Force, Department of Defense.

ACTION: Notice of intent.

SUMMARY: The Department of the Air Force (DAF) is issuing this Notice of Intent (NOI) to prepare an environmental impact statement (EIS) to evaluate the potential environmental effects associated with DAF's authorization of the redevelopment of Space Launch Complex (SLC)–6 to support Falcon 9 and Falcon Heavy operations, including launch and landing at Vandenberg Space Force Base (VSFB); DAF's authorization of an increase in Falcon 9 launches and landings at VSFB and downrange landings in the Pacific Ocean; and the Federal Aviation Administration's (FAA's) issuance or modification of a vehicle operator license to Space Exploration Technologies Corporation (SpaceX) for Falcon 9 and Falcon Heavy operations at VSFB and approval of related airspace closures. The FAA and United States Coast Guard (USCG) are cooperating agencies for this EIS. The Unique Identification Number for this EIS is EISX–007–USF–1728547807.

DATES: A public scoping period of 45 days will take place starting from the date of this NOI publication in the **Federal Register**. To ensure the DAF has sufficient time to consider public scoping comments during preparation of the Draft EIS, please submit comments within the 45-day scoping period. Comments will be accepted at any time during the environmental impact analysis process.

The DAF invites the public, stakeholders, and other interested parties to attend one or more of three in-person scoping meetings or the virtual scoping meeting. In-person meetings will be held in the evenings of January 14th, 15th, and 16th 2025. The exact location and scheduled time for public scoping meetings will be published in local newspapers (Lompoc Record, Los Angeles Times, Ojai Valley News, Santa Barbara Independent, Santa Maria Times, and Ventura County Star) and on the project website a minimum of 15 days prior to the meetings. A virtual meeting is scheduled for January 23rd, 2025, at 6 p.m. Pacific time. Information on how to attend the virtual meeting is available on the project website (*www.VSFBFalconLaunchEIS.com*). The meetings will provide an opportunity for attendees to learn more about the Proposed Action and Alternatives and provide an early and open process to assist the DAF and its Cooperating Agencies in determining the scope of issues for analysis in the EIS, including identifying significant environmental issues and those which can be eliminated from further study. Project team members will be available to answer questions about the Proposed Action, and there will also be an opportunity to provide oral and written comments. Scoping meeting materials will be provided in English and Spanish.

Publication of the Draft EIS is anticipated in March 2025, which will be followed by a 45-day comment period with public hearing opportunities. The Final EIS is anticipated in September 2025. The Record of Decision could be approved and signed no earlier than 30 days after the Final EIS.

ADDRESSES: The project website (*www.VSFBFalconLaunchEIS.com*) provides information related to the EIS, such as environmental documents, schedule, public meeting locations, and project details, as well as a comment form and information on how to comment. Comments may be submitted via the website comment form, emailed to *info@VSFBFalconLaunchEIS.com*, or mailed to ATTN: VSFB Falcon Launch EIS, c/o ManTech International Corporation, 420 Stevens Avenue, Suite 100, Solana Beach, CA 92075. Members of the public who want to receive future mailings informing them of the availability of the Draft EIS and Final EIS are encouraged to submit a comment that includes their name and email or postal mailing address. For other inquiries, including accommodations under the Americans with Disabilities Act, please contact Ms. Hilary Rummel, NEPA Project Manager at *info@VSFBFalconLaunchEIS.com* or VSFB Public Affairs office by phone at 1–805–606–3595.

SUPPLEMENTARY INFORMATION: The purpose of the Proposed Action is to increase the space launch mission capability of the U.S. Department of Defense (DOD) and other federal and commercial customers and to enhance the resilience and capacity of the nation's space launch infrastructure, while promoting a robust and competitive national space industry. As directed by U.S. policy (10 U.S.C. 2273, "Policy regarding assured access to space: national security payloads"; see

Figure E-1: Federal Register Notice (continued)

also the White House's 2021 Space Priorities Framework), the United States seeks to provide greater launch and landing capabilities and infrastructure to support national security objectives, including deploying satellites and other space assets that enable intelligence, reconnaissance, and global security operations. The United States aims to promote a hybrid space architecture that diversifies access to space, reduces dependency on singular systems, and ensures rapid reconstitution capabilities.

The Proposed Action is needed to meet current and near-term U.S. Government space launch requirements from the DoD space launch range that supports launches centered at VSFB (Western Range), specifically for medium and heavy lift launches to polar, geostationary, and other orbits less reliably available elsewhere without compromising current launch capabilities. The Proposed Action is also needed to expand launch capacity by returning heavy lift launch capability to the Western Range. Finally, the proposed action is needed to fulfill (in part) 10 U.S.C. 2276(a), "Commercial space launch cooperation," authorizing the Secretary of Defense to maximize the use of the capacity of the space transportation infrastructure of the DOD by the private sector in the U.S.: maximize the effectiveness and efficiency of the space transportation infrastructure of the DOD; reduce the cost of services provided by the DOD related to space transportation infrastructure and launch support facilities and space recovery support facilities; encourage commercial space activities by enabling investment by covered entities in the space transportation infrastructure of the DOD; and foster cooperation between DOD and covered entities. "Covered entity" means a non-federal entity that is organized under the laws of the U.S. or of any jurisdiction within the U.S. and is engaged in commercial space activities.

