PRIVACY ADVISORY

This Environmental Assessment (EA) is provided for public comment in accordance with the National Environmental Policy Act (NEPA), the President's Council on Environmental Quality NEPA Regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508) and 32 CFR Part 989, Environmental Impact Analysis Process (EIAP).

The EIAP provides an opportunity for public input on Department of the Air Force (DAF) decision making, allows the public to offer input on alternative ways for the DAF to accomplish what it is proposing, and solicits comments on the DAF's analysis of environmental effects.

Public commenting allows the DAF to make better, informed decisions. Letters or other written or oral comments provided may be published in the EA. As required by law, comments provided will be addressed in the EA and made available to the public. Providing personal information is voluntary. Any personal information provided will be used only to identify your desire to make a statement during the public comment portion of any public meetings or hearings or to fulfill requests for copies of the EA or associated documents. Private addresses will be compiled to develop a mailing list for those requesting copies of EA; however, only the names of the individuals making comments and specific comments will be disclosed. Personal home addresses and phone numbers will not be published in the EA.

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Draft Final

Environmental Assessment

Falcon 9 Cadence Increase at

Vandenberg Space Force Base, California

September 2024

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

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ACRONYMS AND ABBREVIATIONS

2 ROPS/DON	2nd Range Operations Squadron
AB	Assembly Bill
ac	acre(s)
ACAM	Air Conformity Applicability
ac-ft	acre-feet
AFMAN	Air Force Manual
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AOC	Area of Concern
AOI	Area of Interest
APE	Area of Potential Effects
AQMP	Air Quality Management Plan
BCC	Federal Bird Species of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
BO	Biological Opinion
CalEEMod	California Emissions Estimator Model
CCC	California Coastal Commission
CCR	California Code of Regulations
CCZ	California Coastal Zone
CD	Consistency Determination
CDFW	California Department of Fish and Wildlife
CDNL	C-weighted DNL
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHNMS	Chumash Heritage National Marine Sanctuary
CINMS	Channel Islands National Marine Sanctuary
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalent
CRLF	California red-legged frog
CZMA	Coastal Zone Management Act
DAF	Department of the Air Force
dB	decibels
dBA	A-weighted decibels
dBC	C-weighted decibels
dB re 20 µPa	decibels related to 20 micropascals
dB re 20 μPa^2sec	decibels related to 20 micropascals squared seconds
DNL	Day-Night Average Sound Level
DOD	Department of Defense
DODI	Department of Defense Instruction
DOT	Department of Transportation
DPS	Distinct Population Segment
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EO	Executive Order
EPM	Environmental Protection Measure
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FAA	Federal Aviation Administration
FE	federally endangered
FONSI	Finding of No Significant Impact
FT	federally threatened
ft	foot/feet
ft^2	square feet
FWHA	Federal Highway Administration
GAO	Government Accountability Office
GHG	greenhouse gas
HMMP	Hazardous Materials Management Process
HWMP	Hazardous Waste Management Plan
Hwy	highway
Hz	hertz
IAW	in accordance with
ISWMP	Integrated Solid Waste Management Plan
km	kilometer(s)
kW-hr	kilowatt-hour
L_{max}	maximum sound pressure level
L_{eq}	equivalent sound level
L_{peak}	highest instantaneous sound level
lb(s)	pound(s)

LC	Launch Complex
LOA	Letter of Authorization
LOC	Letter of Concurrence
mi	mile(s)
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MMRP	Military Munitions Response Program
MOA	Memorandum of Agreement
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NCI	Northern Channel Islands
ND	negative determination
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Air Missions
NOTMAR	notice to mariners
NRHP	National Register of Historic Places
O_3	ozone
OSHA	Occupational Safety and Health Administration
P	proposed for listing under the ESA
P2	pollution prevention
PHS	Pacific harbor seal
$PM_{2.5}$	particulate matter less than 2.5 microns (fine particulate matter)
PM_{10}	particulate matter less than 10 microns
POC	point of contact
psf	pound(s) per square foot
RCRA	Resource Conservation and Recovery Act
RGF	Regional Growth Forecast
RHNA	Regional Housing Needs Allocation
ROI	region of influence
RORO	roll-on-roll-off
RWQCB	Regional Water Quality Control Board
SBCAG	Santa Barbara County Association of Governments
SCAB	South Coast Air Basin
SCAQMD	South Coast Air Quality Management District
SCCAB	South-Central Coast Air Basin
SC-GHG	social cost of greenhouse gases
SE	state endangered species
SEA	Supplemental Environmental Assessment
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLC	Space Launch Complex
SLD 30	Space Launch Delta 30
SLD 30/SEL	Space Launch Delta 30, Launch Safety
SMI	San Miguel Island
SO_2	sulfur dioxide
SOx	sulfur oxides
SpaceX	Space Exploration Technologies Corporation
SR	State Route
SSC	California Species of Special Concern
SYBCI	Santa Ynez Band of Chumash Indians
tpd	tons per day
tpy	tons per year
UPRR	Union Pacific Railroad
U.S.	United States
USC	United States Code
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USSF	United States Space Force
VCAPCD	Ventura County Air Pollution Control District

VSFB	Vandenberg Space Force Base	WOTS	Waters of the State
VSMR	Vandenberg State Marine Reserve	WOTUS	Waters of the United States
VOC	volatile organic compounds		

1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 Introduction and Background

The Department of Air Force (DAF) Space Launch Delta 30 (SLD 30) has prepared this Environmental Assessment (EA) to evaluate an increase in Falcon 9 annual launch cadence from 36 to 50 launches per year at Space Launch Complex 4 (SLC-4) on Vandenberg Space Force Base (VSFB), increase Falcon 9 first stage and fairing recovery activities, and expand the recovery area in the Pacific Ocean. This EA also evaluates the potential environmental impacts associated with the Federal Aviation Administration's (FAA's) licensing determinations to continue conducting Falcon launch operations at VSFB and FAA's approval of related airspace closures. Space Exploration Technologies Corporation (SpaceX) currently launches United States (U.S.) Government and commercial payloads using the Falcon 9 from SLC-4. SpaceX supports, and is under contract for, the full spectrum of U.S. Government space mission requirements, including spacecraft launches for National Aeronautics and Space Administration (NASA) and the U.S. Department of Defense (DOD). The current launch capacity is insufficient to meet critical DOD and key commercial launch missions.

This EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 as amended (42 United States Code [USC] Section 4321, et seq.), the Council on Environmental Quality's (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), the DAF's Environmental Impact Analysis Process (32 CFR Part 989), and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*. The DAF is the lead agency for the preparation and coordination of the EA; the FAA and United States Coast Guard (USCG) are cooperating agencies.

As 40 CFR Section 1501.12 indicates, agencies shall incorporate relevant material into environmental documents by reference when the effect is to cut down on bulk without impeding agency and public review of the action, including the documents incorporated by reference therein:

- *Final Draft Environmental Assessment Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East, Vandenberg Air Force Base, California* (2011 EA; DAF 2011)[1]
- Final Environmental Assessment Boost-Back and Landing of the Falcon 9 Full Thrust First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option (2016 EA; DAF 2016)[2]
- *Final Supplemental Environmental Assessment Launch, Boost-Back, and Landing of the Falcon 9 at Vandenberg Air Force Base, California and Offshore Landing Contingency Options* (2018 SEA; DAF 2018)[3]

[1] https://www.vandenberg.spaceforce.mil/Portals/18/documents/Environmental/EIAP-2011-03-1_EA_Falcon9-SLC-4E.pdf?ver=ltWVg_TKsa8haZ0zvhdM6A%3d%3d

[2] https://www.vandenberg.spaceforce.mil/Portals/18/documents/Environmental/EIAP-2016-04-1_EA_Falcon9_Boost-back.pdf?ver=ICyyMrxyiTGXagCmf29TXA%3d%3d

[3] https://www.vandenberg.spaceforce.mil/Portals/18/documents/Environmental/EIAP-2018-01-31_SEA_Falcon9_Launch-Boost-back.pdf?ver=kTLZUufAucxBEFEzzsQlAw%3d%3d

- *Final Supplemental Environmental Assessment Falcon 9 Cadence Increase at Vandenberg Space Force Base, California and Offshore landing Locations* (2023 SEA; DAF 2023)[4]
- *Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles* (NASA 2011)[5]

These documents were reviewed to identify any changes in existing conditions or expected effects that have occurred since their publication. Any changes that were identified are incorporated into this EA.

In a forthcoming Environmental Impact Statement (EIS), the DAF will analyze a proposal to modify SLC-6 at VSFB to launch Falcon 9 and Falcon Heavy launches and increase cumulative launch cadence of Falcon 9 and Falcon Heavy on VSFB to 100 launches per year. The current Proposed Action will be included in the upcoming EIS as a past action in the cumulative impacts analysis.

1.2 Purpose and Need for the Proposed Action

The purpose of the Proposed Action is to provide greater mission capability to the DOD, NASA, and commercial customers by increasing Falcon 9's flight opportunities. This is in furtherance of U.S. policy to ensure capabilities necessary to launch and insert necessary national security payloads into space (10 USC Section 2273, "Policy regarding assured access to space: national security payloads").

The need for the Proposed Action is to ensure United States Space Force (USSF) Assured Access to Space without compromising current launch capabilities and fulfill (in part) the U.S. Congress's grant of authority to the Secretary of Defense, pursuant to 10 USC Section 2276(a), "Commercial space launch cooperation," that the Secretary of Defense is permitted to take action to:

- Maximize the use of the capacity of the space transportation infrastructure by the DOD by the private section 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.
- Foster cooperation between the DOD and covered entities.[6]

Satisfaction of these needs benefit the government and public interests and reduces operational costs. 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 as a whole. Demand for launch services has continued to increase over the past 20 years, and the space industry's growth projections indicate this will continue into the foreseeable future. SpaceX's Proposed Action would

[4] https://www.vandenberg.spaceforce.mil/Portals/18/documents/Environmental/EIAP-2023-05-1_SEA_SpaceX_Falcon9CadenceIncrease.pdf?ver=gsIu4FWj4nqnZsbyzmodpA%3d%3d

[5] https://www.vandenberg.spaceforce.mil/Portals/18/documents/Environmental/EIAP-2011-11_EA_ProgrammaticNASARoutinePayloads_ExpendableLaunchVehicles.pdf?ver=0YCTsNGDrYeI9uWSMoHVNQ%3d%3d

[6] The term "covered entity" means a non-Federal entity that is organized under the laws of the United States or of any jurisdiction within the United States and is engaged in commercial space activities.

continue the U.S. goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure.

1.3 Lead and Cooperating Agency Actions

Pursuant to agreements between the DAF and the FAA, the DAF is the lead agency for preparing and coordinating this EA (40 CFR Section 1501.7) because the proposed action will be from and on a DAF installation. The FAA and the USCG are cooperating agencies (40 CFR Section 1501.8). Pursuant to 10 USC Section 2276, *Commercial Space Launch Cooperation*, DOD Instruction 3100.12, *Space Support,* and DOD Instruction 3230.3, *DOD Support for Commercial Space Launch Activities,* the USSF, under the DAF, is responsible for implementing support to commercial launch and reentry activity. In addition, as the federal department with the sole administrative authority over this U.S. owned property for the purposes of national defense, the DAF has authority over space-related operations, to include ground-based operations on VSFB. After the public and consulting parties review the EA, if the DAF, as lead agency, determines that the Proposed Action would not individually or cumulatively result in significant impacts on the human or natural environment, the DAF would issue a Finding of No Significant Impact (FONSI). Alternatively, if the DAF determines at any point in the NEPA process that the Proposed Action may, individually or cumulatively, result in significant impacts, it would either issue a Notice of Intent to prepare an Environmental Impact Statement, or issue a decision to select the No Action Alternative for this proposal.

The FAA is a cooperating agency because it is the organization within the Department of Transportation (DOT) with the responsibility of licensing certain commercial space launch operations in the U.S. and approves related airspace closures. The Commercial Space Launch Act of 1984, as amended, and 51 USC Sections 50901-50923, authorizes the Secretary of Transportation to oversee, license, and regulate certain commercial launch and reentry activities, and the operation of launch and reentry sites within the U.S. Section 50905 directs the Secretary of Transportation to exercise this responsibility consistent with public health and safety, safety of property, and the national security and foreign policy interests of the U.S. In addition, Section 50903 states that the Secretary of Transportation shall encourage, facilitate, and promote commercial space launches and reentries by the private sector. As codified at 49 CFR Section 1.83(b), the Secretary of Transportation delegated authority to carry out these functions to the FAA administrator. The FAA is also responsible for creating airspace closure areas in accordance with FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters,* to ensure public safety.

The FAA's Proposed Action is to issue certain licenses along with potential renewals and modifications to licenses within the scope of operations analyzed in this EA to SpaceX that would allow SpaceX to continue to launch and land Falcon at VSFB. In addition, the FAA must also approve related airspace closures for launch and landing operations. If, after reviewing this EA, the FAA determines the Proposed Action would not individually or cumulatively result in significant impacts on the human environment, the FAA would adopt this EA and issue its own decision document to support issuing a launch and reentry license to SpaceX and approving related airspace closures. The FAA would draw its own conclusions from the analysis presented in this EA and assume responsibility for its environmental decisions and any related mitigation measures. For the FAA to use this analysis to support its determination, the EA must meet the requirements of FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, which contains the FAA's policies and procedures for compliance with NEPA. Successfully completing the environmental

review process does not guarantee that the FAA would issue SpaceX's commercial launch and reentry license or approve related airspace closures.

The USCG is a cooperating agency because of its regulatory authority over waters subject to jurisdiction of the U.S. pursuant to the Ports and Waterways Safety Act, 46 USC Section 700, and regulatory authority of U.S. and foreign flag vessels as outlined in Titles 33 and 46 of the CFR. The USCG also reviews and advises SLD 30 on all launch and reentry site evaluation risk assessments with focus on vessel navigation safety. The USCG also supports SLD 30 with early warning communication to the maritime industry with notice to mariners (NOTMAR) as outlined in 33 CFR subpart 72.01. SLD 30 and USCG District Eleven have entered into a Memorandum of Agreement (MOA) to assist with maritime safety and space operational review that have a maritime nexus. USCG District Eleven utilizes authorities authorized in the Ports and Waterways Safety Act and the CFR to evaluate SpaceX and SLD 30 navigation risk assessments with launch and reentry activities associated with commercial and recreational vessels on the high seas off the California Coast. The USCG evaluates every launch and reentry activity for risk to waterway users and the environment under this process.

1.4 Intergovernmental Coordination, Public, and Agency Participation

1.4.1 Public Notification and Review

Following the publication of a Notice of Availability (NOA) in the Lompoc Record, Santa Maria Times, Ventura County Star, Ojai Valley News, and Santa Barbara Independent, the DAF made the Draft EA and FONSI available for public review and comment for 30 days. The DAF also distributed the draft EA and FONSI per the current VSFB NEPA Distribution List (Appendix K), including the State Clearinghouse. [placeholder for public involvement summary]

1.4.2 Native American Coordination

Executive Order (EO) 13175, "Consultation and Coordination with Indian Tribal Governments" directs federal agencies to coordinate and consult with Native American tribal governments whose interests might be directly and substantially affected by activities on federally administered lands. There is no National Historic Preservation Act (NHPA) Section 106 trigger for this project, and therefore, the federally recognized Santa Ynez Band of Chumash Indians (SYBCI) was not consulted under Section 106. However, this Draft EA is being submitted to the SYBCI for review following EO 13175.

1.4.3 Interagency Coordination

During the development of this EA, DAF coordinated with various local, state, and federal agencies regarding the Proposed Action and will continue to coordinate with these agencies as required.

In accordance with (IAW) Section 7 of the Endangered Species Act (ESA), DAF has engaged with the United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). A Biological Assessment was submitted to USFWS in support of Section 7 consultation (Appendix A). The resultant Biological Opinion (BO; USFWS 2024; Appendix A) assessed the effects of 16 additional launches between 1 October and 31 December 2024 (thus reaching a cadence of 50 launches in calendar year 2024) on endangered and threatened species due to the Proposed Action. NMFS issued a Section 7 Letter of Concurrence (LOC) on 17 April 2024 (Appendix B). DAF also engaged with NMFS in accordance with the Marine Mammal Protection Act (MMPA) and was issued a renewed Letter of Authorization (LOA) in April

2024 (Appendix B). DAF provided an assessment to NMFS in August 2024 determining the Proposed Action falls within the take numbers covered under the current LOA and are adequate to cover shifting impacts from portions of the Northern Channel Islands (NCI) to two mainland haulouts.

Pursuant to the Coastal Zone Management Act (CZMA), DAF has engaged with the California Coastal Commission (CCC) and has submitted a Federal Consistency Determination (CD) (Appendix D).

IAW the DOT Act of 1966, now codified at 49 USC Section 303, DAF coordinated with the FAA regarding compliance with Section 4(f), which pertains to potential effects to parks, recreational lands, wildlife refuges, and historic sites.

2 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The Proposed Action is to increase the annual Falcon 9 launch cadence at SLC-4 on VSFB from 36 to 50 to support future U.S. Government and commercial launch service needs. 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). 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.

2.1.1 Launch Vehicle

SpaceX would continue to launch Falcon 9 from SLC-4. Falcon 9 is approximately 229 feet (ft) tall and produces approximately 1.7 million pounds (lbs) of thrust at liftoff. A discussion of Falcon 9 can be found in Section 2.3 of the 2016 EA and Section 2.2 of the 2018 SEA.

2.1.2 Launch

SpaceX would conduct launch operations in the same way as described in Section 2.2 of the 2018 SEA and previous environmental documents. One to 3 days before each launch, an engine static fire test, which lasts a few seconds, may be performed. The need to conduct a static fire test depends on the mission, but there would be no more than 30 static fire events per year. Typically, 5 weather balloons are released prior to each launch to measure wind speed. The data are used to create wind profiles that help determine if it is safe to launch and land the vehicle. A radiosonde, the size of a half-gallon milk carton, is attached to the weather balloon to measure and transmit atmospheric data to the launch operator. The latex balloon rises to approximately 20-30 kilometers (km) above Earth's surface and bursts. The radiosonde and shredded balloon pieces fall back to Earth and are not recovered. The radiosonde does not have a parachute and is expected to sink to the ocean floor. Launch operations would occur day or night, at any time during the year.

2.1.2.1 Launch Safety

SpaceX, the DAF, the FAA, and the USCG implement numerous protocols and procedures to assess, avoid, mitigate, and minimize potential risks to public safety and the environment during space launch, which are discussed throughout this EA. The Falcon 9 launch vehicle is proven as one of the most reliable space launch vehicles ever developed, with over a 99% launch success rate since June 2010. Due to the Falcon 9 vehicle success rate, launch failure would be an extremely low probability and would represent an off-nominal, worst-case scenario and is not assessed in detail for these reasons. SpaceX implements an Operations Safety Plan at SLC-4, and in the event of a launch failure, SpaceX would activate an Emergency Action Plan. Accordingly, the potential impacts on the environment resulting from a launch failure are not expected to be significant.

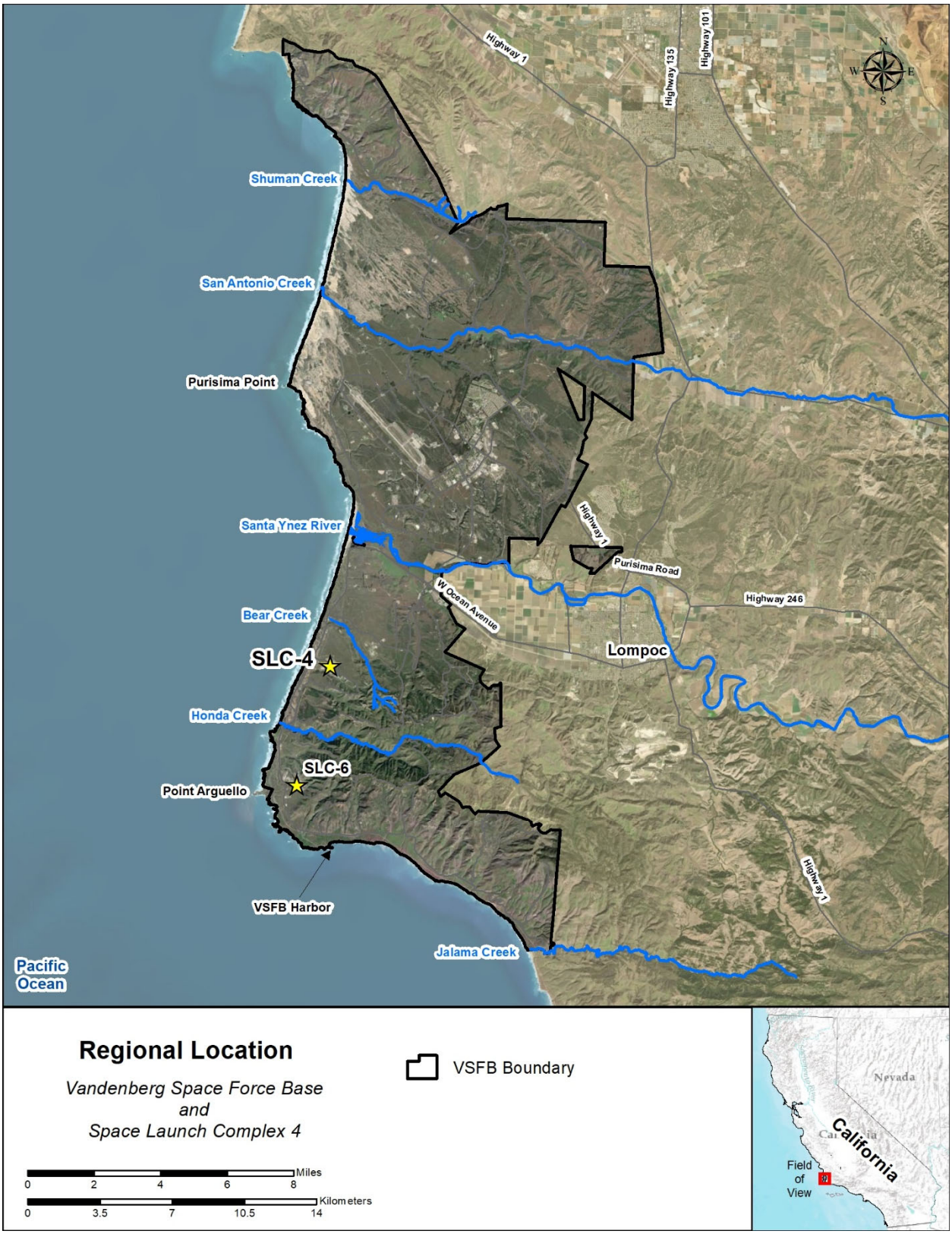

Figure 2.1-1. Project Location Map

2.1.2.1.1 Shipping Lanes

The Proposed Action does not include altering the dimensions of shipping lanes. USCG District Eleven was granted specific regulatory authority to restrict vessel movement, implement safety and warning zones, and provide early warning advisement, but all responsibility to limit risk to navigation safety is solely on SpaceX. USCG District Eleven will advise SpaceX and SLD 30 when the risk exceeds acceptable levels and the primary applicant will be responsible for minimizing the risk with alternate strategies before formal publications. Federal government agencies, including the USCG, are responsible for ensuring maritime safety as required applicable statutes and regulations, such as the Ports and Waterways Safety Act, 46 USC Sections 70001–70054 and implementing regulations, 33 CFR Part 1 (*General Provisions*), 14 CFR Part 450 (*Launch and Reentry License Requirements*), and 40 CFR Section 229.3 (*Transportation and Disposal of Vessels*). To comply with the necessary notification requirements, SpaceX would notify USCG of any upcoming launch operations to ensure safe launches over the high seas and navigable waters of the U.S. (WOTUS), consistent with current procedures. The USCG would be responsible for issuing NOTMARs that provide hazard area locations before each mission event with ocean impacts. A NOTMAR provides notice of temporary changes in conditions or hazards in navigable waterways with maritime traffic to assist in mitigating risks for dangers associated with waterway users. This tool provides an established and reliable line of communication with the maritime public. The NOTMAR would include the operations dates and times and coordinates of the hazardous operation area.

2.1.2.1.2 Airspace

The Proposed Action does not include altering the dimensions (shape and altitude) of the airspace. All launch and reentry operations would be infrequent and of short duration and comply with the necessary notification requirements, including issuing Notice to Air Missions (NOTAMs), as defined in agreements required for an FAA issued launch license. Advance notice via NOTAMs and identifying Aircraft Hazard Areas assist general aviation pilots to schedule around any temporary disruption of flight activities in the operation area. A NOTAM provides notice of unanticipated or temporary changes to components of, or hazards in, the National Airspace System (NAS; FAA Order JO 7930.2S, Notices to Air Missions). The FAA issues a NOTAM at least 24 hours before a launch or reentry activity in the airspace to notify pilots and other interested parties of temporary conditions. SpaceX regularly provides FAA with updates and schedule changes to their notional three-month launch schedule to minimize interruption to air traffic. FAA's licensing requirements, the process for closures of the National Air Space System, and SLD 30 Range Safety actions during launch operations are described in Section 2.2.1 of the 2023 SEA.

2.1.2.2 Launch Frequency

The DAF proposes to increase the Falcon 9 SLC-4 launch cadence at VSFB from 36 to 50 launches per year. SpaceX has continued to improve its turn-around time between launches, which has provided more opportunity for launches at SLC-4. Increasing launch cadence would help meet the need for critical DOD, National Security, and key commercial launch missions, as described in Section 1.2.

2.1.2.3 Trajectories

Trajectories (i.e., the flight path of rockets) from SLC-4 would remain within the previously analyzed azimuth range of 140 to 325 degrees. Each trajectory would be provided in SpaceX's Flight Safety Data Package and submitted to the FAA before the launch.

2.1.2.4 Landing

SpaceX would land first stage boosters at VSFB or downrange on a droneship as described in Section 2.3.2 of the 2016 EA and Section 2.2.3 of the 2023 SEA. Following each launch, SpaceX would perform a landing of the first stage, either downrange on a droneship or at SLC-4. Mission objectives may occasionally require expending the first stage booster in the Pacific Ocean, as described in Section 2.1.1 of the 2011 EA. If expended, the first stage would break up upon atmospheric re-entry and there would be no residual propellant or explosion upon impact with the Pacific Ocean. The first stage remnants are not buoyant and would sink to the bottom of the ocean. SpaceX would continue to land up to 12 boosters per year at SLC-4. Fairing recovery and jettisoning the Merlin Vacuum Engine skirt ring would occur as described in Section 2.2.1.4 and 2.2.2 of the 2023 SEA. SpaceX is proposing to expand its downrange recovery area by approximately 900 mi west and approximately 1,000 mi south (Figure 2.1-2) to account for potential missions with an expended first-stage booster. The droneship would then transport the booster to the Port of Long Beach as described in Section 2.2.3 of the 2023 SEA.

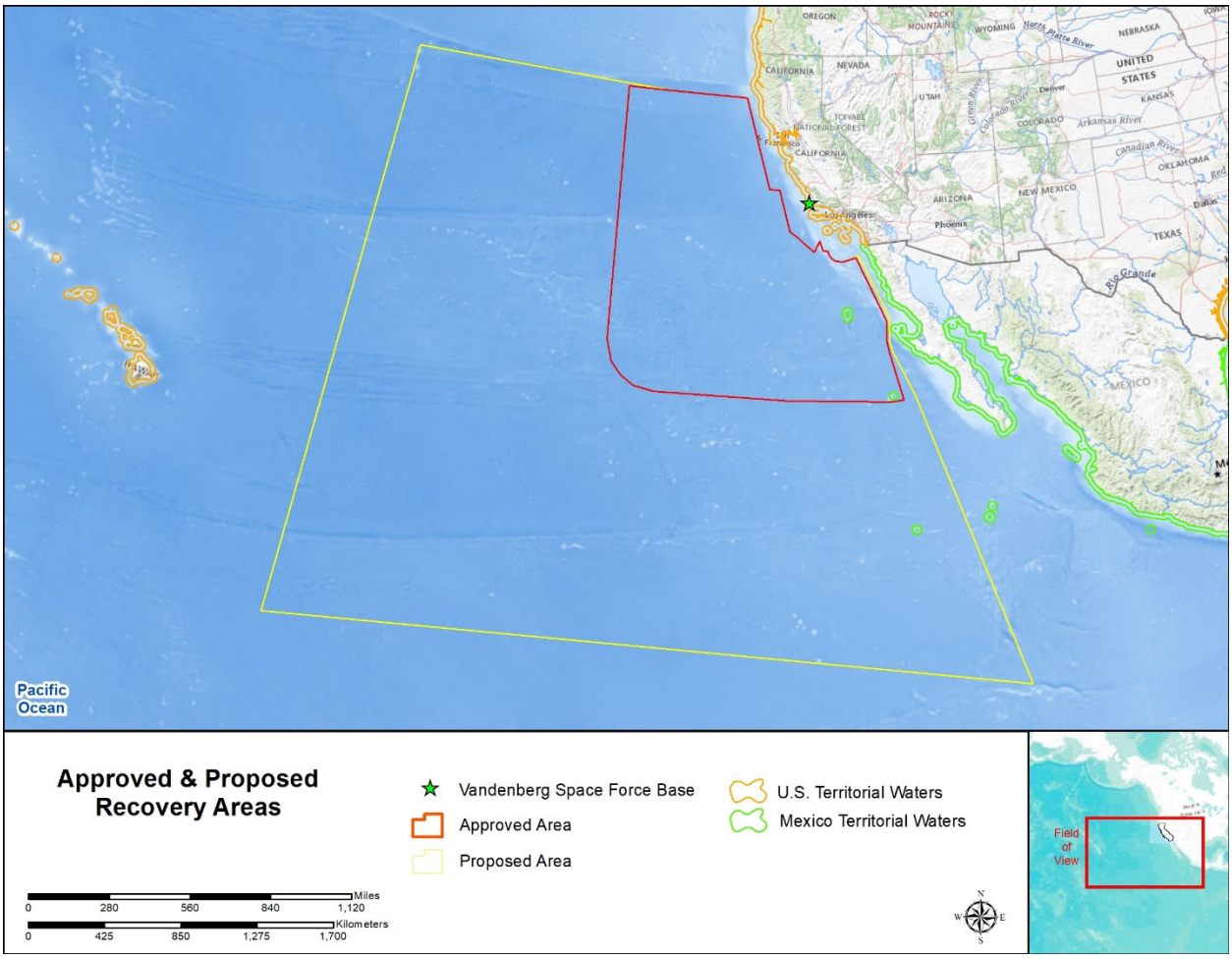

Figure 2.1-2. Proposed Recovery Area

2.1.2.5 Payloads

Payloads and their associated materials/fuels/volumes are mission-dependent but would be similar to current U.S. Government and commercial payloads as described in the 2011 *Environmental Assessment*

for Launch of NASA Routine Payloads (NASA 2011), for which the DAF was a cooperating agency. As discussed in Section 2.2.6 of the 2023 SEA, Falcon launches from SLC-4 would continue to have similar payloads. Novel payloads such as reentry capsules would undergo a separate review under NEPA and require their own FAA Vehicle Operator License.

2.1.3 Personnel and Ground Operations

Operations would be similar to those described in Section 2.2.6 of the 2023 SEA at SLC-4. To support a cadence increase, SpaceX anticipates adding up to 400 additional personnel to VSFB operations over time, for a total of 700 staff.

The existing SpaceX facilities are adequate to support the staff increase. Ground transportation support during launch campaigns would continue to be minimal. SpaceX would continue to utilize specialized trucks to transport boosters between existing SpaceX facilities, including facilities in Hawthorne, California, Building 398, and at SLC-4 on VSFB. The first stage, second stage, interstage, and payload are each transported by 18-wheel trucks. Fuel and helium are also delivered by 18-wheel trucks on a weekly basis. Personal vehicles would be used by employees to commute locally on and off site. Payload integration and pre-launch protocols associated with the Proposed Action would remain unchanged. However, these operations would increase in frequency to support 50 launches per year.

2.1.4 Utilities

SpaceX would utilize approximately 70,000 gallons of water per launch at SLC-4, as described in Section 2.2.1.3 of the 2023 SEA. Landing operations at SLC-4 previously utilized approximately 40,000 gallons per landing, but no longer require the use of water for operations. At maximum cadence, the Proposed Action would use up to 18.6 acre-feet (ac-ft) of water per year, including increased water use for personnel and operations. Existing utilities at SLC-4, such as power, communications, and fluids systems are adequate to support the proposed increase in cadence. Generators would continue to be utilized at SLC-4 to support operations and for emergency power. Increased personnel at SLC-4 are not expected to result in septic systems exceeding capacity. The septic system at Building 398 has planned improvements independent of the Proposed Action, thus would be able to support increased personnel use.

2.1.5 Vehicle Refurbishment

SpaceX would continue to process vehicles at existing SpaceX facilities such as Building 398. Operations include refurbishing the recovered first stage and fairing for reuse in future missions. Up to 50 boosters and 50 fairings would be refurbished each year. Solvents such as isopropyl alcohol, isopar, and Simple Green would be used during these operations, as well as for launch pad operations, facility maintenance, and vehicle system(s) flushing during refurbishment. System flushing includes the purging of residual waste from the vehicle to maintain system health and avoid contamination. Remaining hazardous waste is contained in drums and disposed of or recycled in accordance with applicable federal, state, and local regulations.

2.1.6 Harbor Operations

SpaceX 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 Section 2.2.5 of the 2023 SEA. The Proposed Action would include increasing from 36 to up to 50 operation events per year. Each harbor

operation lasts for approximately four hours, or one tide window. Harbor operations could occur at any time of day, as they are dependent on the tides. The Proposed Action does not include additional dredging outside the quantity and depth specified by SLD 30's existing permit from the United States Army Corps of Engineers (USACE).

2.2 Alternative Screening Criteria

IAW 32 CFR Section 989.8, SLD 30 and SpaceX evaluated alternative sites to increase Falcon annual launch cadence for reasonableness using the following selection criteria:

- **Criterion 1:** Ability to launch payloads to polar and geostationary orbits.
- **Criterion 2:** Require minimal construction to meet near-term manifest needs.

2.3 Alternatives Carried Forward for Analysis

The DAF carried Alternative 1, the Proposed Action, and the No Action Alternative forward for analysis.

2.3.1 No Action Alternative

Under the No Action Alternative, SpaceX would not increase the annual cadence for Falcon 9 operations from VSFB, increase Falcon 9 first stage and fairing recovery activities, or expand the recovery area. SpaceX would not meet the DOD requirements for Assured Access to Space nor fully meet the National Space Transportation Policy goals of providing low-cost reliable access to and from space would be negatively affected, as would the more short-term need to meet the increase in current and future manifest demands.

Under the No Action Alternative, there would be no new impacts on the environmental impact categories analyzed in this EA. The No Action Alternative is the environmentally preferable alternative. However, the No Action Alternative does not meet the Purpose and Need. The No Action Alternative provides the basis for comparing the environmental consequences of the Proposed Action.

2.4 Alternatives Considered but Eliminated from Further Analysis

CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500–1508) require federal agencies to use the NEPA process to identify and assess the reasonable alternatives to the Proposed Action that would foster informed decision making.

2.4.1 Kennedy Space Center/Cape Canaveral Space Force Station

SpaceX evaluated its existing leased facilities at Cape Canaveral Space Force Station (SLC-40) and Kennedy Space Center Launch Complex [LC]-39A for reasonableness. SpaceX currently launches Falcon 9 from SLC-40 and LC-39A including crew missions. SLC-40 and LC-39A were dismissed from consideration as they predominantly support a different range of trajectories. For example, polar trajectories or those with an inclination greater than 53 degrees cannot be launched from LC-39A or SLC-40 without substantial impacts to vehicle performance, to the point that certain payloads cannot be launched. Accordingly, these sites do not meet screening criterion #1.

2.4.2 Non-SpaceX VSFB Facilities

SpaceX evaluated existing facilities at VSFB for reasonableness. Non-SpaceX sites at VSFB would not be able to readily provide infrastructure requirements without substantial construction activities, which would result in additional impacts and would not support the near-term launch manifest needs, thus do not meet screening criterion #2.

2.5 Permits, Licensees, and Other Authorizations

The Proposed Action would require a modification of SpaceX's existing FAA launch license (LLO-18-111). An air permit would also be required from the Santa Barbara County Air Pollution Control District.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The resources listed in Table 3.0-1 were considered but eliminated from detailed analysis in this EA because the resource would not be affected or there would be no change from what was analyzed in the 2023 SEA.

Table 3.0-1. Resources not analyzed

Resource	Reason not Analyzed
Land Use and Aesthetics	The activities under the Proposed Action are consistent with those already conducted at VSFB. SLC-4 would be used for the proposed expansion of SpaceX activities. The proposed activities would be similar to launch activities that have been performed at this site and nearby launch sites on VSFB. The proposed increase in launch cadence would be consistent with existing land use at the project site, would not result in a change to land use or be incompatible with adjacent land uses, such as agricultural land, and would not alter the existing industrial character of the area. Views along the coastline would not change and no alterations to the visual landscape would occur. Therefore, this resource was considered but eliminated from detailed analysis in this EA.
Visual Effects, Light Emissions, and Visual Resources/Visual Character	The Proposed Action would not change the existing or planned use of VSFB. Launch and landing would occur from existing sites at SLC-4 on VSFB. The Proposed Action would conform to the existing designated land uses. With regards to human impacts, the additional proposed launch activities would not differ visually from those activities already occurring at VSFB. Rockets may be visible to people in the sky more often and there could be greater instances of nighttime lighting, but the visual sensitivity of VSFB is low because it is a federal launch range. Therefore, this resource was considered eliminated from detailed analysis in this EA.
Geological Resources	The Proposed Action does not include any construction or new ground disturbing activities that weren't already considered in prior EAs and SEAs; therefore, this resource was considered but eliminated from detailed analysis in this EA.
Environmental Justice and Protection of Children	Under the Proposed Action launches and landings would occur on VSFB and primarily over open ocean away from populated areas. VSFB controls public access to the Base and therefore no public member would be present near the launch site during launch operations. Launch and landing would not occur near any schools or childcare facilities. Therefore, launch and landing under the Proposed Action does not have the potential for disproportionately high and adverse effects on minority or low-income populations or a disproportionate health or safety risk to children. Noise

Resource	Reason not Analyzed
	created during launch and landing activities would impact various communities in Santa Barbara, Ventura, and Los Angeles Counties (see Section 3.2), but would not disproportionately impact any communities with Environmental Justice concerns. Therefore, this resource was considered but eliminated from detailed analysis in this EA.
Farmlands (Section 4(f))	The Proposed Action would not convert prime agricultural land to other uses or result in a decrease in the land's productivity. Therefore, this resource was considered bu eliminated from detailed analysis in this EA.
Natural Resources (Section 4(f))	The Proposed Action would minimally affect supplies of energy, water, and would not affect asphalt, aggregate, and wood, and other natural resources in the region because the project either requires none to relatively small amounts of these resources or there are abundant suppliers available in the region. Therefore, the potential impacts to natural resources are considered but eliminated from detailed analysis in this EA.
Wild and Scenic Rivers (Section 4(f))	There are no rivers protected under the California Wild and Scenic Rivers Act within the affected environment. Therefore, this resource was considered eliminated from detailed analysis in this EA.

3.1 Air Quality and Climate

3.1.1 Affected Environment

The approach to analysis under the Clean Air Act of 1970 (42 USC Part 7401 et seq.), as amended, and General Conformity Analysis (40 CFR Part 93) under NEPA are discussed in Appendix E. The region of influence (ROI) for air quality includes the Study Area and adjoining land several mi inland, which may be downwind from emission sources associated with the Proposed Action, and includes Santa Barbara, Ventura, and Los Angeles Counties.

3.1.1.1 Climate of the Study Area

The climate of the Pacific Ocean and adjacent land areas is influenced by surface water temperatures, water currents, and wind. Offshore climates are moderate and seldom have extreme seasonal variations because the ocean is slow to change temperature. Ocean currents influence climate by moving warm and cold water between regions. Adjacent land areas are affected by the wind that is cooled or warmed when blowing over these currents. The wind also moves evaporated moisture from the ocean to adjacent land areas and is a major source of rainfall.

The climate of coastal Southern California and adjacent offshore Pacific Ocean waters consists of warm, dry summers and cool, typically wet winters (although the region has been subject to regular severe drought), mainly influenced by a semi-permanent high-pressure system (the Pacific High) in the eastern Pacific Ocean. This Pacific High maintains clear skies in Southern California for much of the year. When the Pacific High moves south during the winter, this pattern changes and low-pressure centers migrate into the region, bringing precipitation, falling mainly as rain in October-April. The predominant regional

wind directions are westerly and west-southwesterly during all four seasons. Surface winds are typically from the north and west (onshore) during the day and from the east (offshore) at night (Dudek 2024).

3.1.1.2 Existing Air Quality

Offshore air quality is generally better than adjacent onshore areas because there are few or no large sources of criteria air pollutants offshore. Much of the air pollutants in offshore areas are transported there from adjacent land areas by low-level offshore winds, so concentrations of criteria air pollutants generally decrease with increasing distance from land. No criteria air pollutant monitoring stations are located in offshore areas, so air quality in the Study Area must be inferred from adjacent land areas where air pollutant concentrations are monitored.

The Proposed Action includes activities in the South Central Coast and the South Coast Air Basins (SCAB). Coastal waters within 3 nautical miles (nm) of the shore are under the same air quality jurisdiction as the contiguous land areas of the South-Central Coast Air Basin (SCCAB). VSFB is located within the SCCAB, which includes San Luis Obispo, Santa Barbara, and Ventura counties. The SBCAPCD has jurisdiction over Santa Barbara County and the Ventura County Air Pollution Control District (VCAPCD) has jurisdiction over Ventura County. The Proposed Action would also include vessel travel to and from the Port of Long Beach in Los Angeles County. Los Angeles County is located within the SCAB and the South Coast Air Quality Management District (SCAQMD).

Santa Barbara County is in attainment for all National Ambient Air Quality Standards (NAAQS). Ventura County is in serious nonattainment for NAAQs eight-hour ozone (O_3). Los Angeles County is in extreme nonattainment for the NAAQS eight-hour- ozone (O_3), maintenance for carbon monoxide, nonattainment for lead, nonattainment for particulate matter 2.5, and maintenance for particulate matter 10. Within attainment areas, SpaceX is required to ensure air quality does not significantly deteriorate due to air emissions associated with the Proposed Action. The Proposed Action is required to demonstrate conformity with the approved State Implementation Plan (SIP) if the net emissions equal or exceed the *de minimis* emission levels in nonattainment and maintenance areas.

3.1.1.2.1 Criteria Air Pollutants

Air pollutants emitted more than 3,000 ft above ground level are considered to be above the atmospheric inversion layer and, therefore, do not affect ground-level air quality (U.S. Environmental Protection Agency [USEPA] 1992). Emissions released above this altitude distance are often too highly dispersed within the atmosphere to impact pollutant concentrations over land and the surface of the water in the lower atmosphere, measured at ground-level monitoring stations, upon which federal, state, and local regulatory decisions are based. However, since all of the sources of pollutants are mobile, and it is difficult to determine where exactly emissions would be released within the Study Area, all emissions occurring under 3,000 ft are considered when comparing against the *de minimis* thresholds. Table 3.1-1 shows annual emissions from SpaceX activities (including launch and landing activities; static firing; booster and fairing recoveries; work transits; vendor deliveries; and generator use) from 36 launch events.

Table 3.1-1. Estimated annual criteria pollutant emissions under the current environmental baseline conditions[1]

Criteria Pollutants	Annual Emissions (tons per year)				
	CO	**NO_x**	**VOC**	**SO_x**	**PM_{10}**
Emissions (0–3 nm)	7.7511	13.8268	9.1476	0.1158	0.4000
Emissions (3–12 nm)	0.5065	2.5509	0.2132	0.1312	0.0643
TOTAL	**8.2576**	**16.3777**	**9.3608**	**0.247**	**0.4643**

[1]Table includes criteria pollutant precursors (e.g., volatile organic compounds [VOCs]). Individual values may not add exactly to total values due to rounding.