Additionally, public interests largely intersect with the government interests identified, including greater mission capability for space exploration, and advancing reliable and affordable access to space which in turn advances the scientific and national security benefits of the U.S.Space Program.

The DAF has identified a Proposed Action, Alternative 1, and the No Action Alternative to be carried forward for analysis in the EIS. Under the Proposed Action, the DAF would authorize Falcon 9 and Falcon Heavy launch and landing operations at SLC–6, including modifications to SLC–6 required to support those operations and construction of landing zones. The DAF would also authorize an increase in Falcon 9 launches from SLC–4, which currently hosts Falcon 9 launch operations, and an increase in downrange landings on a droneship in the Pacific Ocean. The overall launch cadence for Falcon 9 and Falcon Heavy at both SLCs, combined, would be 100 launches per year. No modification of SLC–4 infrastructure is proposed. The FAA would issue or modify a vehicle operator license for Falcon 9 and Falcon Heavy operations and approve corresponding temporary airspace closures for operations. Under the Proposed Action, the existing horizontal integration facility (HIF) located north of SLC–6 would be modified into a hangar for use by SpaceX to support Falcon 9 and Falcon Heavy operations. Alternative 1 is the same as the Proposed Action except rather than modifying the existing HIF, DAF would authorize SpaceX to construct a new hangar south of the HIF and north of the launch pad at SLC–6. Under the No Action Alternative, the DAF would not authorize any Falcon 9 or Falcon Heavy launches or landing operations at, or modifications to, SLC–6, nor would the DAF authorize additional Falcon 9 launches from SLC–4. SpaceX would not apply for an FAA vehicle operator license for Falcon operations at SLC–6 or increased launches from SLC–4.

Potential effects may include noise, air quality, and hazardous material effects associated with launch and landing operations and construction, as well as effects on biological and cultural resources due to ground disturbance, and operational noise and vibrations. A full assessment of potential impacts to all relevant resource areas will be included in the EIS, including an analysis of environmental effects of the Proposed Action and Alternatives when added to the effects of other past, present, and reasonably foreseeable future actions. As part of that effort, the cumulative impacts analysis in the EIS will examine the effects of the Proposed Action that was the subject of the Environmental Assessment of Falcon 9 Cadence Increase at Vandenberg Space Force Base, California (EAXX–007–57–USF–1724161195), the final of which was published in November 2024. SpaceX would be required to obtain or modify an FAA vehicle operator license for Falcon 9 and Falcon Heavy at SLC–6, which could include launch, reentry, or both. A National Pollutant Discharge Elimination System permit may be required. The Proposed Action and Alternatives are within wetlands and floodplains; therefore, the Proposed Action is subject to the requirements and objectives of Executive Order 11988 "Floodplain Management" and Executive Order 11990 "Protection of Wetlands", and this NOI initiates early public review and requests public comment on the Proposed Action and any practicable alternatives.

Scoping and Agency Coordination: Consultation will include, but not necessarily be limited to, consultation under section 7 of the Endangered Species Act, consultation under section 106 of the National Historic Preservation Act, to include consultation with federally recognized Native American Tribes, and consultation under the Coastal Zone Management Act. Regulatory agencies with special expertise in wetlands and floodplains, such as the U.S. Army Corps of Engineers, will be contacted and asked to comment. Comments are requested on alternatives and effects, as well as on relevant information, studies, or analyses with respect to the Proposed Action.

Tommy W. Lee,

Acting Air Force Federal Register Liaison Officer.

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DEPARTMENT OF DEFENSE

Department of the Air Force

Notice of Adoption of Categorical Exclusions Under the National Environmental Policy Act; Correction

AGENCY: Department of the Air Force, Department of Defense.

ACTION: Notice of adoption of categorical exclusions; correction.

SUMMARY: This document corrects the description for five categorical exclusions (CATEXes) adopted by the Department of the Air Force through posting in the **Federal Register** on 25 November 2024.

FOR FURTHER INFORMATION CONTACT: Mr. Jack Bush, DAF NEPA Policy and Execution Oversite, 703–695–1773, *af.a4c.nepaworkflow@us.af.mil.*

SUPPLEMENTARY INFORMATION:

Correction

In the **Federal Register** of November 25, 2024, in FR Doc. 2024–27545, on pages 92912 and 92913, the following corrections are made:

On page 92912 in the third column for DON CATEX (f)(27), the word "like" is corrected to "similar to" in the sentence.