Notes: CO = carbon monoxide, NO_X = nitrogen oxides, NO_2 = nitrogen dioxide, PM_{10} = particulate matter ≤ 10 microns in diameter, SO_2 = sulfur dioxide, SO_X = sulfur oxides, VOC = volatile organic compound, nm = nautical miles

3.1.1.2.2 Climate

Current activities in the Study Area involve mobile sources using fossil fuel combustion. Greenhouse gas (GHG) emissions can persist in the atmosphere from 12 years for methane to up to 200 years for carbon dioxide. Where GHG emissions are released does not affect their contribution to climate change. Emissions generated by specific activities contribute incrementally in combination with past and future emissions from all other sources to global warming that produces the adverse effects of climate change. Table 3.1-2 shows the current environmental GHG emissions baseline produced under SpaceX activities (including launch and landing activities; static firing; booster and fairing recoveries; work transits; vendor deliveries; and generator use) from 36 launch events and compares them against total national GHG emissions.

Table 3.1-2. Estimated annual greenhouse gas emissions under the current environmental baseline conditions

Emissions of CO_2e (Metric Tons per Year)	
Current Environmental Baseline GHG Emissions	23,565
National GHG Emissions	5,981,400,000
Percent of National Emissions	0.000394%
California GHG Emissions	369,200,000
Percent of California Emissions	0.006383%

Notes: CO_2e = carbon dioxide equivalent

3.1.2 Environmental Consequences

Air quality impacts would be significant if the action would cause pollutant concentrations to exceed one or more of the NAAQs, as established by the USEPA under the Clean Air Act, for any of the time periods

analyzed in this EA, or to increase the frequency or severity of any such existing violations. There are no significance thresholds for commercial space launch GHG emissions, nor has the FAA identified specific factors to consider in making a significance determination for GHG emissions. There are currently no accepted methods of determining significance applicable to commercial space launch projects given the small percentage they contribute.

3.1.2.1 Alternative 1

With the exception of launch activities, emissions were calculated using the USAF Air Conformity Applicability Model (ACAM). ACAM does not provide functionality for launch activities; these emissions were calculated using engine-specific emissions factors provided by SpaceX. Emission estimates were also calculated using the California Emissions Estimator Model (CalEEMod), which are presented in Appendix E. While this section presents summary tables of each component activity, Appendix E includes detailed calculation tables and air modeling output reports.

3.1.2.1.1 Operations

Operations under the Proposed Action would generate VOCs, NOx, CO, SOx, PM_{10}, and $PM_{2.5}$ emissions from stationary and mobile sources, including vehicle trips from passenger vehicles and heavy-duty trucks, marine vessels, booster launches and landings, launch vehicle processing, and off-road equipment used for maintenance. Annual emissions of the Proposed Action would not exceed the Prevention of Significant Deterioration threshold of significance for VOC, NOx, CO, SOx, PM_{10}, or $PM_{2.5}$ in the SBCAPCD. As such, project operations under Alternative 1 would not have an adverse effect on air quality in the SBCAPCD jurisdiction (Table 3.1-3).

Table 3.1-3. Estimated criteria pollutant emissions produced under the Proposed Action from operational activities in the SBCAPCD

Source	Annual Emissions (tons per year)						
	VOC	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**Pb**
Operational Activities	12.26	56.24	71.95	1.48	2.09	2.00	0.01
Baseline	8.02	8.01	2.89	0.05	0.10	0.10	0.00
Delta (Proposed Action – Baseline)	4.24	48.23	69.06	1.43	1.99	1.90	0.01
Prevention of Significant Deterioration Threshold	250	250	250	250	250	250	25
Threshold Exceeded	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Notes: (1) Table includes criteria pollutant precursors (e.g., VOCs). Ozone is a secondary pollutant tracked by its precursor. (2) CO = carbon monoxide, NO_X = nitrogen oxides, Pb = lead, PM_{10} = particulate matter ≤ 10 microns in diameter, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, SO_X = sulfur oxides, VOC = volatile organic compounds, Pb = lead, nm = nautical miles, (3) Individual values may not add up exactly to total values due to rounding.

As shown in Table 3.1-4, annual emissions of the Proposed Action would not exceed the General Conformity de minimis threshold of significance for VOC, NOx, CO, SOx, PM_{10}, or $PM_{2.5}$ in the VCAPCD. As such, project operations under Alternative 1 would not have an adverse effect on air quality in the VCAPCD jurisdiction.

Table 3.1-4. Estimated criteria pollutant emissions produced under Alternative 1 from operational activities in the VCAPCD

Source	Annual Emissions (tons per year)						
	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb
Operational Activities	2.11	25.18	37.40	0.50	0.54	0.54	0.00
Baseline	0.19	0.88	0.85	0.00	0.03	0.03	0.00
Delta (Proposed Action – Baseline)	1.92	24.30	36.55	0.50	0.51	0.51	0.00
General Conformity De Minimis Threshold	50	50	100	100	100	100	25
Threshold Exceeded	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Notes: (1) Table includes criteria pollutant precursors (e.g., VOCs). Ozone is a secondary pollutant tracked by its precursor. (2) CO = carbon monoxide, NO_X = nitrogen oxides, PM_{10} = particulate matter ≤ 10 microns in diameter, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, SO_X = sulfur oxides, VOC = volatile organic compounds, Pb = lead, nm = nautical miles, (3) Individual values may not add up exactly to total values due to rounding.

As shown in Table 3.1-5, annual emissions of the Proposed Action would not exceed the General Conformity de minimis threshold of significance for VOC, CO, SOx, PM10, or PM2.5 in the SCAQMD. However, emissions of NOx would exceed the threshold. As such, a general conformity determination is necessary to determine if the Proposed Action under Alternative 1 would have an adverse effect on air quality in the SCAQMD jurisdiction.

Table 3.1-5. Estimated criteria pollutant emissions produced under Alternative 1 from operational activities in the SCAQMD

Source	Annual Emissions (tons per year)						
	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb
Operational Activities	2.68	33.36	46.66	0.68	0.76	0.76	0.01
Baseline	0.34	2.1	1.35	0.05	0.07	0.07	0.00
Delta (Proposed Action – Baseline)	2.34	31.26	45.31	0.63	0.69	0.69	0.01
General Conformity De Minimis Threshold	10	10	100	250	100	70	25
Threshold Exceeded	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**

Notes: (1) Table includes criteria pollutant precursors (e.g., VOCs). Ozone is a secondary pollutant tracked by its precursor. (2) CO = carbon monoxide, NO_X = nitrogen oxides, Pb = lead, PM_{10} = particulate matter ≤ 10 microns in diameter, $PM_{2.5}$ = particulate matter ≤ 2.5 microns in diameter, SO_X = sulfur oxides, VOC = volatile organic compounds, Pb = lead, nm = nautical miles, (3) Individual values may not add up exactly to total values due to rounding.

3.1.2.1.2 Airspace Impacts

Airspace closures associated with commercial space operations would result in additional aircraft emissions mainly from aircraft being re-routed and expending more fuel. Minimal, if any, additional emissions would be generated from aircraft departure delays because the FAA has rarely, if ever, received reportable departure delays associated with launches at VSFB. Based on SpaceX's proposal, airspace-related impacts could increase up to a maximum of 50 times per year. Any delays in aircraft departures from affected airports would be short-term. Therefore, these emissions increases are not expected to result in an exceedance of a NAAQS for any criteria pollutant. Emissions from aircraft being re-routed

would occur above 3,000 ft (the mixing layer) and thus would not affect ambient air quality. Therefore, airspace closures associated with the Proposed Action under Alternative 1 are not expected to result in significant air quality impacts.

3.1.2.2 General Conformity Impacts

The general conformity determination process is intended to demonstrate that a proposed Federal action will not: (1) cause or contribute to new violations of a NAAQS; (2) interfere with provisions in the applicable SIP for maintenance of any NAAQS; (3) increase the frequency or severity of existing violations of any standard; or (4) delay the timely attainment of any standard. As such, for general conformity determination, the proposed federal action needs to conform to the latest approved SIP/Air Quality Management Plan (AQMP). The SCAB is designated as an extreme non-attainment area for ozone, serious non-attainment for $PM_{2.5}$ and maintenance area for CO. In order to accommodate projects subject to general conformity requirements and to streamline the review process, general conformity budgets for NOx and VOC emissions are established in the AQMP. The 2016 AQMP, which is the latest plan approved by USEPA, established set aside accounts to accommodate emissions subject to general conformity requirements. The set-aside accounts include 2 tons per day (tpd) or 730 tons per year (tpy) of NOx and 0.5 tpd or 182.5 tpy of VOC each year starting in 2017 through 2030, and 0.5 tpd (182.5 tpy) of NOx and 0.2 tpd (73 tpy) of VOC each year in 2031 and thereafter.

The Proposed Action exceeds the General Conformity de minimis threshold of NOx in the years 2025 through 2055. The Proposed Action's NOx emissions would be held steady during the lifetime of the project at 21.26 tpy, or 116.49 lbs per day. As of March 2024, the General Conformity budget for NOx in 2025 is 299 tons. Therefore, the Proposed Action's NOx emissions would not exceed the remaining set aside budget. As such, upon approval to use the NOx set-aside accounts from SCQMD, the Proposed Action will conform to the latest USEPA approved AQMP as the emissions from the project are accommodated within the AQMP's emissions budgets, and the proposed project is not expected to result in any new or additional violations of the NAAQS or impede the projected attainment of the NAAQS.

3.1.2.3 Climate

3.1.2.3.1 Alternative 1

CalEEMod was used to calculate the annual GHG emissions from all emission sources (Appendix E) for the Proposed Action. Estimated operational GHG emissions from the Proposed Action would be approximately 46,356 metric tons CO_2e per year. When accounting for the Baseline emissions, the Proposed Action would result in an additional 18,300 metric tons of CO_2e per year.

The social cost of GHG (SC-GHG) is an economic concept used to quantify the monetary value of the long-term societal damage caused by the emission of GHGs into the atmosphere. This metric seeks to capture the various adverse impacts associated with GHG emissions, such as climate change, health problems, ecosystem damage, and economic losses. By assigning a dollar value to these damages, the SC-GHG provides a tool for policymakers, businesses, and governments to assess the true costs of emitting CO_2, CH_4, N_2O, and other GHGs. The Proposed Action would have a SC-GHGs of over $14 million, under a 3% discount rate over $41 million, and at a 2.5% discount rate over $58 million. Since publication of the Interim Estimates, USEPA has been working on new estimates for the SC-GHGs. These estimates reflect recent advances in scientific literature on climate change and its economic impacts and incorporate

recommendations made by the National Academies of Science, Engineering, and Medicine. Under USEPA's draft estimates for SC-GHGs, the Proposed Action would have a SC-GHG of over $98 million under the 2.5% discount rate, under the 2% discount rate over $152 million, and at a 1.5% discount rate over $245 million. By assigning a dollar value to the damages associated with GHG emissions, policymakers and decision-makers can better evaluate the costs and benefits of actions aimed at reducing emissions. The SC-GHGs provides a tool to make more informed choices about climate-related policies, regulations, and investments.

Airspace closures associated with commercial space operations would result in additional aircraft emissions mainly from aircraft being re-routed and expending more fuel, including CO_2. These temporary increases in aircraft emissions could increase up to a maximum of 50 times per year. The amount of time that affected aircraft spend being re-routed would be short-term and the number of aircraft that would be impacted per launch would not be expected to produce additional emissions that would have a notable impact on climate. Therefore, the increases in GHGs caused by short-term airspace closures during commercial space operations under the Proposed Action is not expected to result in significant climate-related impacts.

The FAA has not established a significance threshold for climate, nor has the FAA identified specific factors to consider in making a significance determination for GHG emissions. The scientific community is continuing efforts to better understand the impact of aviation emissions on the global atmosphere. The FAA is leading and participating in a number of initiatives intended to clarify the role that commercial aviation plays in GHG emissions and climate. The FAA, with support from the U.S. Global Change Research Program and its participating federal agencies, has developed the Aviation Climate Change Research Initiative in an effort to advance scientific understanding of regional and global climate impacts of aircraft emissions.

3.1.2.4 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on air quality, beyond those described in the 2023 SEA.

3.2 Noise

3.2.1 Affected Environment

A detailed description of noise/sound, ambient sound guidance documents, Federal Interagency Committee on Urban Noise (1980) criteria, and USEPA noise standards is contained in Appendix F. Additionally, noise modeling, using RNOISE software to estimated rocket engine noise (Plotkin et al. 1997a; Plotkin 2010) and PCBoom software to estimate sonic boom levels (Page et al. 2010; Bradley et al. 2018) was performed to estimate sound levels generated from the proposed activities at SLC-4. is the model results are referenced herein, but provided in detail in Appendix F (KBR 2024).

The sound ROI includes noise-sensitive receptors and ambient noise levels in the area potentially affected by rocket engine noise and sonic booms. Rocket engine noise and sonic booms are acute, non-sustained, and unpredictable. A sonic boom is an impulsive noise similar to thunder caused when an aircraft or rocket vehicle exceeds the speed of sound. Booms with overpressures of about 1.0 pound per square foot (psf) are generally audible and can startle people, but generally do not cause adverse effects such as damage to structures (Plotkin et al. 1997b; Benson 2013; National Oceanic and Atmospheric Administration

[NOAA] 2024). A boom below that magnitude could be heard by someone who is expecting it and listening for it, but usually would not be noticed. The 1.0 psf sonic boom noise contour will also fully encompass any areas affected by launch, landing, and static fire rocket engine noise, when considering A-weighted decibels (dBA; A-weighting is an adjustment applied to sound measurement to reflect how a noise is perceived by the human ear). Therefore, the ROI for noise was determined by examining the 1.0 psf sonic boom contours from model results.

3.2.1.1 Noise Metrics

3.2.1.1.1 Day-Night Average Sound Level & Community Noise Equivalent Level

The Day-Night Average Sound Level (DNL) metric is the energy-averaged sound level measured over a 24-hour period, with a 10 dBA penalty assigned to noise events occurring between 10 p.m. and 7 a.m. (acoustic night). The A-weighted DNL is the standard noise metric used by the U.S. Department of Housing and Urban Development, FAA, USEPA, and the DOD (used surrounding air installations). Most people are exposed to sound levels of 50–55 dBA DNL or higher on a daily basis. Noise-sensitive land uses, such as housing, schools, and medical facilities, are considered compatible in areas where the DNL is less than 65 dBA. Therefore, the 65 dBA DNL noise contour is typically used to determine compatibility of military operations with local land use.

Per FAA Order 1050.1F, Community Noise Equivalent Level (CNEL) may be used in lieu of DNL for FAA actions needing approval in California. CNEL, like DNL, is an energy-averaged sound level measured over a 24-hour period. CNEL, like DNL adds a ten times weighting (equivalent to a 10 dBA "penalty") to each operation between 10:00 p.m. and 7:00 a.m. CNEL also includes a three times weighting (equivalent to an approximately 5 dBA penalty) for each operation during evening hours (7:00 p.m. to 10:00 p.m.). As such, DNL and CNEL are very similar and have been determined to be a reliable measure of long-term community annoyance and will be used for this analysis. Transient residential use such as motels may be considered compatible within the 65 dBA CNEL noise contour where adequate noise attenuation is provided.

Noise exposure from sonic booms that exceeds the significance threshold of C-weighted day-night average noise level (CDNL) 60 dBC (C-weighted decibels) for impulsive noise sources (equivalent to DNL 65 DbA) is a significant impact (FAA 2020). The FAA uses CDNL to assess cumulative annoyance from impulsive noise like sonic booms, while using other metrics to evaluate hearing loss and other noise related health effects (FAA 2024). Given unique characteristics of commercial space operations, the FAA's guidance recommends that other supplemental noise metrics may also be used in conjunction with DNL "to describe and assess noise effects for commercial space operations" (FAA 2024). The FAA does not use these supplemental metrics to make decisions. Rather, the FAA has established a system of noise measurement that comprises a single, core decision-making metric, the A-weighted DNL. Under FAA Order 1050.1F, significant noise impacts would occur if the Proposed Action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dBA noise contour, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase in noise exposure, when compared to the No Action alternative for the same timeframe. FAA's NEPA implementing policies and procedures did not exempt commercial space transportation from this

threshold. See FAA Order 1050.1F at Exhibit 4-1. Until the FAA revises its noise policy, all actions including commercial space transportation actions, are subject to this metric and significance threshold[7].

3.2.1.1.2 Equivalent Sound Level

The Equivalent Sound Level (L_{eq}), measured in decibels (dB), is a cumulative noise metric that represents the average sound level (on a logarithmic basis) over a specified period of time—for example, an hour, a school day, daytime, nighttime, weekend, facility rush periods, or a full 24-hour day.

3.2.1.1.3 Maximum Sound Pressure Level

The maximum sound pressure level (L_{max}) is the highest time-weighted sound level measured during a noise event during a given period of time. Often, this parameter will be described along with information about the weightings used (for example, L_{Amax} indicates the maximum level measured with A-weighting). It is important to note that this is not the same as L_{peak}, which is the highest instantaneous sound level, in dB, with no weighting.

3.2.1.1.4 Pounds per Square Foot

While rocket launches are typically measures in Lmax or L_{eq}, psf is used to present units of peak overpressure. The peak pressure of a sonic boom in psf can be converted to the peak sound pressure level in decibels (L_{peak}) by the mathematical relationship of: $L_{peak} = 127.6 + 20 \log_{10}(psf)$.

3.2.1.2 Sensitive Receptors

Noise sensitive areas are those areas where noise interferes with normal activities. These include residential, educational, health, and religious sites, parks, recreational areas, wildlife refuges, and cultural

[7] The FAA determined that changes in transportation use, public expectations, and technology warranted a review of its civil aviation noise policy. On January 13, 2021, the FAA published in the Federal Register a notice entitled, "*Review of FAA Aircraft Noise Policy and Research Efforts: Request for Input on Research Activities to Inform Aircraft Noise Policy*", 86 FR 2722, which described the FAA's noise research portfolio and a first of its kind nationally scoped survey that updated FAA's understanding of the dose-response relationship between exposure to aircraft noise and community annoyance (Neighborhood Environmental Survey or NES). FAA also requested input on the FAA's research activities that would inform the FAA's noise policy and would inform the future direction of the FAA noise research portfolio. The NES showed that a higher percentage of people were "highly annoyed" by aircraft noise across all levels of noise exposure that were studied. In addition to setting forth the FAA noise policy and research efforts, this Notice described the results of research into the societal benefits and costs of noise mitigation measures. On May 1, 2023, the FAA published in the Federal Register a notice entitled "*Request for Comments on the Federal Aviation Administration's Review of the Civil Aviation Noise Policy, Notice of Public Meeting*" (88 FR 26641). In this notice, the FAA announced that it intends to consider how changes to the FAA civil aviation noise policy may better inform agency decisions and the types of impacts FAA considers in making decisions (e.g., community annoyance, certain types of adverse health impacts highly correlated with aviation noise exposure). The FAA requested suggestions of potential improvements to how the FAA analyzes, explains, and presents changes in exposure to civil aviation noise. In this notice, the FAA specifically sought public comments on whether it should establish noise thresholds for low-frequency events, such as those associated with the launch and reentry of commercial space transportation vehicles authorized by the FAA Office of Commercial Space Transportation, which metrics should be used to establish these noise thresholds, and the appropriate noise exposure level to define the threshold of significant noise impacts. As part of this policy review, FAA is also examining the body of scientific and economic literature to understand how aviation noise correlates with annoyance as well as environmental, economic, and health impacts. The FAA is also evaluating whether any of these impacts are statistically significant and the metrics that may be best suited to disclose them. Until this policy development process is concluded, the FAA will continue to rely on DNL to make decisions regarding the significance of potential noise impacts.

sites. Users of designated recreational areas are considered sensitive receptors. Noise sensitive land uses on and near VSFB, southern Santa Barbara County, and Ventura County include residential areas, hospitals, schools, and libraries. No human sensitive receptors are located on or near the SLC-4 project sites. In addition, with the exception of being a recreational area, there are no other human sensitive receptors at Channel Islands National Park which is within the overflight path.

3.2.1.3 Ambient Noise Conditions

Existing noise levels on VSFB are quite low due to the large areas of undeveloped landscape and sparse noise sources. Background noise levels are primarily driven by wind noise; louder noise levels can be found near industrial facilities and transportation routes, including the railway. On VSFB, ambient one-hour average sound level measurements range from around 35 to 60 dB (Thorson et al. 2001). Regularly occurring sources of instantaneous noise near the ROI include crashing ocean surf, which generates approximately 78 dBA (6.6 ft tall waves) and can be louder during high surf events (Bolina & Abom 2010) or passing trains. Ambient sound levels were characterized at Surf Beach, approximately 5.3 mi north of SLC-4 reported at 45.5 dBA L_{eq} at night, 51.8 dBA L_{eq} during the day, and 53.1 dBA L_{eq} during the evening. Rocket launches and aircraft overflights create louder intermittent noise levels, while ambient in-air noise levels are driven primarily by wind and wave noise. Noise levels in the adjacent city of Lompoc are primarily driven by transportation noise and regional aircraft activities. DNLs are typically between 55 and 65 dBA (City of Lompoc 2014).

3.2.2 Environmental Consequences

Per FAA Order 1050.1F, noise impacts would be significant if the action would increase noise by DNL 1.5 dBA or more for a noise-sensitive area that is exposed to noise at or above the DNL 65 dBA noise exposure level, or that will be exposed at or above the DNL 65 dBA level due to a DNL 1.5 dBA or greater increase, when compared to the No Action Alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dBA to 65 dBA. The CNEL may be used in lieu of DNL for FAA actions in California. Per 40 CFR Part 1501.3(d)(2), the analyses below also consider the intensity (loudness) and context (proximity to sensitive receptors) in determining if noise impacts would be significant.

3.2.2.1 Alternative 1

The scope of this noise analysis is limited to the launch, boost-back, and landing of the Falcon 9 as described in Chapter 2. Vessel transit activities are excluded from the noise analysis as their activity is removed from sensitive receptors. There are two noise components to the Proposed Action: 1) continuous engine noise created by the launch, during static fire tests (lasting several seconds), during launch ascent (lasting several minutes), and during first stage and booster landings (lasting approximately 60 seconds); and 2) impulsive sonic booms created during the launch of the rocket and the returning first stages and boosters (both lasting less than one second). Static fire, launch engine noise, landing engine noise and impacts on human sensitive receptors are presented in units of dBA. Sonic booms are presented in terms of psf.

3.2.2.1.1 Static Fire, Launch, and Landing Rocket Engine Noise

The 90 dBA through 130 dBA L_{max} contours for engine noise during Falcon 9 launches at SLC-4 are shown in Figure 3.2-1. These contours represent the maximum levels estimated for each Falcon 9 launch at SLC-

4. The higher contours (100 – 130 dBA L_{max}) are located within about 4 mi of SLC-4. Only the 90 dBA L_{max} contour extends beyond the VSFB property line to the western side of Lompoc, CA (Figure 3.2-1; KBR 2024). Real-world noises that may be similar include power mower (96 dBA L_{max}), a motorcycle passing by at 25 ft (90 dBA L_{max}), or an active car wash standing 20 ft away (89 dBA L_{max}). If a Falcon 9 launch occurs during the day, when background levels are in the 50 to 60 dBA L_{max} range, residents of Lompoc may notice launch noise levels above 70 dBA L_{max} and up to 90 dBA L_{max} (KBR 2024). If the same launch occurs during the night, when background levels are lower than during the day (e.g., below 40 to 50 dBA L_{max} range), Lompoc residents, the residents of Orcutt, CA to the north, and Conception, CA to the south may notice launch noise levels that exceed 60 dBA L_{max} (KBR 2024). A prevailing on-shore or off-shore breeze may also strongly influence noise levels in these communities.

Launch events are the loudest single events of all the proposed Falcon 9 flight and test operations. Accordingly, Falcon 9 launch single event noise levels were evaluated to guidelines for hearing conservation and potential for structural damage. An estimate of the areas in the vicinity of Falcon 9 launches at SLC-4, where a hearing conservation program should apply, was made using Occupational Safety and Health Administration's (OSHA) permissible daily noise exposure limit of 115 dBA L_{max} (slow response) for a duration of 0.25 hours or less. Noise levels are less than OSHA's 115 dBA L_{max} upper noise limit guideline at distances greater than approximately 1.5 mi from the launch pads (KBR 2024). Falcon 9 launch noise events last a few minutes at most, at a single location, with the highest noise levels occurring for less than a minute such that OSHA's 115 dBA L_{max} daily noise exposure limit is not expected to be exceeded (KBR 2024).

For Falcon 9 booster landings at SLC-4, the 90 dBA L_{max} contour for engine noise is entirely within the VSFB property line (Figure 3.2-1). Residents of Lompoc, CA may notice Falcon 9 landing event levels above 60 dBA L_{max} especially for nighttime events. Compared with the Falcon 9 orbital launch noise levels, discussed above, Falcon 9 descent/landing noise levels at SLC-4 are considerably lower due to the much lower total engine thrust and limited firing schedule used for landing operations.

The 90 dBA L_{max} contour for Falcon 9 static fire events at SLC-4 does not extend off VSFB property (Figure 3.2-1). To the west of SLC-4, this contour extends much farther out due to modeling sound propagation over water compared with propagation over land to the east. Residents of Lompoc, CA may hear Falcon 9 static test events above 60 dBA L_{max}, and particularly at night and if onshore wind conditions favor sound propagation to the east (KBR 2024).

The potential for structural damage due to launch, landing, and static fire test events was assessed using the conclusions from a recent, applicable study to ascertain whether range activities (i.e., test, evaluation, demilitarization, and training activities of items such as weapons systems, ordinance, and munitions would cause structural damage; Fenton & Methold 2016). The study concluded that structural damage becomes improbable below 140 dB L_{max} (unweighted). No glass or plaster damage is expected below 140 dB L_{max} and no damage is expected below 134 dB L_{max} (Fenton & Methold 2016).

Applying these criteria indicates that no damage is expected from engine noise generated during Falcon 9 launches or any of the other Falcon 9 operations that generate lower noise levels than launches. The 134 dB L_{max} contour for all Falcon 9 flight and test operations is well within VSFB property, such that no significant off-base impacts, including Lompoc, are expected (KBR 2024). The unweighted L_{max} 110 dB through 140 dB contours estimated for Falcon 9 orbital launch events at SLC-4 is shown in Figure 3.2-2.

Falcon 9 launch events from SLC-4 are estimated to generate L_{max} of 134 dB approximately 0.5 mi from the launch pads, well within VSFB property (KBR 2024).

3.2.2.1.2 Community Noise Equivalent Level

The FAA defined land use compatibility guidelines for aviation noise exposure that are also applicable to rocket noise exposure. These guidelines consider the noise limit for residential land use compatibility to be DNL 65 dBA (or 65 dBA CNEL as explained in Section 3.2.1.1). CNEL was estimated using RNOISE for projected launch, landing, and static fire test operations at SLC-4. The results indicated that none of the operation types alone are expected to cause adverse CNEL (KBR 2024; Appendix F). CNEL was also assessed for the proposed maximum cadence, which includes all combinations of these operation types assuming an almost equal distribution between night and day activities. The resulting CNEL estimates for the combined annual operations are shown in Figure 3.2-5. The 65 dBA CNEL contour is located entirely within the VSFB property and does not include residential land use. Therefore, the Proposed Action would not result in significant impacts related to noise and noise-compatible land use.

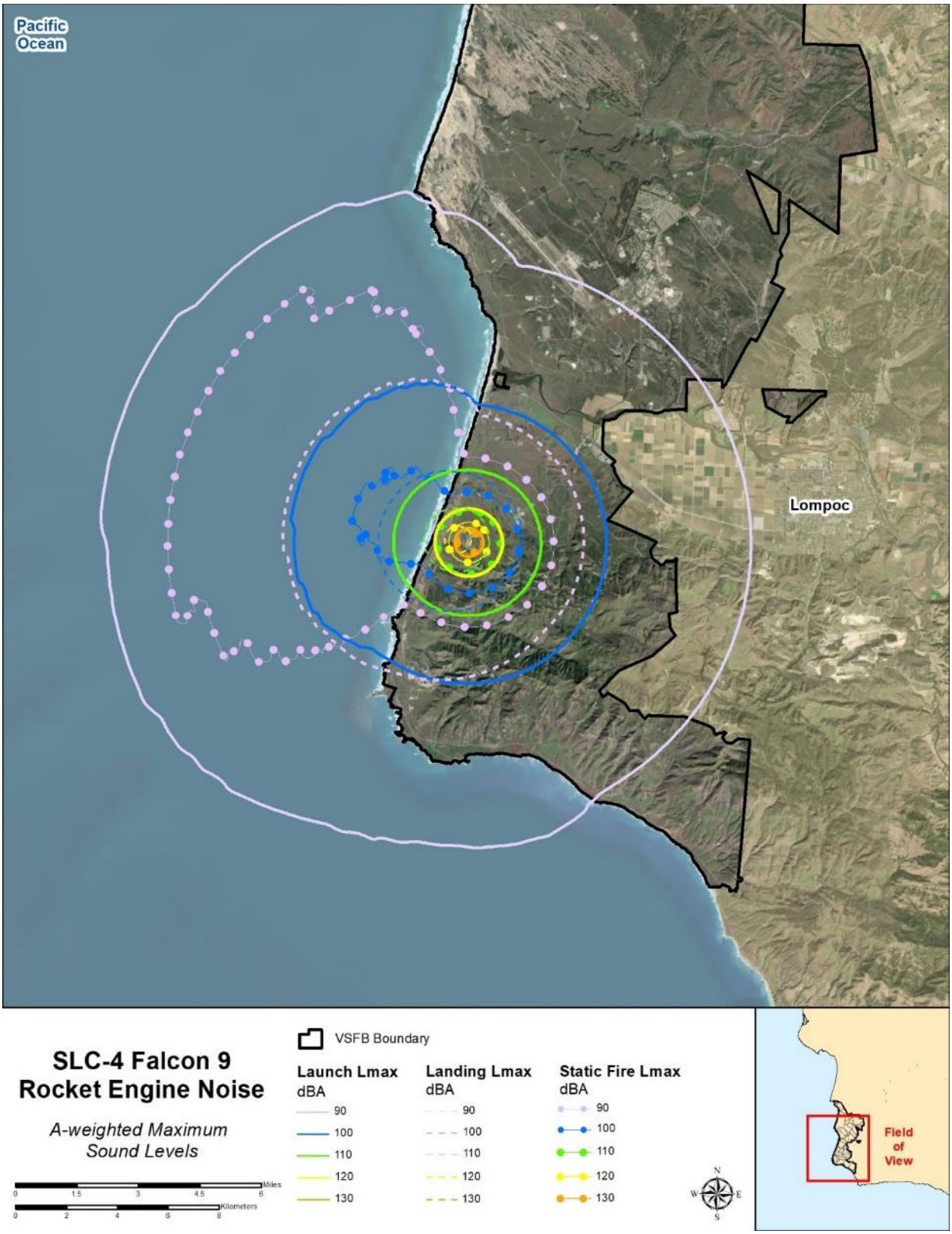

Figure 3.2-1. Falcon 9 static fire, launch, and landing rocket engine noise model results at SLC-4

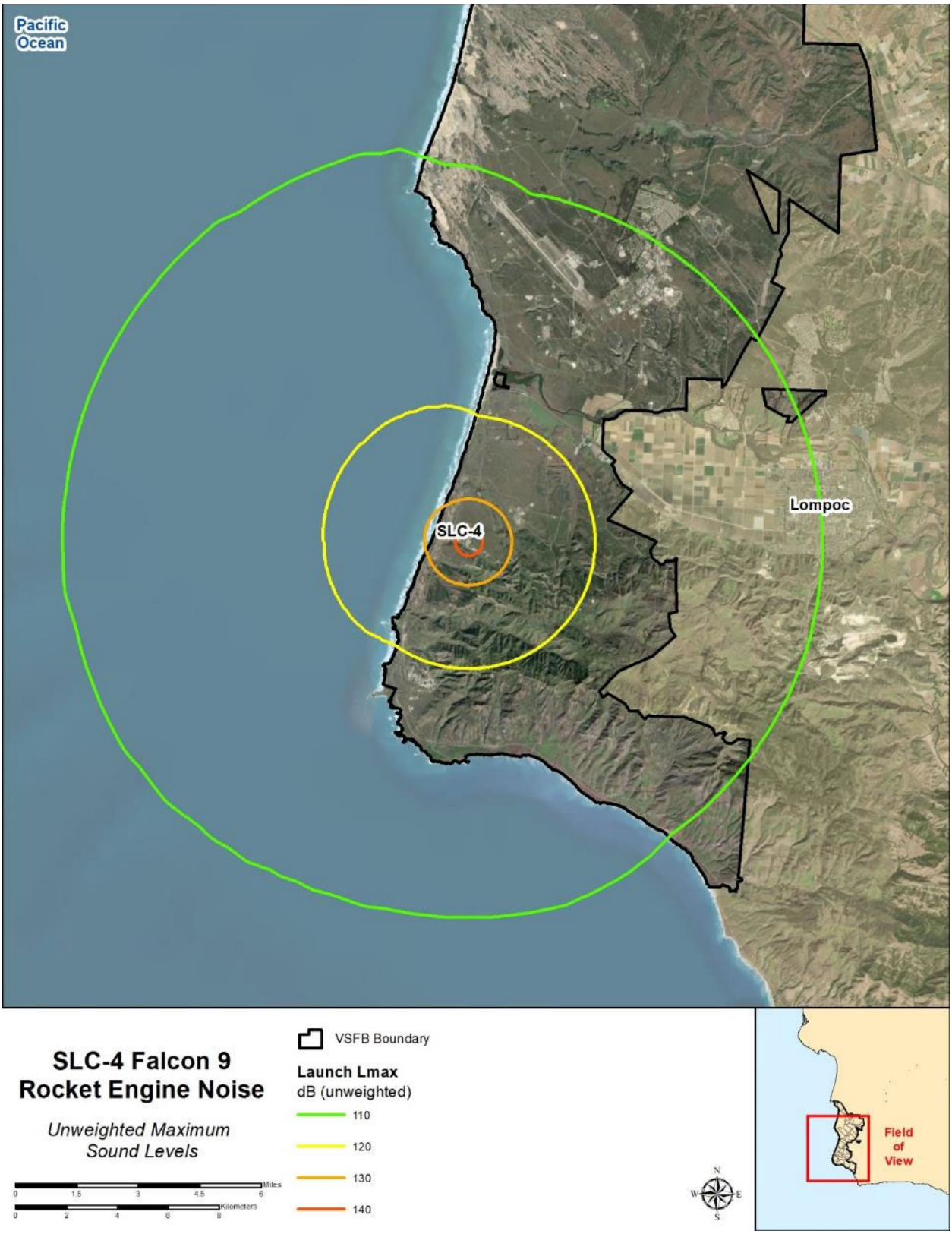

Figure 3.2-2. Unweighted L_{max} contours for Falcon 9 launch at SLC-4

3.2.2.1.3 Launch and Landing Sonic Boom

Sonic Boom from Falcon 9 Launch at SLC-4

Sonic boom model profiles for Falcon 9 launches from SLC-4 are similar to those analyzed in Section 3.2 of the 2023 SEA, with the exception of an increase in frequency due to higher cadence. Falcon launches with easterly trajectories may result in sonic booms that impact eastern Santa Barbara, Ventura, and northwestern Los Angeles Counties (Figure 3.2-3). To supplement the typical model output of sonic boom contours, DAF conducted additional sonic modeling for the ascent phase of easterly trajectories to capture potential variability in the noise environment. For these trajectories sonic booms may impact a sub-portion of the potential impact area shown in Figure 3.2-3, which shows the conglomeration of 125 different model results. Probabilities were then derived from this modeling to predict the potential location and intensity of a sonic boom. Of these, 15% of the model runs predicted sonic boom impacts in eastern Santa Barbara County; 50% of the sonic boom levels were less than 0.25 psf, approximately 17% were greater than 1.0 psf, and 0.3% were greater than 2.0 psf. The highest level predicted was 2.13 psf. 97% of model runs predicted impacts in Ventura County; 65% were less than 0.25 psf, approximately 14% were greater than 1.0 psf, 0.04% were greater than 2.0 psf. The highest predicted boom level was 2.03 psf. Of the 125 model results, 94% of model runs predicted impacts in western Los Angeles County; 95% were less than 0.25 psf and none were greater than 0.75 psf. A 2.13 psf overpressure equates to a CDNL of 42.6 dBC, well below the 60 dBC significance threshold. However, CDNL is not a useful metric for ascent sonic booms as they are heavily dependent on the actual trajectory and atmospheric conditions thus the actual location of the sonic boom is expected to vary between launches.

Sonic Boom from Falcon 9 Landings at SLC-4

Sonic boom footprints for Falcon 9 first stage landings at SLC-4 were modeled using PCBoom software and sample mission trajectories that depict an estimated worst-case scenario in terms of boom levels and extent of the impact footprint (KBR 2024). Figure 3.2-4 shows an example sonic boom footprint, in the form of overpressure contours in psf for the Falcon 9 first stage landing at SLC-4. The boom levels in the vicinity of the SLC-4 landing pad range from about 5.0 to 9.5 psf. Boom levels on VSFB range from 0.1 to 5.0 psf in areas away from the landing pad. The broad crescent, with boom levels of 0.1 psf is located mostly over the Pacific Ocean, however this contour surrounds VSFB and Lompoc, CA, and Orcutt, CA to the east, as well as Conception, CA to the south. If all 12 landings at SLC-4 were to occur at night with overpressures of 4 psf on Lompoc, the corresponding CDNL would be 59.4 dBC, below the 60 dBC significance threshold. This is a conservative analysis, as landings could occur at any time of day and are not expected to consistently result in overpressure levels of that magnitude in populated areas.

Sonic Boom from Falcon First Stage Landings Downrange in the Pacific Ocean

Similar engine noise and noise impacts would occur during landings of the Falcon 9 first stage boosters offshore of California (minimum distance of 12 nm within the Proposed Landing Area), which has been analyzed in Section 3.2 of the 2023 SEA and would not result in any different impacts as discussed in these documents, with the exception of an increase in frequency due to higher cadence. Since the noise from

offshore landing activities would occur far from sensitive receptors, there would be no significant impacts associated with implementing the landings at the offshore locations.

Overall Sonic Boom Effects

In general, booms in the 0.2 to 0.3 psf range could be heard by someone who is expecting it and listening for it, but usually would not be noticed. Booms of 0.5 psf are more likely to be noticed, and booms of 1.0 psf are certain to be noticed. Therefore, during launches with easterly trajectories, people in eastern Santa Barbara and Ventura Counties would occasionally hear sonic booms and sometimes experience sonic booms just over 2 psf. These would likely startle people if they were not anticipating it. People living in western Los Angeles County may occasionally hear a sonic boom, but generally at levels that would not be noticed. People in Lompoc, CA are likely to notice booms from first stage and booster landings at SLC-4, as are people located on VSFB and other populated areas around VSFB. People located within the 1.0 psf and 2.0 psf region (see Figure 3.2-4) would likely be startled and possibly annoyed. Announcements of upcoming Falcon 9 launches and landings serve to warn people about these noise events and are likely to help reduce adverse reactions to these noise events.

As described in Section 3.2.2.1.1, the duration of a noise event plays heavily into OSHA's permissible daily noise exposure. A sonic boom is typically between 300 and 600 milliseconds in duration. As such, the contribution to the daily exposure is extremely minimal and would not contribute substantially towards reaching a CNEL of 65 dBA. Further, injury to the ear has been noted above levels of 8,000 Pascals (Fisher 2008), which is roughly the same as a 170 psf boom, very far above predicted levels for the Falcon 9, thus injuries would not occur.

Boom levels over land, which are less than 5.0 psf in most areas, are unlikely to cause structural damage. Materials in good condition do not normally fail under sonic boom levels below 6 psf (NOAA 2023). NOAA publishes overpressure levels of concern that indicate the typical pressure for glass failure is 21.6 psf, although glass failure could occur at 5.76 psf (NOAA 2023). In 1965, NASA conducted a study of potential structural effects from sonic booms near the White Sands Missile Range and found that there was no structural damage until 8 psf (after more than 1500 tests), but that damage could occur to glass, plaster, tile, and stucco that was already in a vulnerable condition (Benson 2013). Sonic booms above 1.5 psf in the Lompoc, eastern Santa Barbara County, and Ventura County are expected to be infrequent events and would vary in impact location. The DAF and SpaceX will also notify the public prior to missions with the potential to impact these areas so that the public can anticipate and prepare for the potential disturbance. Therefore, there would be no significant impacts from sonic booms produced during landing at SLC-4 resulting from the Proposed Action under Alternative 1.

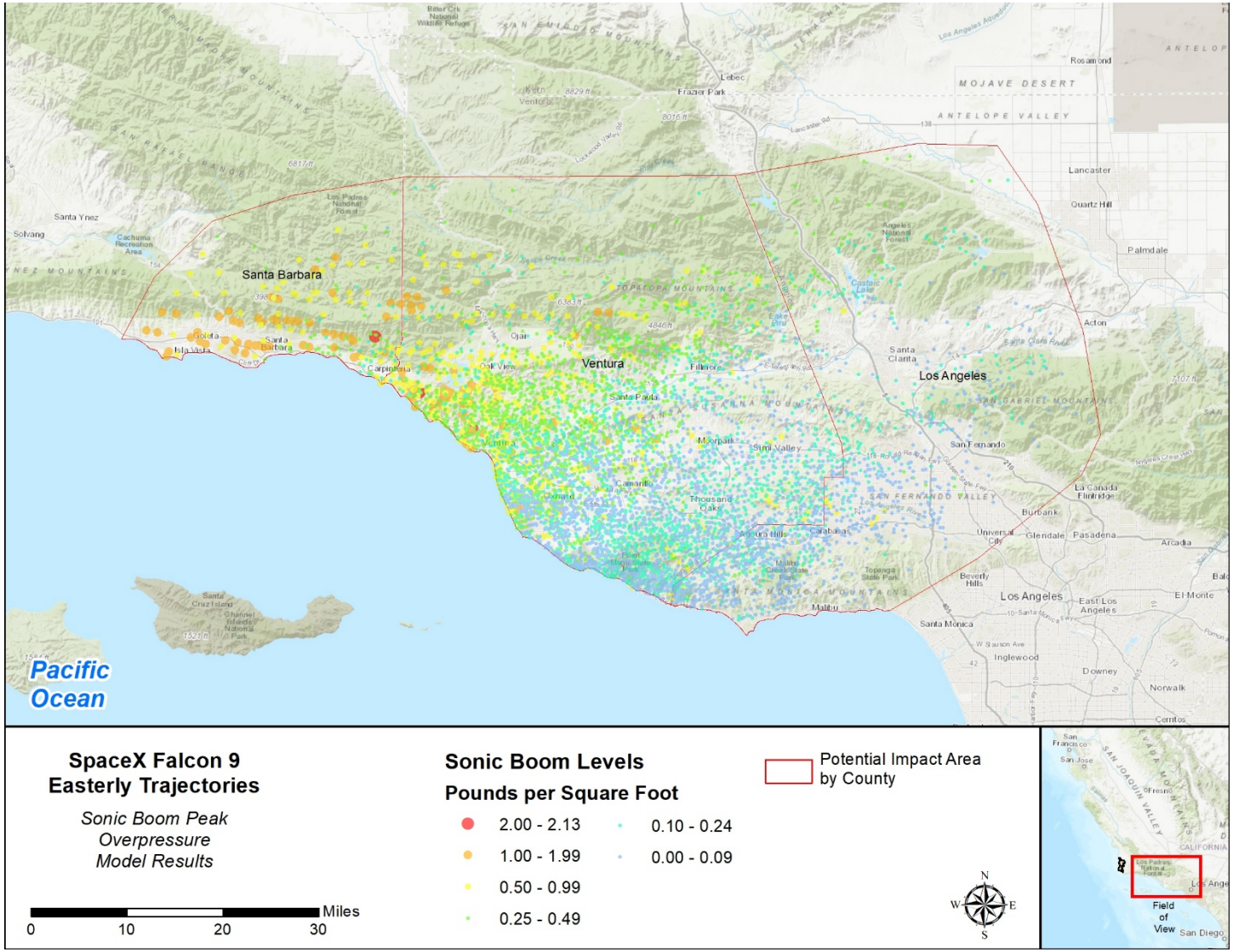

Figure 3.2-3. Sonic boom model results for 125 runs for easterly SpaceX Falcon 9 trajectories showing range of possible boom impact areas and levels, depending on meteorological conditions (Note: the image is intended to show the array of potential sonic booms; no single launch would result in impacts across the entire areas depicted nor at the specific levels depicted).