E.1.1.2 Stakeholder Notification Letter

The SLD 30 Commander signed personalized notification letters to 68 federal and local elected officials, government agencies, and nongovernmental organizations. The DAF outreach team mailed the letters first-class 13 December 2024. An example of this letter is shown in Figure E-2.

E.1.1.3 Stakeholder Database

The DAF outreach team developed a stakeholder database to manage and document the distribution of project notices.

E.1.1.4 Newspaper Advertisements

Display advertisements were published two times in daily newspapers and once in weekly newspapers beginning 16 December 2024, through 2 January 2025. Additional advertisements were published prior to the public scoping meetings from 9 January 2025 through 15 January 2025. A Spanish translated newspaper ad was also published. The newspapers and publication dates are shown in Table E-1. The English newspaper advertisement is shown in Figure E-3, and the Spanish newspaper advertisement is shown in Figure E-4.

Table E-1. Newspaper Publications for Public Scoping Period

Newspaper	Newspaper Coverage	Publication Schedule	Publication Dates
Los Angeles Times	Los Angeles County	Daily	Monday, 16 December 2024 Sunday, 22 December 2024 Sunday, 12 January 2025 Monday, 13 January 2025
Lompoc Record	Lompoc	Weekly	Wednesday, 18 December 2024 Wednesday, 13 January 2025
Santa Maria Times en Espanol (Spanish e-newspaper)	Santa Maria Valley	Daily; full week runs	Friday, 20 December 2024 Friday, 10 January 2025
Ventura County Star	Ventura County	Daily, except Saturday	Friday, 20 December 2024 Sunday, 22 December 2024 Friday, 10 January 2025 Sunday, 12 January 2025
Ojai Valley News	Ojai Valley	Daily online; Friday print only	Friday, 20 December 2024 Friday, 10 January 2025
Santa Barbara Independent	Greater Santa Barbara area	Weekly	Thursday, 2 January 2025* Thursday, 9 January 2025

*The Santa Barbara Independent made an error causing the initial publication date of 19 December 2024 to be missed. Due to the publication error the ad instead ran on 2 January 2025.

Figure E-2. Scoping Notification Letter (Example)

DEPARTMENT OF THE AIR FORCE
UNITED STATES SPACE FORCE
SPACE LAUNCH DELTA 30

December 13, 2024

Salutation1 First Name Last Name
Title
Organization
Address 1&2
City, State ZIP

Dear Salutation2 Last Name:

The Department of the Air Force (DAF) is preparing an Environmental Impact Statement (EIS) to evaluate the potential environmental effects associated with:

- DAF's authorization of the redevelopment of Space Launch Complex (SLC)-6 to support Falcon 9 and Falcon Heavy operations, including launch and landing at Vandenberg Space Force Base (VSFB);

- DAF's authorization of an increase in Falcon 9 launches and landings at VSFB and downrange landings in the Pacific Ocean; and

- The Federal Aviation Administration's (FAA's) issuance or modification of a vehicle operator license to Space Exploration Technologies Corporation (SpaceX) for Falcon 9 and Falcon Heavy operations at VSFB and approval of related airspace closures.

The DAF has identified a Proposed Action, Alternative 1, and the No Action Alternative to be carried forward for analysis in the EIS. The DAF is the lead federal agency, with the FAA and United States Coast Guard as cooperating agencies. The successful completion of the environmental review process does not guarantee that the FAA would issue a vehicle operator license. The project must also meet all FAA safety, risk, and indemnification requirements for the appropriate license.

The DAF requests your input on the Proposed Action and assistance in identifying any potential areas of environmental impact to be assessed in this analysis under the National Environmental Policy Act (NEPA), and the project's potential to affect historic properties pursuant to Section 106 of the National Historic Preservation Act (NHPA). Additionally, the Proposed Action and Alternatives are within wetlands and floodplains; therefore, the Proposed Action is subject to the requirements and objectives of Executive Order 11988 "Floodplain Management" and Executive Order 11990 "Protection of Wetlands", and this notification initiates early public review and requests public comment on the Proposed Action and any practicable alternatives.

The DAF will hold three in-person public scoping meetings and a virtual public scoping meeting to inform the public about the Proposed Action and accept comments on the scope of the analysis. During the in-person public scoping meetings, project team members will be available

Figure E-2. Scoping Notification Letter (Example) (continued)

to provide information, and there will be an opportunity to provide oral and written comments. Scoping meeting materials will be provided in English and Spanish at the in-person scoping meetings and online at **www.VSFBFalconLaunchEIS.com**.