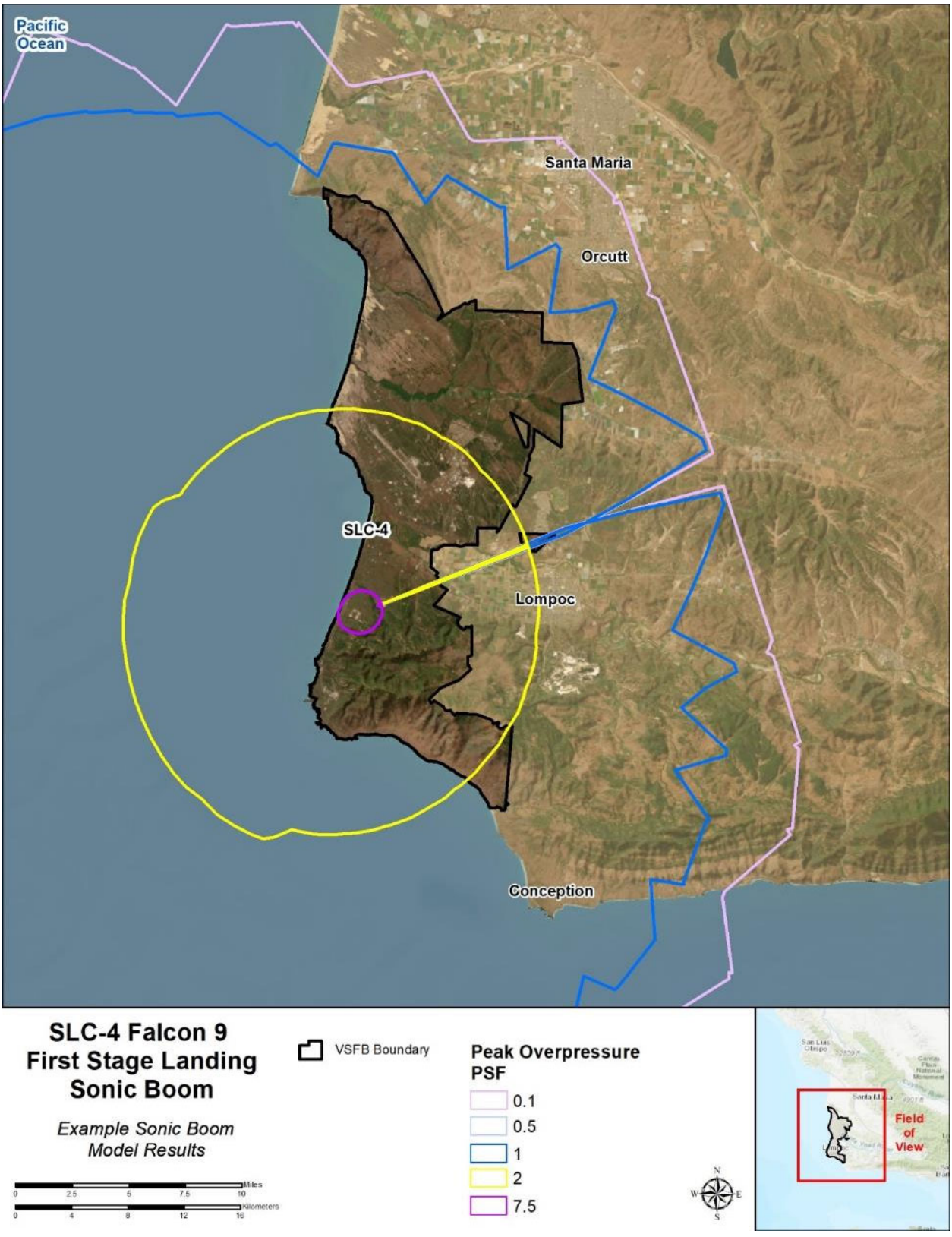

Figure 3.2-4. Example sonic boom model results for Falcon 9 first stage landing at SLC-4W

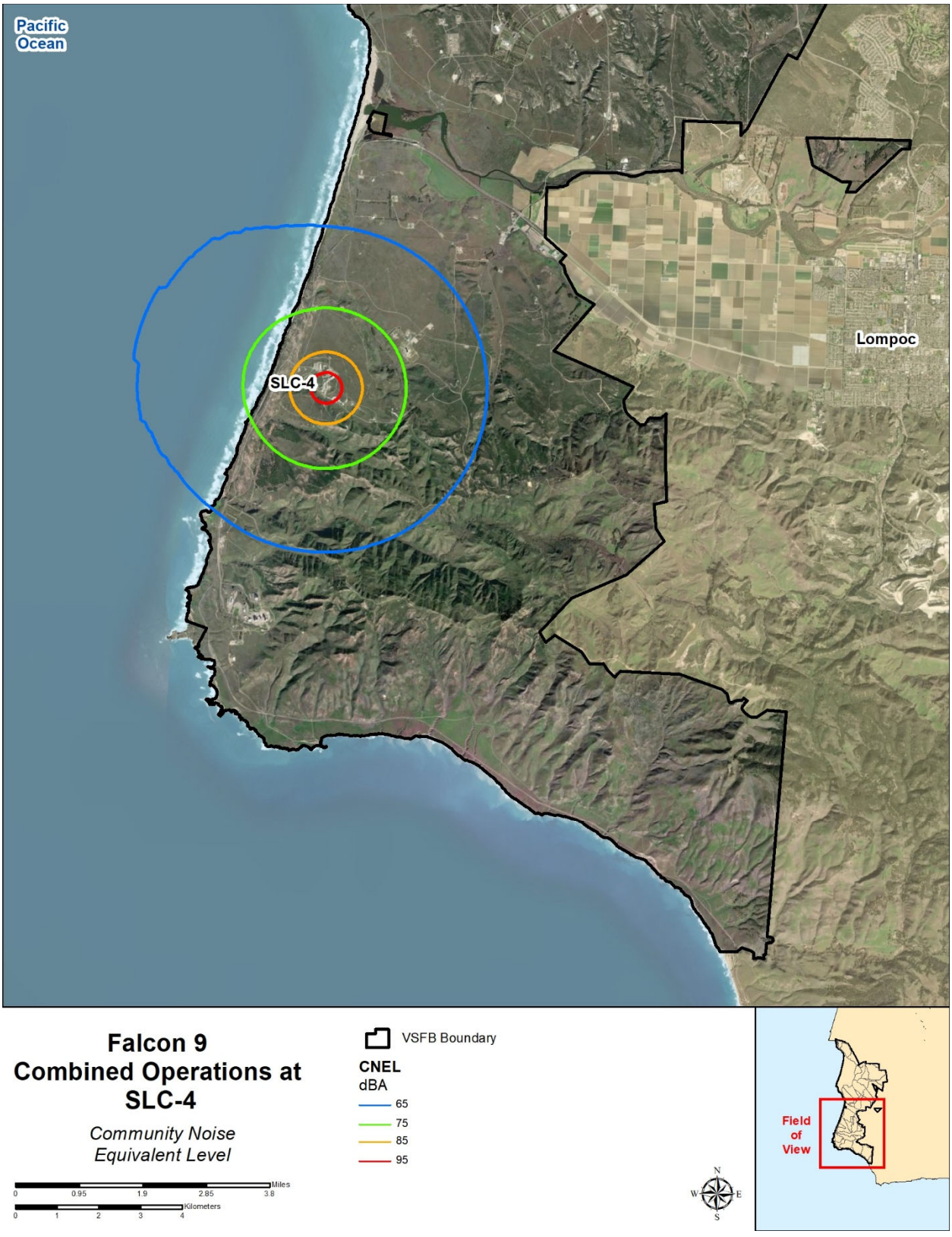

Figure 3.2-5. Falcon 9 CNEL contours for combined operations at SLC-4

3.2.2.1.4 Airspace

Airspace closures associated with commercial space operations could result in temporarily grounded aircraft at affected airports and re-routing en-route flights on established alternate flight paths. The FAA has rarely, if ever, received reportable departure delays associated with launches at VSFB. Aircraft could be temporarily grounded if airspace above or around the airport is closed. Ground delays are also used under some circumstances to avoid airborne reroutes. If aircraft were grounded, noise levels at the airport could temporarily increase as the planes sit idling waiting for takeoff. Depending on the altitude at which aircraft approach an airport, there could be temporary increases in noise levels in communities around the airports. However, aircraft would travel on existing en-routes and flight paths that are used daily to account for weather and other temporary restrictions. Not all launch and reentry missions would affect the same aircraft routes or the same airports and re-routing associated with launch-related closures represents a small fraction of the total amount of re-routing that occurs from all other reasons in any given year. Any incremental increases in noise levels at individual airports would only last the duration of the airspace closure periodically and a meaningfully change existing DNL at the affected airports and surrounding areas is not expected. Therefore, airspace closures due to commercial space operations are not expected to result in significant noise impacts.

3.2.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on the noise environment, beyond those described in the 2023 SEA.

3.3 Terrestrial Biological Resources

3.3.1 Affected Environment

Under Section 7 of the ESA of 1973, as amended (16 USC Section 1531, et seq.), federal agencies must assess project effects on species that are federally listed or proposed for listing based on the best scientific and commercial data available. Section 7 consultations with the USFWS and NMFS are required for federal projects that have the potential to adversely affect (directly or indirectly) listed species or destroy or adversely modify critical habitat. Also, when evaluating project impacts USSF policy is to consider other federal special status species, state-listed protected species, and species protected by state law. In California, these include species that the California Department of Fish and Wildlife (CDFW) designates per the California Fish and Game Code Sections 3511, 4700, 5050, and 5515 as “fully protected” wildlife species. "Fully protected" designation means the species is at risk of extinction within California. This term was used before California’s Endangered Species Act became law. California also protects species of special concern. Although SLD 30’s Integrated Natural Resource Management Plan is not subject to California’s requirements, SLD 30 protects and conserves these species when practicable and consistent with the military mission. SLD 30 also must comply with requirements of the Migratory Bird Treaty Act (MBTA) of 1918 (16 USC Sections 703-712) as amended. This MBTA protects native migratory birds, including their eggs, active nests, and young.

The ROI for terrestrial biological resources includes areas potentially impacted by sonic boom, rocket engine noise, and increased water usage, which includes VSFB and the surrounding region, as well as the NCI.

3.3.1.1 Methodology

The DAF reviewed prior special status species survey and monitoring data, biological reports, and California Natural Diversity Database (CNDDB) records to assess the documented and potential occurrence, distribution, and habitat use of plants and animals, including special status species, within the region potentially affected by the Proposed Action.

3.3.1.2 Wildlife Resources

Common birds within the ROI include house finch (*Carpodacus mexicanus*), Brewer's blackbird (*Euphagus cyanocephalus*), cliff swallow (*Hirundo pyrrhonota*), barn swallow (*Hirundo rustica*), and California thrasher (*Toxostoma redivivum*). Amphibians within the ROI include the Baja California treefrog (*Pseudacris hypochondriaca*), Monterey ensatina (*Ensatina eschscholtzii*), and black-bellied slender salamander (*Batrachoseps nigriventris*). Reptiles include western fence lizard (*Sceloporus occidentalis*), western skink (*Eumeces skiltonianus*), and southern Pacific rattlesnake (*Crotalus oreganus helleri*). Various mammal species are also expected to occur within the ROI, including brush rabbit (*Sylvilagus bachmani*), coyote (*Canis latrans*), black bear (*Ursus americanus*), and California ground squirrel (*Otospermophilus beecheyi*). Small mammals include kangaroo rats (*Dipodomys* spp.) and pocket gopher (*Thomomys bottae*). Bat species in the area include big brown bat (*Eptesicus fuscus*) and western red bat (*Lasiurus blossevillii*). The NCI host the island scrub jay (*Aphelocoma insularis*), Channel Islands spotted skunk (*Spilogale gracilis amphialus*), island fox (*Urocyon littoralis*), and the island deer mouse (*Peromyscus maniculatus santacruzae*).

3.3.1.3 Special Status Wildlife Species

Species were considered "special status" if they met at least one of the criteria listed in Table 3.3-1. Potential occurrence was determined based on past documentation of special status species within the vicinity of the ROI and suitability of habitat and occurrence within the region (Table 3.3-2 through Table 3.3-7). Detailed information is contained in Appendix A.

Table 3.3-1. Terrestrial special status species considered

Special-Status Biological Resources
Plant and wildlife species that are federally listed, proposed for listing, or candidates for listing
Plant and wildlife species that have been delisted
Plant and wildlife species that are state listed or candidates for listing
California fully protected species
Wildlife species considered California Species of Special Concern by CDFW
Plant species listed as endangered, threatened, or rare by the state of California
Golden eagles and bald eagles protected under the Bald and Golden Eagle Protection Act
Federal Birds of Conservation Concern
Winter roost locations for monarch butterflies protected under the Local Coastal Plan of Santa Barbara County

Table 3.3-2. Federal and State special status invertebrate species occurrence within the ROI

Species	Status		Occurrence within the ROI
	Federal	California	
Crotch bumble bee (*Bombus crotchii*)	-	SSC	Present in the noise footprint on VSFB, in eastern Santa Barbara, Ventura, and western Los Angeles Counties.
Monarch butterfly (*Danaus plexippus*)	P	Special Animal	Overwintering stands within noise footprint on VSFB, in eastern Santa Barbara, Ventura, and western Los Angeles Counties.

Notes: P = proposed for listing under the ESA; SSC = California State Species of Special Concern; "Special Animals" is a broad term used to refer to all the animal taxa tracked by the CDFW.

Table 3.3-3. Special status fish species occurrence within the terrestrial portion of the ROI

Species	Status		Occurrence within the ROI
	Federal	California	
Tidewater goby (*Eucyclogobius newberryi*)	FT	-	Historic occurrence in Honda Creek on VSFB; surveys have not detected since 2001. Present in San Antonio Creek and Jalama Creek on VSFB. Present in coastal streams within the noise footprint in eastern Santa Barbara, Ventura, and western Los Angeles Counties.
Unarmored Threespine Stickleback (*Gasterosteus aculeatus*)	FE	SE	Currently extirpated on Honda Creek on VSFB; historic introduction in Honda Creek in 1984. No individuals have been detected in Honda Creek since the late 1990's. Present in San Antonio Creek on VSFB.
Arroyo chub (*Gila orcuttii*)	-	SSC	Not present on Honda Creek and San Antonio Creek on VSFB. Present within the noise footprint on Malibu and Calleguas Creeks in Ventura and western Los Angeles Counties.
Steelhead - southern California DPS (*Oncorhynchus mykiss*)	FE	Candidate	Present within the noise footprint in coastal streams and rivers of Santa Barbara (including VSFB) and western Los Angeles Counties.

Notes: DPS = Distinct Population Segment; FE = Federally Endangered Species; FT = Federally Threatened Species; SE = State Endangered Species; SSC = California State Species of Special Concern

Table 3.3-4. Special status amphibian species occurrence within the terrestrial portion of the ROI

Species	Status		Potential Occurrence within the ROI
	Federal	California	
California tiger salamander (*Ambystoma californiense*)	FE	ST	Not on VSFB. Present within noise footprint in Santa Barbara County.
Coast range newt (*Taricha torosa*)	-	SSC	Not on VSFB. Present within the noise footprint in coastal streams of Santa Barbara, Ventura, and western Los Angeles Counties
California red-legged frog (*Rana draytonii*)	FT	SSC	Present in aquatic habitats within noise footprint in Santa Barbara County, including VSFB.
Arroyo toad (*Anaxyrus californicus*)	FE	SSC	Not on VSFB. Present within noise footprint in Santa Barbara, Ventura, and Los Angeles Counties.
Western spadefoot (*Spea hammondii*)	P	SSC	Present within noise footprint in Santa Barbara (including VSFB), Ventura, and Los Angeles Counties.

Notes: FE = Federally Endangered Species, FT = Federally Threatened Species; ; P = proposed for listing under the ESA; SSC = California State Species of Special Concern; ST = State Threatened Species

Table 3.3-5. Special status reptile species occurrence within the terrestrial portion of the ROI

Species	Status		Potential Occurrence within the ROI
	Federal	California	
Northern legless lizard (*Anniella pulchra*)	-	SSC	Present within the noise footprint in Santa Barbara County, including VSFB.
Southern legless lizard (*Anniella stebbinsi*)	-	SSC	Not on VSFB. Present within the noise footprint in Ventura and western Los Angeles Counties.
Coastal whiptail (*Aspidoscelis tigris stejnegeri*)	-	SSC	Not on VSFB. Present within the noise footprint in western Los Angeles County.
Coast horned lizard (*Phrynosoma blainvillii*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Southwestern pond turtle (*Actinemys pallida*)	P	SSC	Present within the noise footprint in coastal streams and wetlands of Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.

Two-striped garter snake (*Thamnophis hammondii*)	-	SSC	Present within the noise footprint in Honda Creek on VSFB and the noise footprint in western Santa Barbara County. Potential occurrence in the noise footprint in eastern Santa Barbara and western Los Angeles Counties.

Notes: P = proposed for listing under the ESA; SSC = State Candidate Species

1 **Table 3.3-6.** Special status bird species occurrence within the terrestrial portion of the ROI

Species	Status		Potential Occurrence within the ROI
	Federal	California	
Allen's hummingbird (*Selasphorus sasin*)	BCC	-	Present within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Bald eagle (*Haliaeetus leucocephalus*)	BCC; BGEPA	SE; Fully Protected	Documented occasional flyovers on VSFB; foraging habitat within noise footprint. Rarely present within the noise footprint in eastern Santa Barbara, Ventura, and western Los Angeles Counties.
Bank swallow (*Riparia riparia*)	-	ST	Present within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Belding's savannah sparrow (*Passerculus sandwichensis beldingi)*	-	SE	Present in coastal plains within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Black oystercatcher (*Haematopus bachmani*)	BCC	-	Present on sandy beaches and cliffs of VSFB shoreline and within the noise footprint in Santa Barbara, Ventura, and western Los Angeles Counties.
Black skimmer (*Rynchops niger*)	BCC	-	Present in nearshore ocean waters within the noise footprint in Santa Barbara (including offshore of VSFB), Ventura, and western Los Angeles Counties.
Brant (*Branta bernicla*)	-	SSC	Present in nearshore ocean waters within the noise footprint in Santa Barbara (including offshore of VSFB), Ventura, and western Los Angeles Counties.
Burrowing owl (*Athene cunicularia*)	BCC	SSC	Winters in burrows in grassland areas impacted by noise. Breeding on VSFB has not been documented in optimal breeding habitat on Base since 1984 (reflects a well-documented county-wide decline of the species). Present in coastal plains and agricultural lands within the noise footprint in eastern Santa Barbara, Ventura, and western Los Angeles Counties.

Species	Status		Potential Occurrence within the ROI
	Federal	California	
California brown pelican (*Pelecanus occidentalis californicus*)	-	Fully Protected	Present in nearshore ocean waters and roosts on beaches and rocks within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
California condor (*Gymnogyps californianus*)	FE	SE	One documented brief occurrence on VSFB in 2017 within noise footprint. Unlikely to be present on VSFB. Present within noise footprint in Ventura County.
California least tern (*Sterna antillarum browni*)	FE	SE	Present in noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Coastal California gnatcatcher (*Polioptila californica californica*)	FT	SSC	Not on VSFB. Present within the noise footprint in Ventura and western Los Angeles Counties.
Costa's hummingbird (*Calypte costae*)	BCC	-	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Golden eagle (*Aquila chrysaetos*)	BGEPA	Fully Protected	Present within noise footprint on VSFB and Santa Barbara County. Rare in Ventura and western Los Angeles Counties.
Grasshopper sparrow (*Ammodramus savannarum*)	-	SSC	Present in coastal plains within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Lawrence's goldfinch (*Spinus lawrencei*)	BCC	-	Present in shrub and riparian habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Least Bell's vireo (*Vireo bellii pusillus*)	FE	SE	Present within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Light-footed Ridgeway's rail (*Rallus obsoletus levipes*)	FE	SE	Not on VSFB. Present in coastal salt marshes within the noise footprint of Ventura County.
Loggerhead shrike (*Lanius ludovicianus*)	BCC	SSC; Nesting	Documented in shrub and riparian habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Long-billed curlew (*Numenius americanus*)	BCC	-	Present on rocky coastline at low tide and beaches within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Marbled godwit (*Limosa fedoa*)	BCC	-	Present on sandy beaches and rocky coastline at low tide within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.

Species	Status		Potential Occurrence within the ROI
	Federal	California	
Marbled murrelet (*Brachyramphus marmoratus*)	FT	SE	Present in nearshore ocean waters within noise footprint in Santa Barbara (including offshore of VSFB), Ventura, and western Los Angeles Counties.
Northern harrier (*Circus hudsonius*)	-	SSC; Nesting	Present in grassland within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Nuttall's woodpecker (*Dryobates nuttallii*)	BCC	-	Present in riparian habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Oak titmouse (*Baeolophus inornatus*)	BCC	-	Present in riparian and non-native tree habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Peregrine falcon (*Falco peregrinus anatum*)	BCC; Nesting	Fully Protected; Nesting	Present in coastal habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Short-billed dowitcher (*Limnodromus griseus*)	BCC	-	Present on rocky coastline at low tide and beaches within noise footprint in Santa Barbara, (including VSFB) Ventura, and western Los Angeles Counties.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	FE	SE	Not present on VSFB. Present within the noise footprint in inland Santa Barbara Country and Ventura and western Los Angeles Counties.
Whimbrel (*Numenius phaeopus*)	BCC	-	Present on rocky coastline at low tide and beaches within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Western snowy plover (*Charadrius nivosus nivosus*)	FT; BCC	SSC; Nesting	Present on rocky coastline at low tide, nests on sandy beaches within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Willet (*Tringa semipalmata*)	BCC	-	Present on rocky coastline at low tide and beaches impacted by noise in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
White-tailed kite (*Elanus leucurus*)	-	Fully Protected; Nesting	Present in riparian and non-native tree habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.

Species	Status		Potential Occurrence within the ROI
	Federal	California	
Yellow warbler (*Setophaga petechia*)	BCC	SSC; Nesting	Present in riparian habitat within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.

Notes: BCC = Federal Bird of Conservation Concern; BGEPA = Bald and Golden Eagle Protection Act; FE = Federally Endangered Species; FT = Federally Threatened Species; SE = State Endangered Species; ST = State Threatened Species; SSC = California State Species of Special Concern
* "Special Animals" is a broad term used to refer to all the animal taxa tracked by the CDFW.

1 **Table 3.3-7.** Special status mammal species occurrence within the terrestrial portion of the ROI

Species	Status		Potential Occurrence within the ROI
	Federal	California	
Pallid bat (*Antrozous pallidus*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Spotted bat (*Euderma maculatum*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Townsend's big-eared bat (*Corynorhinus townsendii*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Western red bat (*Lasiurus blossevillii*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
Western mastiff bat (*Eumops perotis californicus*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
San Diego desert woodrat (*Neotoma lepida intermedia*)	-	SSC	Present within the noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.
South coast marsh vole (*Microtus californicus stephensi*)	-	SSC	Not on VSFB. Present within the noise footprint in Ventura County.
Southern California saltmarsh shrew (*Sorex ornatus salicornicus*)	-	SSC	Not on VSFB. Present in coastal salt marshes of Ventura County.
American badger (*Taxidea taxus*)	-	SSC	Present within noise footprint in Santa Barbara (including VSFB), Ventura, and western Los Angeles Counties.

Notes: SSC = California Species of Special Concern

2

3.3.2 Environmental Consequences

3.3.2.1 Alternative 1 (Proposed Action)

The following factors were used to determine if a significant impact on biological resources would result from implementing each alternative:

- Per 40 CFR 1501.3(d), and analyses examine both the context of the Proposed Action and the intensity of the effect. In assessing context and intensity, the duration of the effect was considered and the extent to which an effect is adverse at some points in time and beneficial in others (for example, in assessing the significance of a habitat restoration action's effect on a species, an agency may consider both any short-term harm to the species during implementation of the action and any benefit to the same species once the action is complete). However, agencies shall not offset an action's adverse effects with other beneficial effects to determine significance (for example, an agency may not offset an action's adverse effect on one species with its beneficial effect on another species).

Per FAA Order 1050.1F, impacts would be significant if the USFWS or NMFS determines that the action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species or would result in destroying or adversely modifying federally designated critical habitat.

Impacts on biological resources would occur if project-related activities directly or indirectly affect special status species or their habitats. These impacts can be short- or long-term impacts. For example, short-term or temporary impacts can be from noise and long-term impacts can be from the lost habitat supporting wildlife populations.

Potential impacts on biological resources from the Proposed Action include the following:

- Indirect impacts resulting from water use, which could be extracted from the San Antonio Creek Basin;
- Project-related noise disrupting breeding, foraging, or roosting behaviors and
- Project-related noise causing habitat abandonment, including breeding or roosting sites.

3.3.2.1.1 Wildlife Resources

Temporary disturbances to terrestrial wildlife species within the ROI would occur during the launch, landing, and static fire events. Wildlife responses to noise can be behavioral or physiological, ranging from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Because responses to noise are species specific, exact predictions of the effects on each species are unreliable without data pertaining to the behavioral responsiveness and physiological sensitivity to noise of those species or similar species.

Noise during launches, landing, and static firings at SLC-4 are expected to elicit a startle response in terrestrial wildlife species that may either see or hear these activities. Wildlife hearing thresholds (the range of noise frequencies that species can perceive) could potentially shift (i.e., partial hearing loss or reduction in sensitivity to certain frequencies) either permanently or temporarily in wildlife if they are active on the surface close to SLC-4 during launch, landing, or static fire events. Engine noise would reach as high as 150 dB L_{max} with sonic booms up to 9.5 psf at SLC-4. However, vegetation management within and around SLC-4 reduces wildlife presence above ground in these areas. 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). Because the areas where loud noises would occur are relatively small (see Section 3.2), the noise events are temporary, and wildlife presence is reduced due to vegetation management, potential hearing threshold shifts are unlikely or would affect relatively few individuals and not expected to have population-level impacts. Therefore, would not have a significant effect on wildlife resources.

At maximum cadence, the Proposed Action would use up to 18.6 ac-ft of water per year. This would represent an increase of approximately 0.7 percent of the total annual water usage on VSFB. The current water source for VSFB 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. Even if pumping this entire 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 (Cromwell & Faunt 2024). The Proposed Action's water usage would therefore be discountable and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek.

3.3.2.1.2 Special Status Terrestrial Species

Potential impacts to ESA-protected species would be similar to those described in Section 4.3.1 of the 2023 SEA; however, six ESA-protected species were not included in the 2023 SEA that are within the Proposed Action's ROI due to expansion the area of noise impacts: California tiger salamander, arroyo toad, southwestern willow flycatcher, least Bell's vireo, California gnatcatcher, and light-footed clapper. Because of the lack of any potential physical impacts to these species' habitats and the unlikelihood of noise impacts, the DAF determined the Proposed Action may affect, but not likely to adversely affect these species. A detailed discussion of potential effects to all ESA-protected species and their critical habitat within the ROI is included in the Biological Assessment (Appendix A) and summarized in Table 3.3-8. SLD 30 completed ESA Section 7 consultation with USFWS regarding the Proposed Action. The resultant Biological Opinion (BO; USFWS 2024; Appendix A) assessed the effects of 16 additional launches between 1 October and 31 December 2024 (thus reaching a cadence of 50 launches in calendar year 2024) on threatened and endangered species.

As discussed for non-listed species, the increased tempo of launches and landings would increase the frequency at which listed and proposed species and migratory birds could respond behaviorally and physiologically to noise. There could potentially be a corresponding increase in effects such as long-term habitat avoidance and decreased reproductive success. Some individuals may become habituated to increased noise events and vibration and exhibit diminishing responses over time. It is not feasible to predict the number of exposures that would correspond to these types of effects. Given the lack of quantitative thresholds, population monitoring may be used to evaluate long-term noise impacts. Monitoring of western snowy plover, California least-tern, California red-legged frog (CRLF), and other species occurs currently at VSFB and is expected to continue. If monitoring results indicated population effects, SLD 30 would develop a response strategy accordingly with USFWS.

As discussed in Section 3.2.2, potential sonic booms impacting mainland California during ascent are generally expected to be of low magnitude and infrequent. Due to the lack of any coupled visual stimuli,

sonic booms created during missions with easterly trajectories are not expected to have long-term adverse effects on ESA-protected species.

Increased launch frequency would also increase the occurrence of nighttime lighting at SLC-4. SpaceX is developing a lighting management plan in coordination with SLD 30 and USFWS to reduce potential impacts due to nighttime lighting.

During launch, CRLF may be injured or killed as a result of the release of hot water and vapor into Spring Canyon from the flame bucket (a concrete pit under the rocket that receives the rocket engine flame and is filled with water to reduce vibrations of the vehicle during launch). An assessment of Spring Canyon in 2013 (MSRS 2014), in July 2017 (MSRS 2017), and in February 2023 during record rainfall levels (MSRS 2023) found no suitable aquatic habitat within Spring Canyon within or downstream of the vegetation management area. In addition, since 2017, across 11 survey efforts to perform minimization measures associated with the 2017 Biological Opinion (USFWS 2017), no suitable habitat has been found in this area. Routinely mowing the vegetation in the area impacted by water and vapor also reduces the suitability and attractiveness of the site for CLRF occupancy. It is therefore unlikely that CRLF occupy this area on a regular basis and no direct impacts during vegetation management activities or water release are anticipated.

Table 3.3-8. Federally listed species with potential to occur within ROI and summary of effects determinations

Common Name	Scientific Name	Federal Listing	Critical Habitat	Effects Determinations for the Proposed Action
Tidewater Goby	*Eucyclogobius newberryi*	Endangered	No Effect	May affect, not likely to adversely affect.
Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	Endangered	Not designated	May affect, not likely to adversely affect.
California Tiger Salamander	*Ambystoma californiense*	Endangered	No Effect	May affect, not likely to adversely affect.
California Red-legged Frog	*Rana draytonii*	Threatened	No Effect	**May affect, likely to adversely affect.**
Arroyo Toad	*Anaxyrus californicus*	Endangered	No Effect	May affect, not likely to adversely affect.
Western Spadefoot	*Spea hammondii*	Unlisted	N/A	May affect, not likely to adversely affect.

Common Name	Scientific Name	Federal Listing	Critical Habitat	Effects Determinations for the Proposed Action
Southwestern Pond Turtle	*Actinemys pallida*	Unlisted	N/A	**May affect, likely to adversely affect.**
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	Designated, no overlap with Action Area	May affect, not likely to adversely affect.
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	No Effect	May affect, not likely to adversely affect.
Least Bell's Vireo	*Vireo bellii pusillus*	Endangered	Designated, no overlap with Action Area	May affect, not likely to adversely affect.
Western Snowy Plover	*Charadrius nivosus*	Threatened	No Effect	**May affect, likely to adversely affect.**
California Least Tern	*Sternula antillarum browni*	Endangered	Not designated	**May affect, likely to adversely affect.**
California Condor	*Gymnogyps californianus*	Endangered	No Effect	May affect, not likely to adversely affect.
California Gnatcatcher*	*Polioptila californica californica*	Threatened	No Effect	May affect, not likely to adversely affect.
Light-footed Clapper Rail	*Rallus obsoletus levipes*	Endangered	Not designated	May affect, not likely to adversely affect.

The terms and conditions and reasonable and prudent measures identified in the 2024 BO (USFWS 2024; Appendix A) would be implemented. With continued species monitoring and adaptive management, implementation of measures required by the USFWS, if necessary, increased Falcon launches would not be likely to jeopardize the continued existence of a federally listed threatened or endangered species or result in the destruction or adverse modification of federally designated critical habitat resources. In addition, these measures would decrease the potential for long-term habitat and species loss, as well as adverse effects on reproductive success, mortality rate, or ability to sustain minimum population levels, such that impacts would be less than significant.

3.3.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on terrestrial biological resources, beyond those described in the 2023 SEA.

3.4 Marine Biological Resources

3.4.1 Affected Environment

The ROI for marine biological resources includes areas potentially affected by sonic boom, rocket engine noise, and first stage and fairing recovery activities. The DAF has monitored pinnipeds during launch-related sonic booms on the NCI during numerous launches over the past two decades, and determined in collaboration with NMFS, there are generally no significant behavioral disruptions caused to pinnipeds by sonic booms less than 1.0 psf; therefore, the ROI for marine mammals potentially disturbed by a sonic boom was determined by examining the 1.0 psf sonic boom contours from model results. The ROI also includes the proposed landing and fairing recovery area (Figure 2.1-2), the NCI, and support vessel routes between the Port of Long Beach, the proposed landing area, and VSFB Harbor.

3.4.1.1 Marine Species

Fish, sea turtles, and marine mammal species protected under the ESA or MMPA, and managed by NMFS, have the potential to occur in the ROI. Detailed background information on ESA-listed fish, sea turtles, and marine mammals, including status and maps showing occurrence in the project area, can be found in Appendix B.

Table 3.4-1. ESA-listed fish species occurrence within the ROI

Common Name	Scientific Name	DPS or ESU	Federal Status	Presence in ROI
Steelhead	*Oncorhynchus mykiss*	Southern California Coast	FE	Documented in the nearshore and offshore waters.
Chinook salmon	*Oncorhynchus tshawytscha*	5 ESUs[1]	FT	Specific ESUs present or potentially present in the nearshore and offshore waters.
Coho salmon	*Oncorhynchus kisutch*	4 ESUs[2]	FT	Documented in the nearshore and offshore waters.
Green sturgeon	*Acipenser medirostris*	Southern	FT	Likely present primarily along continental shelf waters of the West Coast
Oceanic whitetip shark	*Carcharhinus longimanus*	-	FT	Present in open ocean waters from Southern California to Peru
Scalloped hammerhead shark	*Sphyrna lewini*	Eastern Pacific	FE	Present in coastal and semi-oceanic water in temperate and tropical regions

Notes: DPS = Distinct Population Segment; ESU = Evolutionarily Significant Unit; FE = federally endangered; FT = federally threatened

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

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

Table 3.4-2. ESA-listed turtle species occurrence within the ROI

Common Name	Scientific Name	DPS or ESU	Federal Status	Presence in ROI
Green sea turtle	*Chelonia mydas*	East Pacific Central North Pacific	FT	Present in offshore and nearshore subtropical waters
Leatherback sea turtle	*Dermochelys coriacea*	-	FE	Present in offshore and nearshore waters
Olive ridley sea turtle	*Lepidochelys olivacea*	Mexico Pacific Coast	FE	Present in offshore and nearshore waters
Hawksbill sea turtle	*Eretmochelys imbricata*	-	FE	Present in offshore and nearshore waters of Mexico
Loggerhead turtle	*Caretta caretta*	North Pacific	FE	Present in small numbers in offshore waters generally north of Point Conception

Notes: DPS = Distinct Population Segment; ESU = Evolutionarily Significant Unit; FE = federally endangered; FT = federally threatened

Table 3.4-3. Special status marine mammal species occurrence within the ROI

Common Name	Scientific Name	DPS or ESU	Federal Status	Presence in ROI
Blue whale	*Balaenoptera musculus*	-	FE; MMPA	High densities in summer/fall; single individuals in winter/spring
Fin whale	*Balaenoptera physalus*	-	FE; MMPA	Higher densities in the summer and fall, present year-round
Gray whale	*Eschrichtius robustus*	Western North Pacific	FE; MMPA	Present during seasonal migration in the winter and spring
Humpback whale	*Megaptera novaeangliae*	Mexico	FT; MMPA	Individuals present year-round with higher seasonal presence during the summer migrations from Mexico and Central America
		Central America	FE; MMPA	
Killer whale	*Orcinus orca*	Southern Resident	FE; MMPA	occasionally present offshore of Central and Southern California
Sei whale	*Balaenoptera borealis*	-	FE; MMPA	Present year round with more likely presence in the winter and spring
Sperm whale	*Physeter macrocephalus*	-	FE; MMPA	Present year round with a preference for deep waters and the continental shelf break and slope
Steller sea lion	*Eumetopias jubatus*	-	MMPA	Documented in coastal waters within the noise footprint
Northern elephant seal	*Mirounga angustirostris*	-	MMPA	Documented in coastal waters within the noise footprint
Pacific harbor seal	*Phoca vitulina richardii*	-	MMPA	Documented in coastal waters within the noise footprint
California sea lion	*Zalophus californianus*	-	MMPA	Documented in coastal waters within the noise footprint
Guadalupe fur seal	*Arctocephalus townsendi*	-	FT; MMPA	Primarily present at NCI and between 50 and 300 km offshore seasonally when not at rookeries in Mexican waters
Southern sea otter	*Enhydra lutris nereis*	-	FT; MMPA	Present along coast of California from Santa Barbara County and north; present along coast of San Nicolas Island

Notes: DPS = Distinct Population Segment; ESU = Evolutionarily Significant Unit; FE = federally endangered; FT = federally threatened

3.4.1.2 Marine Reserves

Under the National Marine Sanctuaries Act, the NOAA established national marine sanctuaries for marine areas with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. Figure 3.4-1 shows marine reserves that may be impacted by the Proposed Action's noise. The Channel Islands National Marine Sanctuary (CINMS) is a collection of marine reserves and marine sanctuaries located at the Channel Islands approximately 40 mi south of SLC-4 (Figure 3.4-1). CINMS regulations listed in 15 CFR Parts 922.71–922.74. Section 922.72(a)(1) prohibits taking any marine mammal, sea turtle, or seabird within or above the CINMS, except as authorized by the MMPA, ESA, MBTA, or any regulation promulgated under the MMPA, ESA, or MBTA.

The coastline from Purisima Point to just south of Point Arguello has been designated as the Vandenberg State Marine Reserve (VSMR) pursuant to California's Marine Managed Areas Improvement Act (Figure 3.4-1). The VSMR management objectives include providing for complete protection of a diverse area containing shallow hard and soft habitats, kelp beds, and associated marine life.

In addition, the Northern Chumash Tribal Council is pursuing designation of the Chumash Heritage National Marine Sanctuary (CHNMS) under the Marine Protection, Research and Sanctuaries Act of 1977. In 2015, NOAA accepted the nomination for future consideration. The CHNMS would encompass an area of the Pacific Ocean from Gaviota Creek to Santa Rosa Creek and out to the western slope of the Santa Lucia Bank. If NOAA designates the CHNMS, the DAF would work with NOAA to develop an exemption for existing activities at VSFB, including SpaceX launches. Because the CHNMS has not been designated at this time, it is not carried forward for analysis.

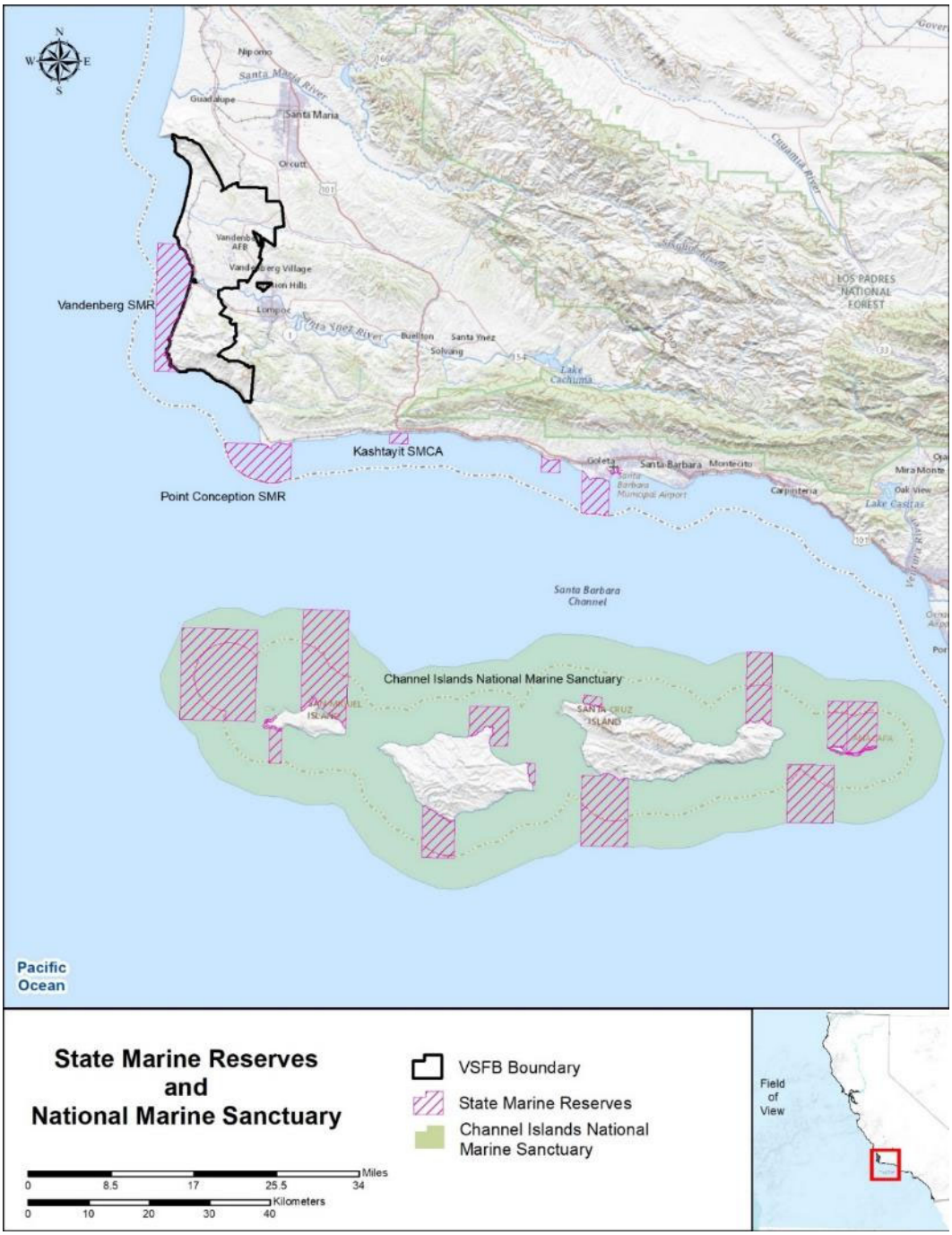

Figure 3.4-1. State Marine Reserves and Channel Islands National Marine Sanctuary

3.4.2 Environmental Consequences

3.4.2.1 Alternative 1

3.4.2.1.1 ESA-listed Fish

The Proposed Action potentially impacts ESA-listed fishes shown in Table 3.4-1 occurring within the ROI. Section 4.4.1 of the 2023 SEA analyzed the potential effects of physical disturbance and impacts by fallen

objects, ship strike, entanglement, and ingestion of expended materials on ESA-listed fish and determined that these would be discountable (DAF 2023). The DAF conducted informal Section 7 consultation with NMFS, which concurred potential impacts ***may affect, but not likely to adversely affect*** ESA-listed fish species through a LOC issued on 20 January 2023 (Appendix B). The Proposed Action has not been modified in a manner that would result in different types of stressors or levels of stressors that were not considered in the written concurrence or would result in take of ESA-listed fish species; nor would the Proposed Action affect ESA-listed fish species or critical habitat in a manner or to an extent not previously considered. The DAF conducted informal Section 7 consultation with NMFS, which concurred through an LOC issued on 17 April 2024 (Appendix B). The DAF would continue to implement all applicable minimization, monitoring, and avoidance measures in the LOC and the environmental protection measures (EPMs) included in Appendix L.