IN-PERSON PUBLIC SCOPING MEETINGS (5 p.m. – 8 p.m. Pacific Time)

Tuesday, Jan. 14, 2025	Veterans of Foreign Wars Post 1679, 3801 Market St., Ventura, CA
Wednesday, Jan. 15, 2025	Westside Neighborhood Center, 423 W. Victoria St., Santa Barbara, CA
Thursday, Jan. 16, 2025	Dick DeWees Community Center, 1120 W. Ocean Ave., Lompoc, CA

VIRTUAL PUBLIC SCOPING MEETING (6 p.m. Pacific Time)

Thursday, Jan. 23, 2025 **www.VSFBFalconLaunchEIS.com**

The DAF welcomes the public's participation during the public scoping period from **Dec. 13, 2024**, through **Jan. 27, 2025**. Comments may be submitted at the public meetings, by email to **info@VSFBFalconLaunchEIS.com**, online at **www.VSFBFalconLaunchEIS.com**, or by U.S. postal mail to:

ATTN: VSFB Falcon Launch EIS
c/o ManTech International Corporation
420 Stevens Avenue, Suite 100
Solana Beach, CA 92075

To ensure the DAF has sufficient time to consider public scoping comments during preparation of the Draft EIS, please submit comments within the 45-day scoping period, which ends on Jan. 27, 2025. This public scoping effort will also support consultation under Section 106 of the NHPA and its implementing regulations.

If you have any questions regarding the EIS process, please contact Ms. Hilary Rummel, NEPA Project Manager, at info@VSFBFalconLaunchEIS.com or VSFB Public Affairs office by phone 1-805-606-3595. To learn more about this project, please go to **www.VSFBFalconLaunchEIS.com**.

MARK A. SHOEMAKER, Colonel, USSF
Commander, SLD 30

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Figure E-3. Scoping Newspaper Advertisement

NOTICE OF PUBLIC SCOPING MEETINGS
DEPARTMENT OF THE AIR FORCE

The Department of the Air Force invites you to attend Public Scoping Meetings for the Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base

The Department of the Air Force (DAF) is preparing an Environmental Impact Statement (EIS) to evaluate the potential environmental effects associated with:

- DAF's authorization of the redevelopment of Space Launch Complex (SLC)-6 to support Falcon 9 and Falcon Heavy operations, including launch and landing at Vandenberg Space Force Base (VSFB);
- DAF's authorization of an increase in Falcon 9 launches and landings at VSFB and downrange landings in the Pacific Ocean; and
- The Federal Aviation Administration's issuance or modification of a vehicle operator license to Space Exploration Technologies Corporation (SpaceX) for Falcon 9 and Falcon Heavy operations at VSFB and approval of related airspace closures.

PUBLIC PARTICIPATION

The DAF will hold three in-person public scoping meetings and a virtual public scoping meeting to inform the public about the Proposed Action and accept comments on the scope of the analysis. During the in-person public scoping meetings, project team members will be available to provide information, and there will be an opportunity to provide oral and written comments. Scoping meeting materials will be provided in English and Spanish at the in-person scoping meetings and online at **www.VSFBFalconLaunchEIS.com**.

IN-PERSON PUBLIC SCOPING MEETINGS (5 p.m.— 8 p.m. Pacific Time)

Tuesday, Jan. 14, 2025	Veterans of Foreign Wars Post 1679, 3801 Market St., Ventura, CA
Wednesday, Jan. 15, 2025	Westside Neighborhood Center, 423 W. Victoria St., Santa Barbara, CA
Thursday, Jan. 16, 2025	Dick DeWees Community Center, 1120 W. Ocean Ave., Lompoc, CA

VIRTUAL PUBLIC SCOPING MEETING (6 p.m. Pacific Time)

Thursday, Jan. 23, 2025 **www.VSFBFalconLaunchEIS.com**

PUBLIC COMMENTS. Public scoping comments can be submitted in English or Spanish in the following ways:

- In-person at one of the three public scoping meetings
- Via comment form on the project website at: **www.VSFBFalconLaunchEIS.com**
- Email to: **info@VSFBFalconLaunchEIS.com**, with the subject line "*Falcon EIS*"
- Mail to: VSFB Falcon Launch EIS, c/o ManTech International Corporation, 420 Stevens Ave., Suite 100, Solana Beach, CA 92075

Scan for Online Comment Form

This public scoping effort will also support consultation under Section 106 of the National Historic Preservation Act and its implementing regulations. Visit the project website at **www.VSFBFalconLaunchEIS.com** to learn more about the project.

To ensure the DAF has sufficient time to consider public scoping comments during preparation of the Draft EIS, please submit comments within the 45-day scoping period.