3.4.2.1.2 ESA-listed Sea Turtles

The Proposed Action potentially impacts ESA-listed sea turtles shown in Table 3.4-2 occurring within the ROI. Section 4.4.1 of the 2023 SEA analyzed the potential effects of physical disturbance and impacts by fallen objects, ship strike, entanglement, and ingestion of expended materials on ESA-listed sea turtles and determined that these would be discountable (DAF 2023). The DAF conducted informal Section 7 consultation with NMFS, which concurred potential impacts ***may affect, but not likely to adversely affect*** ESA-listed sea turtle species through a LOC issued on 20 January 2023 (Appendix B).

The Proposed Action has not been modified in a manner that would result in different types of stressors or levels of stressors that were not considered in the written concurrence; nor would the Proposed Action affect ESA-listed sea turtles or critical habitat in a manner or to an extent not previously considered. The proposed recovery area is larger than analyzed in Section 4.4.1 of the 2023 SEA and overlaps the range of the Central North Pacific Distinct Population Segment (DPS) of the green sea turtle, which was not included in the NMFS 2023 LOC. The DAF conducted informal Section 7 consultation with NMFS, which concurred through an LOC issued on 17 April 2024 (Appendix B). The DAF would continue to implement all applicable minimization, monitoring, and avoidance measures in the LOC and the EPMs included in Appendix L.

3.4.2.1.3 ESA-listed Cetaceans

The Proposed Action potentially impacts the ESA-listed cetaceans shown in Table 3.4-3 occurring within the ROI. Section 4.4.1 of the 2023 SEA analyzed the potential effects of physical disturbance and impacts by fallen objects, ship strike, entanglement, ingestion of expended materials, and noise on ESA-listed cetaceans and determined that these would be discountable (DAF 2023). The DAF conducted informal Section 7 consultation with NMFS, which concurred potential impacts ***may affect, but not likely to adversely affect*** ESA-listed cetacean species through a LOC issued on 20 January 2023 (Appendix B). The Proposed Action has not been modified in a manner that would result in different types of stressors or levels of stressors that were not considered in the written concurrence or would result in take of ESA-listed cetacean species; nor would the Proposed Action affect ESA-listed cetacean species or critical habitat in a manner or to an extent not previously considered. The DAF conducted informal Section 7 consultation with NMFS, which concurred through an LOC issued on 17 April 2024 (Appendix B). The DAF would continue to implement all applicable minimization, monitoring, and avoidance measures in the LOC and the EPMs included in Appendix L.

3.4.2.1.4 MMPA-Protected Pinnipeds

Noise and visual disturbance can cause variable levels of disturbance to pinnipeds that may be hauled out within the areas of exposure, depending on the species exposed and the level of the sonic boom. NMFS has previously determined that the only potential stressors associated with the specified activities that could cause harassment of marine mammals (i.e., rocket engine noise, sonic booms) only have the potential to result in harassment of marine mammals that are hauled out of the water (NMFS 2019a). As a result, not all Falcon 9 first stage recoveries are expected to result in harassment of marine mammals. First stage recoveries throughout the majority of the proposed landing area will not result in landing engine noise or sonic booms greater than 1.0 psf impacting mainland or islands. The DAF has monitored pinnipeds during launch-related sonic booms on the NCI during numerous launches over the past two decades and determined that there are generally no significant behavioral disruptions caused to pinnipeds by sonic booms less than 1.0 psf. Generally, only a portion of the animals present tend to react to sonic booms, and reactions vary greatly by species.

The DAF has also monitored pinnipeds on VSFB during many launches to characterize the effects of noise and visual disturbance on pinnipeds during numerous launches over the past two decades, and determined in collaboration with NMFS, there are generally no substantial behavioral disruptions or anything more than temporary affects to the number of pinnipeds hauled out on VSFB. Again, reactions between species are also different. For example, Pacific harbor seals (PHS) and California sea lion tend to be more sensitive to disturbance than northern elephant seals. Normal behavior and numbers of hauled out pinnipeds typically return to normal within 2 to 4 hours or less (often within minutes) after a launch event. No observations of injury or mortality to pinnipeds during monitoring have been attributed to past launches.

Under the MMPA, NMFS issued a Final Rule for taking marine mammals incidental to VSFB launches (NMFS 2024a), and a LOA (NMFS 2024b; Appendix B). The LOA, which will expire on 9 April 2029, allows launch programs to unintentionally take small numbers of marine mammals during launches. The Proposed Action would not result in exceedance of take thresholds as identified in the 2024 LOA. The DAF is required to comply with the LOA listed conditions and address NMFS concerns regarding marine mammals at VSFB. Under the current LOA, semi-monthly surveys (two surveys per month) must be conducted to monitor the abundance, distribution, and status of pinnipeds at VSFB.

The DAF assessed acoustic impacts to marine mammals to analyze potential acoustic impacts for pinniped haulouts in eastern Santa Barbara, Ventura, and Los Angeles Counties to determine if the increased impact is covered by the estimated take totals in the LOA (NMFS 2024b; Appendix B). Full details of this analysis are provided in Appendix B. Below is a summary of the findings.

Two harbor seal haulouts were identified on the mainland in the geographic noise footprint, the Carpinteria Harbor Seal Rookery and the Point Mugu Lagoon haulout. The DAF applied NMFS thresholds as the best available science to estimate level of take resulting from in-air non-impulsive (rocket engine noise) noise and impulsive (sonic boom) for harbor seals at these haulouts. During missions with easterly trajectories, the received engine noise levels (non-impulsive noise) would be substantially less than the NMFS threshold for behavioral disturbance for harbor seals. 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. Approximately 39% of missions with easterly trajectories are predicted to impact the Carpinteria Harbor Seal 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. 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. The highest predicted level was 1.6 psf. 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. This is supported by over two decades of pinniped monitoring by the DAF during sonic booms caused by numerous launches where the DAF has observed that there are generally no significant behavioral disruptions caused to pinnipeds by sonic booms less than 1 psf.

VSFB's LOA permits a total of 11,135 PHS to be incidentally taken by Level B harassment (behavioral disruption) annually due to launch activities (NMFS 2024b). 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 PHS (estimated to be 2,868 per year total) would be offset by a reduction in take on San Miguel Island (SMI). 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 SMI, where there are large numbers of PHS and other pinnipeds. It is therefore unnecessary to increase the number of permitted takes by Level B harassment of PHS under the LOA, despite the change in geographic area of potential impacts. The DAF provided this analysis to NMFS 2 August 2024.

MMPA-protected marine mammals have the potential to be disturbed during RORO operations. However, we do not anticipate adverse effects because the EPMs in Appendix L, including entering the harbor to the extent possible at high tides when pinnipeds are not present, initiating any nighttime activities before dusk, and slowly starting any noisy activities, would help minimize and avoid any behavior disruptions.

Considering the authorizations and EPMs in place, including the required monitoring, the Proposed Action would not result in significant impacts on MMPA protected pinnipeds.

3.4.2.1.5 Guadalupe Fur Seal

The Proposed Action potentially impacts the ESA-listed Guadalupe fur seal. Section 4.4.1 of the 2023 SEA analyzed the potential effects of sonic booms on the NCI on Guadalupe fur seal (DAF 2023). In general, Guadalupe fur seals are relatively insensitive to disturbance, occur in low numbers at SMI in isolated locations, and are adept at jumping into the water if they do flee from a disturbance (Harris 2015). Section 4.4.1 of the 2023 SEA and Appendix B contain more detailed Guadalupe fur seals behavioral reaction discussion. The DAF conducted informal Section 7 consultation with NMFS, which concurred potential impacts were *not likely to adversely affect* the Guadalupe fur seal through a LOC issued on 20 January 2023 (Appendix B). The Proposed Action has not been modified in a manner that would result in different types of stressors or levels of stressors that were not considered in the written concurrence or would result in take of Guadalupe fur seals; nor would the Proposed Action affect Guadalupe fur seal in a manner or to an extent not previously considered. Critical habitat has not been designated for this species.

Additionally, the LOA (NMFS 2024) allows unintentionally take of small numbers of Guadalupe fur seals during launches. The Proposed Action would not result in exceedance of take thresholds as identified in the 2024 LOA. The DAF is required to comply with the LOA listed conditions. The DAF would continue to implement all applicable minimization, monitoring, and avoidance measures in the LOC, LOA, and the EPMs included in Appendix L.

3.4.2.1.6 Southern Sea Otter

Appendix A includes maps depicting noise model results and the overlap with southern sea otter habitat discussed below. Areas directly offshore of SLC-4 would receive visual disturbance and noise levels of less than 130 dB L_{max} during Falcon 9 launches and approximately 110 dB L_{max} during up to 12 first stage landing at SLC-4W. During static fire events, noise directly off the coast of SLC-4 would be less than 125 dB L_{max} and there would be no associated visual disturbance. Landing at SLC-4W would also generate a sonic boom directly offshore that would range from approximately 1 to 5 psf. Otters are only occasionally observed along the coast between Purisima Point and Point Arguello transiting through the area between suitable habitat to the north and south. Beginning at the Boat Dock and continuing south along Sudden Flats, the inshore habitat supports expansive kelp beds and a relatively high density of otters. Noise levels would reach between approximately 100 and 110 dB L_{max} during up to 50 Falcon 9 launches from SLC-4 per year and less than 80 dB L_{max} during up to 12 first stage landing each year at SLC-4W in these areas. Sonic booms during up to 12 SLC-4W landings per year would range from approximately 1 to 4 psf along Sudden Flats.

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). In addition, according to Ghoul and Reichmuth (2014), "Under water, hearing sensitivity [of sea otters] was significantly reduced when compared to sea lions and other pinniped species, demonstrating that sea otter hearing is primarily adapted to receive airborne sounds." This study suggested that sea otters are less efficient than other marine carnivores at extracting noise from ambient noise (Ghoul & Reichmuth 2014). Therefore, the potential impact of underwater noise caused by in-air sound would be discountable.

Extensive launch monitoring has been conducted for sea otters on both north and south VSFB. No abnormal behavior, mortality, or injury of effects on the population has ever been documented for sea otter as a result of launch-related noise and visual disturbance (SRS Technologies, Inc. 2006a, 2006b, 2006c, 2006d, 2006e, 2006f, 2006g, 2006h; MSRS 2007a, 2007b, 2008a, 2008b, 2009; 2021c). Most recently, otters were monitored during four Falcon 9 launches from SLC-4 during 2023 and there were no discernible impacts on overall southern sea otter numbers at the monitoring site (MSRS 2024).

As detailed in Appendix A, most of the sonic boom energy is less than 250 hertz (Hz), well below the region of best sensitivity of the sea otter (2–22.6 kilohertz). While the sea otter would likely hear the sonic boom, it would only be responding to acoustic energy that is above 250 Hz and total sound levels much less than 135 dB L_{max}. As the sonic boom increases in pressure, it is likely that the sea otter would detect more energy, most notably in frequencies higher than 250 Hz. Appendix A presents a sonic boom spectrum and sea otter hearing sensitivity curve, along with an audiogram used to derive an auditory weighting function. The otter weighting function was applied to a timewave form recording of the June 2022 Falcon 9 SARah-1 launch and resulted in a peak level of approximately 70 dB L_{max} (see Appendix A), which by comparison to human hearing sensitivity is equivalent to the sound level of a household washing machine.

Otters have also been shown to quickly acclimate to disturbances from boats, people, and harassment devices (air horns). A summary of studies related to sea otters and disturbance is included in Appendix A. Extensive launch monitoring of sea otters on VSFB has shown that rocket disturbance is not a primary driver of sea otter behavior or using the habitat along Sudden Flats and has not had any apparent long-term consequences on populations, potentially indicating that this population has acclimated to launch activities. Therefore, impacts from noise or visual disturbance resulting from the Proposed Action is expected to be limited to minor behavioral disruption and insignificant.

Because there is very little overlap in the hearing sensitivity of otters and noise produced during rocket launches, otters would perceive very little noise during launch activities and the DAF has determined that impacts on southern sea otter would be insignificant as a result of the Proposed Action, including the collective effects of increased launch activities at VSFB. Therefore, the DAF determined that the Proposed Action may affect, but is not likely to adversely affect, the southern sea otter off VSFB's coast. The DAF completed Section 7 consultation with the USFWS for potential impacts on southern sea otter and would implement all applicable minimization, monitoring, and avoidance measures in the resultant BO (Appendix A) and the EPMs included in Appendix L.

3.4.2.1.7 Marine Reserves

The Proposed Action would not result in any impacts to existing marine reserves. Sonic booms created by the Falcon 9 would reach above 5.0 psf at CINMS on rare occasions. The CINMS prohibitions do not apply to military activities carried out by the DOD, according to Section 3.5.9 of the CINMS Final Environmental Impact Statement (EIS), entitled "Department of Defense Activities" ("preexisting activities") as indicated in Section 922.72(b)(1). Section 3.5.9.1 of the CINMS Final EIS describes spacelift operations originating from VSFB and potential sonic booms from these activities as "pre-existing activities" (NMFS 2007). In addition, impacts to the CINMS would be temporary. Therefore, the Proposed Action would not result in significant impacts on the CINMS.

Noise levels produced during launch activities at SLC-4 would not change from those previously analyzed in Section 4.4.1 of the 2023 SEA. The CDFW and the DAF established a mutual Memorandum of Understanding for the VSMR. Within the VSMR, no take of living marine resources is permitted except take incidental to the mission critical activities of VSFB. Those activities include ones that are important for supporting and defending U.S. launch, range, expeditionary, exercise, test, training, and installation operations, including, but not limited to, space-launch vehicles. Impacts on marine resources within the VSMR would be temporary and limited to sonic boom and landing noise. Therefore, the Proposed Action under Alternative 1 would not result in significant impacts on VSMR.

3.4.2.1.8 Marine Debris

Impacts to marine and coastal resources by marine debris (parachute, parafoils, weather balloons, radiosondes, and residual fuels) under the Proposed Action were analyzed for potential impacts in Sections 4.4 (Marine Biological Resources), 4.5 (Water Resources) and 4.7 (Coastal Zone Management) of the 2023 SEA and would remain highly unlikely to occur and thus discountable, as the amount of debris would not increase per launch/landing, but only the frequency at which the launch/landing occur. Therefore, marine debris would not have a significant impact on marine resources.

3.4.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on marine biological resources, beyond those described in the 2023 SEA.

3.5 Water Resources

3.5.1 Affected Environment

VSFB encompasses portions of two major and four minor drainage basins. San Antonio Creek and the Santa Ynez River represent the major basins, while Shuman Creek, Bear Creek, Honda Creek, and Jalama Creek comprise the minor basins on VSFB. The ROI for water resources include Spring Canyon, San Antonio Creek, and the Pacific Ocean. Surface water in Spring Canyon is entirely on VSFB property, originating at the west end of the Santa Ynez Mountains, north of Honda Canyon. San Antonio Creek drains an area of approximately 154 mi^2 flowing westward and discharging into the Pacific Ocean. Groundwater from the San Antonio Creek basin supplies water for irrigation, domestic, industrial, and municipal purposes through pumping. The Government Accountability Office (GAO) identified VSFB as vulnerable to water-scarcity issues in 2019 (GAO 2019).

3.5.1.1 Surface Water

Surface water resources near SLC-4 include Spring Canyon and the Pacific Ocean. Mean rainfall for the region, measured at Surf from 1927 through 2021, is 11.2 inches (28.4 cm; County of Santa Barbara Public Works 2022). There are no federally designated Wild and Scenic Rivers within the vicinity of VSFB.

Spring Canyon lacks direct connection to the Pacific Ocean and lacks surface flow throughout almost the entire drainage, with flow occurring predominately during and immediately after rainfall (MSRS 2023). Riparian vegetation is removed from a portion of Spring Canyon annually within a 3.3-ac area to avoid and minimize impacts to nesting migratory birds. To protect Waters of the State (WOTS) and meet Basin Plan requirements, the Regional Water Quality Control Board (RWQCB) required implementing a monitoring and mitigation plan in lower Spring Canyon. Mitigation plan implementation is currently in its sixth year.

3.5.1.2 Ground Water

VSFB includes parts of two groundwater basins and at least two sub-basins. The northern third of VSFB is within the San Antonio Creek Basin and the remaining areas are within the Santa Ynez River Basin and associated Lompoc Terrace and Cañada Honda sub-basins. SLC-4 is located in the Santa Ynez River groundwater basin/Lompoc Terrace sub-basin. Groundwater at SLC-4 has been described in Section 3.5.2 of the 2023 SEA and there is no new construction proposed at SLC-4, therefore, groundwater at SLC-4 is not considered further in this EA.

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 last two to three weeks, VSFB utilizes four water wells in the San Antonio Creek Basin. Annual VSFB water use from 2019 through 2021 has averaged 910,500,000 gallons (2,794 ac-ft) per year. The San Antonio Creek Basin is considered in this EA due to the proposed water extraction requirements to support the increase in SLC-4 operations.

3.5.1.3 Waters of the United States and Wetlands

Spring Canyon has surface waters with flowing or standing water for only a short duration in direct response to significant precipitation (surface flow only occurs during and immediately after rain events and standing water may be present sporadically for hours to days after rainfall events). Surface flow in Spring Canyon percolates into the groundwater to pass beneath road embankments, but has no connectivity to the navigable waters of the Pacific Ocean; therefore, under the revised 2023 definition, it does not qualify as a WOTUS

3.5.1.4 Waters of the State and Wetlands

As analyzed in the 2018 SEA (DAF 2018), the RWQCB previously determined that vegetation management activities conducted in Spring Canyon to minimize impact to nesting migratory birds resulted permanent impacts to 1.12 ac to WOTS. To offset these impacts, the RWQCB required mitigation within a 2.6-ac site in lower Spring Canyon. The DAF began implementing riparian restoration at the site in 2018 and is currently in the sixth year of the mitigation plan.

3.5.1.5 Floodplains

The vegetation management area (discussed above) overlaps the 500-year and 100-year floodplains in Spring Canyon. Under EO 13690, floodplains analyses are required for, at a minimum, 500- and 100-year floodplains. EO 11988 requires federal agencies to reduce the risk of flood loss, minimize the impact of flood on human safety, and to restore and preserve the natural and beneficial values served by floodplains and evaluate alternatives prior to proceeding with federal actions that may affect floodplains.

3.5.2 Environmental Consequences

3.5.2.1 Alternative 1

3.5.2.1.1 Surface Water

Activities during launch operations would include using hazardous materials and generating wastewater that if not properly controlled and managed could result in an adverse impact to water resources. BMPs would continue to be implemented to properly manage materials, and to reduce or eliminate project-associated runoff, which reduces the potential for adverse effects.

Wastewater discharges would continue to follow the conditions of the RWQCB letter for Enrollment in the General Waiver of Waste Discharge Requirements for SLC-4E Process Water Discharges to eliminate potential adverse effects to water quality. Any water that remains after launches or stormwater that accumulates within the trench would be tested for contamination. If contamination is encountered, the contents would be pumped out and disposed of per the waiver/permit and state and federal regulations.

Spring Canyon

Potential impacts to Spring Canyon have been described and analyzed in Section 4.5.1 of the 2023 SEA; therefore, surface water resources in Spring Canyon are not considered further in this EA. The DAF will continue to monitor water quality in Spring Canyon, as described in Table 2.1-3.

San Antonio Creek

At maximum cadence, the Proposed Action would use up to 18.6 ac-ft of water per year. This would represent an increase of approximately 0.7 percent of the total annual water usage on VSFB. The U.S. Geological Survey (USGS) estimated this would result in less than a 0.6 percent decrease in base flow at San Antonio Creek if the entire 18.6 ac-ft were extracted from the San Antonio groundwater basin (Cromwell & Faunt 2024). However, the current source for water on VSFB is primarily State Water; therefore, any extraction from San Antonio Creek for the Proposed Action would be negligible. Since VSFB relies primarily on State Water and the amount of annual usage proposed under the Proposed Action is negligible, there would be no measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek. Therefore, impacts to surface water in San Antonio Creeks under the Proposed Action would not be significant.

Broad Ocean Area

Potential impacts to the broad ocean area during first stage recovery activities have been described and analyzed in Section 4.5.1 of the 2023 SEA. The expanded recovery area would not change the results of any prior analyses. Therefore, surface water resources in the broad ocean area are not considered further in this EA.

3.5.2.1.2 Ground Water

At maximum cadence, the Proposed Action would use up to 18.6 ac-ft of water per year. This would represent an increase of approximately 0.7 percent of the total annual water usage on VSFB. The USGS estimated this would result in less than a 0.6 percent decrease in base flow at San Antonio Creek if the entire 18.6 ac-ft were extracted from the San Antonio groundwater basin (Cromwell & Faunt 2024). However, the current source for water on VSFB is primarily State Water; therefore, any extraction from San Antonio Creek for the Proposed Action would be negligible. Since VSFB relies primarily on State Water and the amount of annual usage under the Proposed Action is negligible there would be no measurable impacts to groundwater water levels in San Antonio Creek or exacerbate water scarcity at VSFB or the surrounding area.

Therefore, the Proposed Action's water usage would be negligible and not contribute in any measurable way to the collective effects of water extraction requirements for all VSFB operations. Thus, impacts to groundwater in the San Antonio Creek Basin under the Proposed Action would not be significant.

3.5.2.1.3 Waters of the United States

None of the aquatic features assessed qualify as WOTUS; therefore, there would be no impacts to WOTUS as a result of implementation of the Proposed Action.