Figure E-4. Spanish Translated Scoping Newspaper Advertisement

AVISO DE REUNIONES DE ALCANCE PÚBLICO
DEPARTAMENTO DE LA FUERZA AÉREA

El Departamento de la Fuerza Área le invita a asistir a las Reuniones de Alcance Público sobre la Declaración de Impacto Ambiental para la Autorización de Cambios al Programa de Lanzamiento Falcon en la Base de la Fuerza Espacial Vandenberg

El Departamento de la Fuerza Área (DAF, siglas en inglés) está preparando una Declaración de Impacto Ambiental (EIS, siglas en inglés) para evaluar los posibles efectos ambientales asociados con:

- La autorización de DAF para la remodelación del Complejo Espacial de Lanzamiento (Space Launch Complex) (SLC)-6 para respaldar las operaciones de Falcon 9 y Falcon Heavy, incluido el lanzamiento y aterrizaje en la Base de la Fuerza Espacial Vandenberg (VSFB, siglas en inglés;
- La autorización de DAF para un aumento de lanzamientos y aterrizajes de Falcon 9 en VSFB y aterrizajes para despliegue en el Océano Pacífico; y
- La emisión o modificación por parte de la Administración Federal de Aviación de una licencia de operador de vehículos a Space Exploration Technologies Corporation (SpaceX) para operaciones Falcon 9 y Falcon Heavy en VSFB y la aprobación de cierres de espacio aéreo relacionados.

REUNIONES DE ALCANCE PÚBLICO EN PERSONA (de 5 p.m a 8 p.m. hora Pacífico)

Martes 24 de enero de 2025 - Veterans of Foreign Wars Post 1679, 3801 Market St., Ventura
Miércoles 15 de enero de 2025 - Westside Neighborhood Center, 423 W. Victoria St., Santa Barbara
Jueves 15 de enero de 2025 - Dick DeWees Community Center, 1120 W. Ocean Ave., Lompoc

REUNIÓN VIRTUAL DE ALCANCE PÚBLICO (6 p.m. hora Pacífico)

Jueves, 23 de enero de 2025 - www.VSFBFalconLaunchEIS.com

Visite el sitio web del proyecto en www.VSFBFalconLaunchEIS.com para obtener más información sobre el proyecto.

E.1.1.5 New Release

The SLD 30 Public Affairs Office distributed a news release in English and Spanish to local and regional print and broadcast media outlets 13 December 2024. The news release is shown in Figure E-5.

Figure E-5. Scoping News Release

NEWS RELEASE
Vandenberg Space Force Base

Launch update/
Straight Talk line:
606-VAND

After hours contact:
(805) 606-9961
Facebook:
Vandenberg Space Force Base

Public Affairs · Space Launch Delta 30 · 867 Washington Ave · Vandenberg SFB, CA 93437-6120 · (805) 606-3595 · www.vandenberg.spaceforce.mil

FOR IMMEDIATE RELEASE

Notice of Intent to Prepare an Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base

VANDENBERG SPACE FORCE BASE, Calif. – Dec. 13, 2024 - The Department of the Air Force (DAF) is preparing an Environmental Impact Statement (EIS) to evaluate the potential environmental effects associated with:

- DAF's authorization of the redevelopment of Space Launch Complex (SLC)-6 to support Falcon 9 and Falcon Heavy operations, including launch and landing at Vandenberg Space Force Base (VSFB).
- DAF's authorization of an increase in Falcon 9 launches and landings at VSFB and downrange landings in the Pacific Ocean.
- The Federal Aviation Administration's (FAA's) issuance or modification of a vehicle operator license to Space Exploration Technologies Corporation (SpaceX) for Falcon 9 and Falcon Heavy operations at VSFB and approval of related airspace closures.

The DAF has identified a Proposed Action, Alternative 1, and the No Action Alternative to be carried forward for analysis in the EIS. The successful completion of the environmental review process does not guarantee that the FAA would issue a vehicle operator license. The project must also meet all FAA safety, risk, and indemnification requirements for the appropriate license.

PUBLIC PARTICIPATION

The DAF will hold three in-person public scoping meetings and a virtual public scoping meeting to inform the public about the Proposed Action and accept comments on the scope of the analysis. During the in-person public scoping meetings, project team members will be available to provide information, and there will be an opportunity to provide oral and written comments. Scoping meeting materials will be provided in English and Spanish at the in-person scoping meetings and online at

www.VSFBFalconLaunchEIS.com.

IN-PERSON PUBLIC SCOPING MEETINGS (5 P.M. – 8 P.M. PACIFIC TIME)

- Tuesday, Jan. 14, 2025: Veterans of Foreign Wars Post 1679, 3801 Market St., Ventura, CA
- Wednesday, Jan. 15, 2025: Westside Neighborhood Center, 423 W. Victoria St., Santa Barbara, CA
- Thursday, Jan. 16, 2025: Dick DeWees Community Center, 1120 W. Ocean Ave., Lompoc, CA

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Figure E-5. Scoping News Release (continued)

VIRTUAL PUBLIC SCOPING MEETING (6 P.M. PACIFIC TIME)

- Thursday, Jan. 23, 2025: www.VSFBFalconLaunchEIS.com

SUBMITTING COMMENTS

The public is encouraged to submit comments during the scoping period from Dec. 13, 2024, through Jan. 27, 2025. To ensure the DAF has sufficient time to consider public scoping comments during preparation of the Draft EIS, please submit comments within the 45-day scoping period, which ends on Jan. 27, 2025. Public scoping comments can be submitted in English or Spanish in the following ways:

- In-person at one of the three in-person public scoping meetings
- Via comment form on the project website at: www.VSFBFalconLaunchEIS.com
- Email to: info@VSFBFalconLaunchEIS.com, with the subject line "Falcon EIS"
- Mail to: ATTN: VSFB Falcon Launch EIS c/o ManTech International Corporation 420 Stevens Avenue, Suite 100 Solana Beach, CA 92075

NATIONAL HISTORIC PRESERVATION ACT SECTION 106

This public scoping effort also supports consultation under Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations. Members of the public are invited to participate, provide comments, or raise concerns regarding potential impacts on historic properties. Comments submitted via the project website, email, or by mail will be considered under the National Environment Policy Act (NEPA) and pursuant to Section 106 of the NHPA.

The DAF is committed to meaningful public involvement and will keep the public informed throughout the development of the EIS. Please help DAF inform the community about the intent to prepare an EIS by sharing this information.

Visit the project website at www.VSFBFalconLaunchEIS.com to learn more about the project.

MEDIA AVAILABILITY

If you are interested in attending the media opportunity, or for more information, please contact the SLD 30 Public Affairs Office at 1-805-606-3595 or sld30.pa.workflow@us.af.mil.

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E.1.2 Public Information

E.1.2.1 Project Website

The DAF established a project website (www.VSFBFalconLaunchEIS.com) to provide the public with project information including fact sheets, posters, and a web-based form to submit comments electronically. The project website address is www.VSFBFalconLaunchEIS.com. The website address was included in all public notifications and informational materials.

E.1.2.2 Fact Sheets

The DAF outreach team developed a four-page project fact sheet in English and Spanish that was made available on the project website and during the in-person open house public scoping meetings. The fact sheet included topics such as information on the proposed project and the NEPA process. Additionally, a fact sheet about the VSFB was made available at the scoping meetings.

E.1.2.3 Posters

The DAF outreach team developed nine informational posters that were made available on the project website and during the in-person open house public scoping meetings. Posters included topics such as information on the proposed project and the NEPA process.

E.1.2.4 Open House Public Scoping Meetings

The DAF held three in-person public scoping meetings in California from 14 January 2025, through 16 January 2025. The purpose of the scoping meetings was to inform the public about the Proposed Action and solicit scoping comments. The meetings were held in an open-house format and included poster stations staffed by project representatives who provided information about the Proposed Action and the upcoming environmental impact analysis. A Spanish interpreter was available at each public meeting. The public scoping meetings were held at the following locations.

14 January 2025	**15 January 2025**	**16 January 2025**
5-8 p.m.	**5-8 p.m.**	**5-8 p.m.**
Veterans of Foreign Wars	**Westside Neighborhood Center**	**Dick DeWees**
Post 1679	423 W. Victoria St.	**Community Center**
3801 Market St.	Santa Barbara, CA	1120 W. Ocean Ave.
Ventura, CA		Lompoc, CA

In total, 286 people attended the three open house public scoping meetings. In total, 124 comments, including 123 written comments and one oral comment were submitted at the scoping meetings.

Veterans of Foreign Wars Post 1679, Ventura, Calif.

- 51 attendees
- 25 written comments, 1 oral comment

Westside Neighborhood Center, Santa Barbara, Calif.

- 117 attendees
- 66 written comments

Dick DeWees Community Center, Lompoc, Calif.

- 118 attendees
- 31 written comments

E.1.3 Virtual Scoping Meeting

The DAF held one virtual public scoping meeting on 23 January 2025, beginning at 6:00 p.m. Pacific time. The virtual meeting consisted of a narrated slideshow presentation highlighting the exhibit boards presented at the in-person meetings. There was no question-and-answer session or public oral comment session. In total, 137 individuals attended the virtual public scoping meeting.

E.1.4 Public Scoping Comments

The public scoping period was open from 13 December 2024 to 27 January 2025. The DAF received 1,188 comments during the scoping period. The DAF received 387 comments via email, 664 comments via the project website, 13 comments via U.S. postal mail, and 124 comments at the open house scoping meetings [written comments (123) and oral comments (1)]. Please note that if a comment was submitted by the same person or group more than once via different methods, e.g., the same comment was submitted by U.S. mail and via the website by the same person, it was only counted once. One comment may also include comments on multiple resource areas or topics. A summary of public comments is found in Table E-2. If a similar comment was submitted by multiple people, the number of such comments is shown in the parenthesis.

Table E-2. Summary of Scoping Comments

Resource Area/Topic	Issue/Concern
Air Quality	• Increase in air pollution from increased launches (80). • Concern about the localized depletion of ozone in California (50). • Concern about rocket fuel and increased need with more launches (45). • Rockets create debris, soot, and fiberglass that falls in neighborhoods (35). • Concern about reducing the launch window availability by ‘overcrowding’ the lower atmosphere. • Concern about exceeding the World Health Organization standards in nitrogen oxide emissions. • Request the project obtain an Authority to Construction (ATC) permit from the Santa Barbara County Air Pollution Control District. • Request for the project follow all Santa Barbara County Air Pollution Control District regulations.
Climate Change	• Concern about the increase in greenhouse gas emissions when focus should be on decarbonizing practices (3). • Concern about the contribution of the entire process of design, engineering, construction and satellite launches to global warming (3). • Concern about the launches to impact the local weather (2).

Resource Area/Topic	Issue/Concern
Space Debris	• Presence of space "junk," debris, and pollution from rockets (100). • Include an analysis of the Kessler Syndrome and resulting cumulative or indirect impacts of new satellites and other new orbiting material that would be introduced under the proposed action (10). • Concern about the ability of early detection systems to be confused by "space junk" and not be able to identify potential threats in the lower atmosphere.
Cumulative Impacts	• Concern about cumulative impacts of increasing the launch cadence (30).
Noise	• Concern that sonic booms cause property damage (e.g., cracks appearing in walls or foundations, windows breaking) (890). • Request launches be conducted during daytime hours to reduce noise at night (700). • Concern about increase in noise and sonic booms with increased launches (680). • Concern about noise impacts on pets (415). • Request that all residents receive notice prior to launches via email or text message (100). • Concern that noise is affecting children's sleep patterns and their ability to learn (50). • Disproportionate noise impact on those who reside in mobile homes (3). • Request for the noise study to make a clear distinction between landing operations on the base versus landing operations on drone ships (2). • Concern that sonic booms will impact fault lines in the Proposed Action area (2). • Concern about the creation of a 'sonic boom cone' extending 101 miles in the surrounding areas for each launch. • Request for sonic boom analysis to be measured from real-time launches and maximum permissible sound levels throughout the year rather than computer modeled numbers. • Concern that knowledge of the timing of launches does not help with severe reactions from sonic booms. • Request noise levels inside homes from sonic booms be measured. • Request to include Ojai Valley in the sonic boom analysis. • Request for all sonic boom field measurements collected from Santa Barbara to Malibu to be made public. • Request that noise complaints submitted to VSFB between the Environmental Assessment comment period and now should be considered in the noise evaluation of this EIS. • Claim that residents that moved to the area prior to 2024 have a legal right to live without the "nuisance" of weekly launches. • Concern that sonic boom landings are not necessary since there is the option to use drone ships. • Request for new mitigation measures to be implemented to reduce or dampen the current sonic boom produced by launches. • Question how the night-time launches don't violate current California noise ordinances. • Concern about possible hearing loss from the sonic booms over time. • Stated there is no concern about launches if the sonic booms are mitigated or prevented. • Concern that these sonic booms violate the existing over-land sonic boom prohibition from 1973. • Request for a third party to complete the analysis on noise.
Terrestrial/ Freshwater Biological	• Concern that noise from launches will impact wildlife (257). • Concern about the impact launches may have on birds (167). • Request for studies on the snowy plover and how it is impacted by the launches (35).

Resource Area/Topic	Issue/Concern
Resources	• Concern about the impact on legally protected species such as the golden eagle or snowy plover (25). • Concern about the impact on local farm animals (2). • The California red-legged frog and snowy plover are not intelligent enough to be permanently impacted by the increased launches. • Concern about the impacts on insect behavior due to increased vibrations. • Request to look further into the environmentally sensitive habitats that are located in Santa Barbara and San Luis Obispo counties. • Concern about the impact on Monarch butterflies.
Marine Biological Resources	• Request for environmental impacts on marine life to be studied more closely (97). • Concern that the increased launches will interfere with the migration pathways of marine life (89). • Concern about impacts on critically important environmental marine resources, including marine sanctuaries (45). • Concern about the impacts on the local seal populations (including those at Carpinteria Seal Sanctuary) and the potential for sonic booms to cause them to abandon or trample their young (6). • Marine life is more bothered by human activity than the launch noise so the Proposed Action will promote a healthier ecosystem (2). • Concern about sonic booms causing beached whales (2). • Concern that marine species are hypersensitive to the pressure changes and sounds produced by launches (2). • Request for a comprehensive maritime surveillance plan with an operational capability. • Concern about the impact on southern sea otters.
Water Resources	• Concern about an increase in water pollution with increased cadence (68). • Concern about the increased need for water due to increased cadence (67). • Request release of a detailed analysis of the wastewater created from each launch.
Cultural Resources	• Concern about impacts on critically important prehistoric archaeological resources (2). • Request analysis of potential effects on historic properties over time from increased cadence, booms, and vibrations (2). • Request a comprehensive inventory and assessment of all historic properties within the area of potential impact. • Request to financially support cultural resources and programs in the area.
Utilities	• Concern that launches can cause power outages and burst water mains. • Concern that launches are causing cell service interference. • Concern about removal or demolition of mobile service tower and environmental mobile shelter on SLC-6.
Socioeconomics	• Concern property values will decrease with more launches and disturbances (258). • Taxpayers should not subsidize commercial space programs (189). • Concern that the only wealth being added to the area is going to Elon Musk (7). • Concern about those who must evacuate Jalama Beach when a launch occurs and how the increase will make this harder on those individuals (5). • Concern that increased launches is only to support a private enterprise's requests (3). • Concern about negative impacts on local economy if launches are reduced or stopped. • Concern that 'over-regulation' of the environment is chasing business out of the state. • Reinvestment needed for impacted communities from private entities that benefit from taxpayer subsidized activities (2). • Request a breakdown of commercial versus governmental launches per year.

Resource Area/Topic	Issue/Concern
	• Evaluate impact on small businesses from decline in tourism and health problems. • Concern about housing shortage from additional workers supporting increased cadence.
Transportation	• Concern about increased traffic.
Human Health and Safety	• Concern about health impacts from noise and vibrations, including those sensitive to noise and/or people with Post Traumatic Stress Disorder or prior trauma (560). • Concern about potential fires to start due to a failed launch (100). • Concern about individuals with autoimmune conditions being impacted greatly by the increased activity (46). • Concern about sonic booms and launches to cause ear pain and headaches (18). • Request for a detailed assessment of the psychological and physiological impacts of the increased launches on residents.
Hazardous Materials and Waste Management	• Concern when satellites die and reenter the atmosphere, they burn toxic chemicals (98). • Concern about carcinogenic materials being released and how they will be mitigated (2). • Concern about unknown health impacts of materials used that will become apparent for future residents to have to deal with (2). • Concern about toxic materials to be introduced to marine life. • Concern about human's increased exposure to Hydrazine propellant. • Concern about the impact rocket exhaust will have on soil quality and plant health. • Concern about the impact of sonic booms and vibrations on the nuclear power plant in the region.
Solid Waste Management	• Concern about solid waste reentering the atmosphere and falling back to Earth (180).
Coastal Resources (Coastal Zone Management Act)	• Concern about violations to the Coastal Zone Management Act with previous increase to 50 launches per year. (3) • Concern that California Coastal Commission recently rejected the Air Force's consistency determination (2). • Include all data and results from sonic boom monitoring, as well as current or potential new avoidance and minimization measures, as agreed to under previous conditional consistency determination.
General Project	• Support for the No Action Alternative (725). • Request to reduce or stop launches rather than increasing frequency to 100 (654). • Request to change the launch location to uninhabited or nonresidential and less wildlife rich areas (395). • Threat to sue for property damages (194). • SpaceX missions wrongly classified as essential defense missions (170). • Support for increasing the space program, research, technology, and/or launches (69). • Concern that the space industry is being monopolized (60). • The scale of this project warrants a slow and cautious approach to analysis (3). • Request to "dogleg" the trajectories to allow for the sonic boom to not fall over land (3). • Request for the inclusion of all SLC-6 modifications in the EIS (2). • Request for more detailed descriptions of the launch and landing operations to be held at each space launch complex (2). • Request for the EIS to include all projected launch rates for the future (2). • Request for launches to be limited to 20 per year to create a balance between innovation and environmental stewardship (2). • Request for analysis of additional viable alternatives, such as more gradual, step-wise increase in frequency of launches guided by biological monitoring results. • Request for government oversight of SpaceX activities.

Resource Area/Topic	Issue/Concern
	• Request for compensation for property damage. • Concern that SpaceX would rather pay a fine for a rushed analysis than heed the law. • Support for the project as people who moved to the area knew that the base was in existence before they moved. • Support that national security must outweigh "temporary environmental harm." • Concern that SpaceX has too much power and ability to influence analyses. • Concern that launches will not be able to be reduced in the future. • Request for public to be made aware of the purpose of each individual launch. • Concern about conflict of interest between the project proponents and investigators. • Question whether all launches could occur from SLC-6. • Question whether "Human Annoyance" can be a metric. • Question about plans to introduce Starship/Superheavy launches to VSFB.