3.5.2.1.4 Waters of the State

To comply with the RWQCB, the DAF is implementing mitigation in lower Spring Canyon to offset impacts to WOTS from vegetation removal activities in Spring Canyon at a 2:1 ratio within the same drainage. The DAF began implementing riparian restoration at a 2.6 ac restoration site in 2018 and is currently in the sixth year of the mitigation plan. Therefore, impacts to WOTS under the Proposed Action would not be significant.

3.5.2.1.5 Floodplains

Potential impacts to the floodplain have been described and analyzed in Section 4.5.1 of the 2023 SEA and the Proposed Action would not cause any additional impacts beyond what was already considered. Therefore, impacts to floodplains are not considered further in this EA.

3.5.2.1.6 Conclusion

The Proposed Action would implement the BMPs and EPMs described in Appendix L which would protect surface and ground water from exceeding any federal, State, or local regulatory agencies water quality standards. Wastewater discharges would continue to follow conditions of the RWQCB letter for Enrollment in the General Waiver of Waste Discharge Requirements for SLC-4E Process Water Discharges that would protect ground water quality. Therefore, the Proposed Action would not significantly impact water resources.

3.5.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on water resources beyond those described in the 2023 SEA.

3.6 Cultural Resources

3.6.1 Affected Environment

Cultural resources encompass a range of sites, properties, and physical resources relating to human activities, society, and cultural institutions. Such resources include past and present expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, structures, objects, and districts that are considered important to a culture or community. Cultural resources also include aspects of the physical environment, namely natural features and biota that are a part of traditional ways of life and practices and are associated with community values and institutions.

The NHPA establishes national policy for protecting significant cultural resources that are considered "historic properties." Historic properties are defined as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the National Register of Historic Places" (NRHP) (36 CFR Part 800.16).

The ROI for cultural resources includes VSFB's regional setting and the specific Proposed Action study area (the Area of Potential Effects [APE]). The cultural resources within the project area are discussed below. The APE of an undertaking is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 CFR Part 800-16(d)). The APE considers any physical, visual, or auditory effects that the project may have on cultural resources. Since no ground-disturbing or landscape-altering actions are proposed, the APE for the current project is limited to auditory effects and was predicated on vibratory impacts. These auditory effects include noise exceeding 120 dB and sonic booms exceeding 2.0 psf based on previous studies that have determined at which levels structures and archaeological resources could potentially be affected by rocket noise and sonic booms. Sound pressure levels below 120 dB (linear) are considered to have no material effects on structures (Fenton & Methold 2016).

The DAF previously found there would be no potential to cause effects to historic properties to any known historic properties from launches and landings at SLC-4. A discussion of historic properties within that APE is included in the *Final Supplemental Environmental Assessment Falcon 9 Cadence Increase at Vandenberg Space Force Base, California and Offshore landing Locations* (DAF 2023).

3.6.2 Environmental Consequences

3.6.2.1 Alternative 1

The DAF previously found there would be no potential to cause effects to historic properties to any known historic properties from launches and landings at SLC-4 (Appendix C). Under 36 CFR Part 800.4(d)(1), when the agency finds there are no historic properties present or there are historic properties present but the undertaking will have no effect upon them, the agency makes a no historic properties affected determination. The agency informs the State Historic Preservation Office (SHPO) and any consulting parties of this determination and may proceed if the SHPO concurs with the finding or fails to respond within 30 days. The SHPO did not respond to the DAF's previous "no historic properties affected" determination for launches and landings at SLC-4. Therefore, no further consultation is required.

3.6.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on cultural resources beyond those described in the 2023 SEA.

3.7 Coastal Zone Management Act

3.7.1 Affected Environment

The CZMA (16 USC Section 1451, et seq.) is the primary federal law for managing coastal resources. Federal actions that have reasonably foreseeable effects on natural resources or land or water uses in the coastal zone, regardless of the project's location, are required to be consistent, to the maximum extent practicable, with the enforceable policies of federally approved state coastal management programs (16 USC Section 1456; 15 CFR Part 930). Federal agencies submit a CD to the state coastal management program when an action could foreseeably affect coastal resources. If a federal action would not foreseeably affect the coastal zone or coastal resources, then the federal agency may prepare a negative determination (ND) for that action. Neither the DAF nor FAA have established a significance threshold for coastal resources.

The ROI for coastal zone management extends to those coastal resources off VSFB property that may be affected by the Proposed Action, including natural resources, land uses, water uses, public access, and recreation within the California Coastal Zone (CCZ). The CCZ generally extends 1,000 yards inland and up to 3 nm seaward, but may extend up to 5 mi inland for significant coastal estuarine, habitat, and recreational areas and less than 1,000 yards inland in urban areas. SLC-4 is located on VSFB, property which is owned by the U.S. and operated by the DAF as the federal agency with full administrative authority and operational management over the federal property. As defined in Section 304 of the CZMA, the term "coastal zone" does not include "lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal government, its officers or agents." However, the DAF recognizes that actions outside the coastal zone may affect land or water uses or natural resources in the coastal zone off VSFB and therefore may be subject to the provisions of the CZMA.

In 1998, the USAF received the CCC's concurrence on a CD (CD-049-98) for south Base launch activity. In December 2003, the USAF received concurrence on ND-103-03 for implementing the Falcon 1 launch vehicle program at SLC-3W. In 2005, the USAF received concurrence on ND-088-05 for relocating the Falcon 1 program from SLC-3W to SLC 4. In 2010, the CCC concurred with the USAF on ND-055-10 for modifying SLC-4 infrastructure to meet SpaceX needs. In 2014, the CCC issued concurrence on ND-0035-14 for the SpaceX Dragon in flight abort test, constructing a SLC-4W landing pad and a single Falcon 9 rocket launch. In 2015, the USAF received concurrence on ND-0027-15 for 6 Falcon 9 launches per year and land on a barge or at SLC-4W. Formal consultation with CCC did not occur to increase the launch cadence from 6 to 12 launches. In 2023, the DAF determined that the Proposed Action would not affect and impact coastal uses or resources because measures will be taken to prevent, minimize, and mitigate effects. Therefore, for this Proposed Action the DAF requested CCC concurrence on a ND. The CCC issued concurrence with the ND on 5 May 2023 (ND-0009-23). However, the CCC reopened the ND on 15 December 2023 and issued a request to the DAF to take remedial action for inconsistencies in the project description and coastal zone effects in February 2024. The DAF subsequently submitted a CD to the CCC in March 2024. The CCC conditionally concurred with the CD on 14 August 2024 (CD 0003-24). The DAF submitted a CD to the CCC on 9 July 2024 to address the potential impacts of SpaceX's increased cadence to 50 launches per year at SLC-4.

3.7.2 Environmental Consequences

3.7.2.1 Alternative 1

VSFB property is statutorily excluded from the coastal zone. Downrange landings would occur outside of state waters, and would not occur within intertidal areas, salt marshes, estuaries, or coral reefs. The Proposed Action does not include any coastal construction nor seafloor disturbing activities. However, effects from launch and landing (e.g., noise, public access restrictions) may occur within the California coastal zone. A detailed analysis of the Proposed Action's potential effects to the California coastal zone is discussed in the CD prepared for the Proposed Action (Appendix D). The DAF determined the Proposed Action was fully consistent with the enforceable policies of the California Coastal Management Plan. The DAF submitted the CD and requested concurrence from the CCC on 9 July 2024. Accordingly, the Proposed Action would not result in significant impacts to coastal resources. [Placeholder for outcome]

3.7.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on coastal resources beyond those described in the 2023 SEA.

3.8 Department of Transportation Section 4(f)

3.8.1 Affected Environment

The DOT Act of 1966 (now codified at 49 USC Section 303), Section 4(f), protects significant publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historic sites listed or eligible for listing on the NRHP. Section 4(f) provides that the Secretary of Transportation may approve a transportation program or project requiring the use of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance, or land of an historic site of national, State, or local significance, only if there is no feasible and prudent alternative to the use of such land and the program or project includes all possible planning to minimize harm resulting from the use.

Procedural requirements for complying with Section 4(f) are set forth in DOT Order 5610.1D, *Procedures for Considering Environmental Impacts*. The FAA also uses Federal Highway Administration (FWHA) regulations (23 CFR Part 774) and FHWA guidance (e.g., Section 4(f) Policy Paper) when assessing potential impacts on Section 4(f) properties. These requirements are not binding to the FAA; however, the FAA may use them as guidance to the extent relevant to FAA projects.

The ROI for Section 4(f) is defined by launch and landing rocket engine noise, sonic booms, and potential debris impact corridors associated with launch trajectories. Potential Section 4(f) properties within the ROI would not receive rocket engine noise exceeding 100 dBA L_{max} (Figure 3.8-1). However, Point Sal State Park, Wall Beach, County of Santa Barbara Ocean Beach Park, Surf Beach, La Purisima Mission State Park, Miguelito Park, Jalama Beach County Park, Gaviota State Beach, Refugio State Beach, and El Capitan State Beach may occasionally receive sonic booms of 1 psf or greater (Figure 3.8-2).

FAA identified three Section 4(f) properties that might be subject to evacuation during launch operations: Jalama Beach County Park, Surf Beach, and County of Santa Barbara Ocean Beach Park. These parks offer various recreational options, including picnicking, surfing, whale watching, bird watching, nature photography, and fishing with peak attendance in summer and on holidays. Jalama Beach County Park also offers camping.

3.8.2 Environmental Consequences

Impacts on Section 4(f) properties would be significant if the FAA's Proposed Action involves more than a minimal physical *use* of a Section 4(f) resource or constitutes a *constructive use* based on an FAA determination that the project would substantially impair the Section 4(f) resource. The concept of *constructive use* is that a project that does not physically use land in a park, for example, may still, by means of noise, air pollution, water pollution, or other impacts, dissipate its aesthetic value, harm its wildlife, restrict its access, and take it in every practical sense. *Constructive use* occurs when the impacts of a project on a Section 4(f) property are so severe that the activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features, or attributes of the Section 4(f) property that contribute to its significance or enjoyment are substantially diminished. This means that the value of the Section 4(f) property, in terms of its prior significance and enjoyment, is substantially reduced or lost. For example, noise would need to be at levels high enough to have negative consequences of a substantial nature that amount to a taking of a park or portion of a park for transportation purposes.

3.8.2.1 Alternative 1

The Proposed Action does not include any construction activities within, or actual physical taking of, a Section 4(f) property through the purchase of land or a permanent easement, physical occupation of a portion or all of Section 4(f) property, or alteration of structures or facilities on Section 4(f) property. Impacts to Jalama Beach County Park would result from occasional temporary evacuation of the public during launch/landing events. Surf Beach and County of Santa Barbara Ocean Beach Park would only be closed during SLC-4 landing events up to 12 times per year.

SLD 30 Range Safety would individually review launch trajectories for each mission to determine what areas would be affected since the hazard risk analysis is unique to each vehicle, history of reliability, and mission trajectory. If necessary for the safety of park visitors, the County Parks Department and the

County Sheriff would evacuate the Jalama Beach County Park upon request from SLD 30 and under agreement between DAF and Santa Barbara County. The Proposed Action would comply with these procedures. Given the formal evacuation agreement in place and the temporary nature of the closure, implementation of the Proposed Action under Alternative 1 would not substantially diminish the protected activities, features, or attributes of any Section 4(f) properties and therefore would not result in substantial impairment of the properties.

All potential Section 4(f) properties in the ROI would experience sound levels less than 100 dBA L_{max} during launches, landings, and static fire events (Figure 3.8-1). First stage and booster landings at SLC-4 could create sonic booms between approximately 1.0 and 3.0 psf at Section 4(f) properties (Figure 3.8-2). However, there is no reasonable potential for launch-related noise to impair the majority of the Section 4(f) properties within the ROI because a quiet setting is not part of the significant attributes or features qualifying these properties for protection under Section 4(f).

Peak overpressures in the Channel Islands National Park may peak at 7.0 psf, across a very focused geographic area over the islands, although typical levels are 3 psf or less and vary in impact locations with every launch, mostly impacting the ocean (see Section 3.2.2). Although launch trajectories overfly the Channel Islands National Park, impacts would not be so severe that the activities, features, or attributes that qualify the Channel Island National Park for protection under Section 4(f) are substantially impaired.

Both rocket engine noise and sonic booms are classified as short-duration, intermittent events. Given the short duration of increased sound levels during a launch and the small area impacted, the FAA has preliminarily determined that noise generated during launches or landing would not substantially diminish the protected activities, features, or attributes of any of the potential Section 4(f) properties and therefore would not result in a *constructive use* of any potential Section 4(f) property. Additionally, given the history of beach and park closures for launches at VSFB, the formal evacuation agreement in place, and the temporary nature of the closures, the FAA has preliminarily determined that the Proposed Action would not substantially diminish the protected activities, features, or attributes of any of the potential Section 4(f) properties and therefore would not result in a *constructive use* of any Section 4(f) property. Therefore, implementation of the Proposed Action under Alternative 1 would not result in significant DOT Act Section 4(f) impacts. The FAA will make a final determination based on any public input received during the draft EA comment period EA comment period.

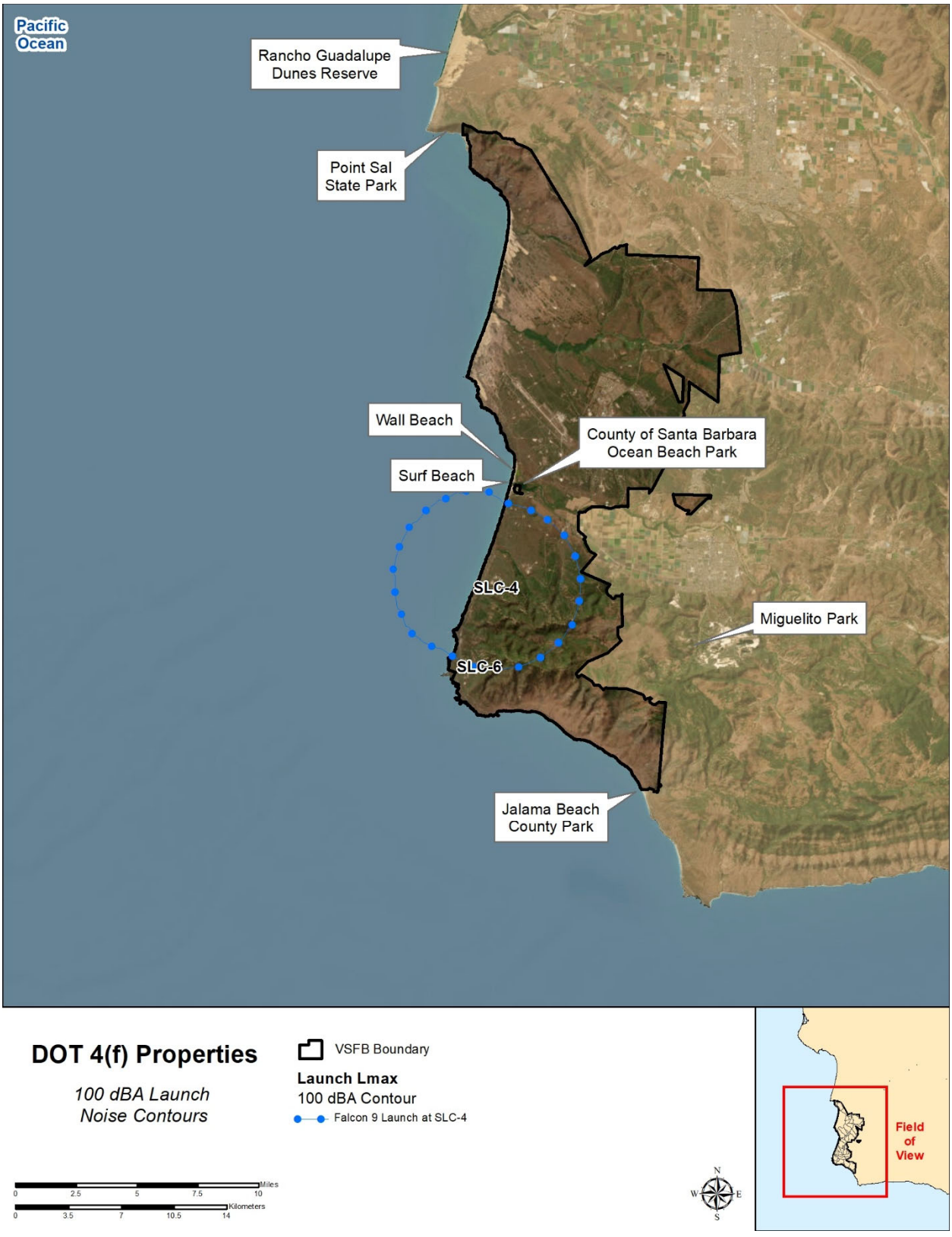

Figure 3.8-1. Potential DOT 4(f) properties and launch engine noise

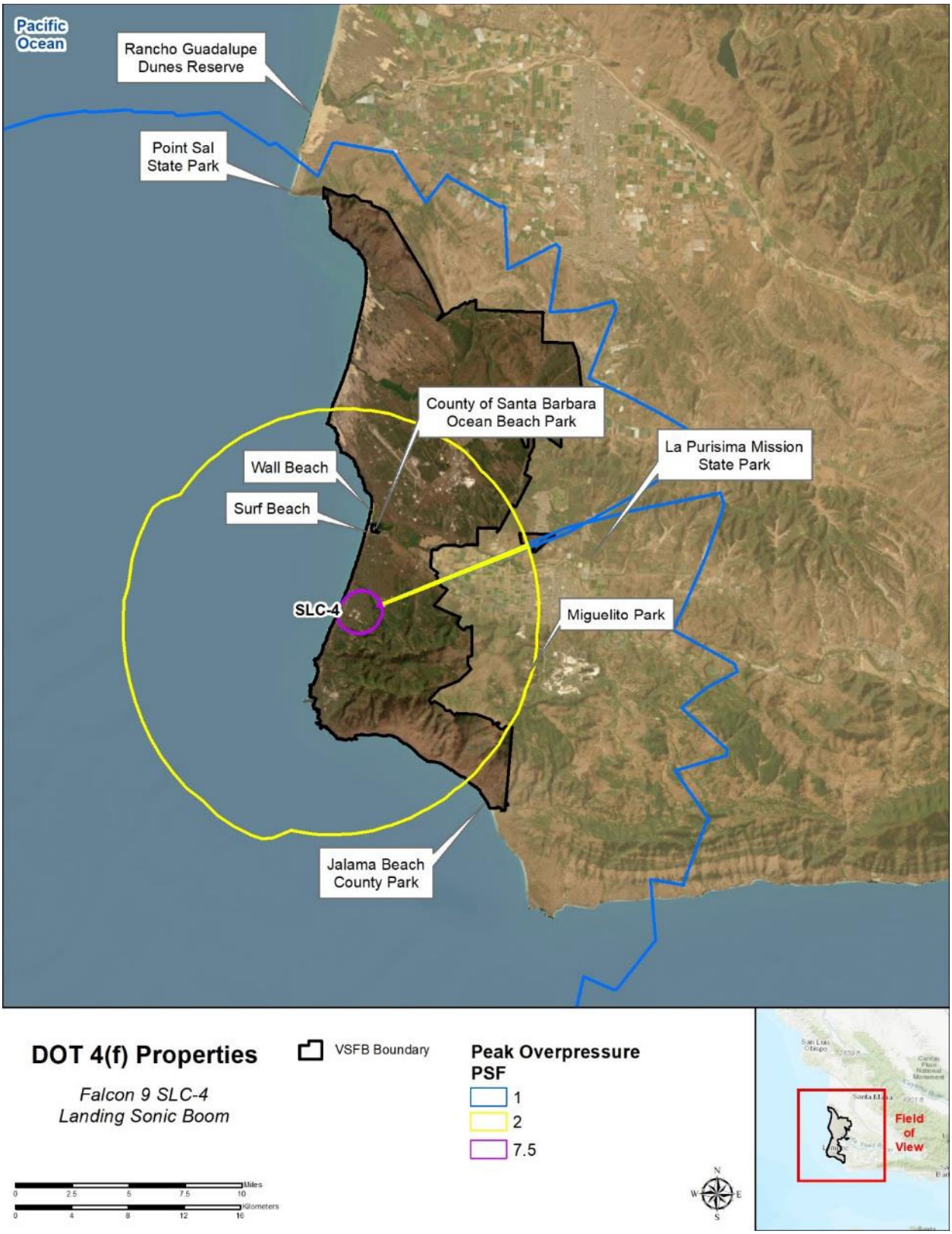

Figure 3.8-2. Potential DOT 4(f) properties and sonic boom for Falcon 9 first stage landing at SLC-4W

3.8.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on Section 4(f) properties beyond those described in the 2023 SEA.

3.9 Utilities

3.9.1 Affected Environment

The ROI includes SLC-4 and south VSFB utilities (e.g., communications, electricity, domestic water supply, and domestic wastewater). Communications infrastructure at SLC-4 is provided by existing commercial fiber lines. Electrical infrastructure is primarily provided from the Pacific Gas and Electric Company substation north of VSFB, powered by the Diablo Canyon nuclear power plant. In 2023, SpaceX used 6.8 million kilowatt-hour (kW-hr) of electricity at SLC-4 and 1.6 million Kw-hr at Building 398 (SpaceX 2024). 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. Domestic wastewater at SLC-4 is managed by existing septic sewer systems. The GAO identified VSFB as vulnerable to water-scarcity issues in 2019 (GAO 2019).

3.9.2 Environmental Consequences

Impacts associated with utilities are related to changes in the supply (also referred to as capacity) or demand for a particular resource. As long as the capacity of a particular utility is higher than the demand for that resource, no impact occurs. However, if the demand exceeds the capacity or if the demand is increased beyond the resource's projected rate of increase, an impact would occur, and the significance of the impact is determined based on the degree to which the capacity is strained.

3.9.2.1 Alternative 1

Existing lines would provide communication and electricity to SpaceX facilities at SLC-4. The Proposed Action would add approximately 400 personnel, increase launch cadence at SLC-4, which would increase the demand for electricity, water, and the septic system. Electricity is primarily provided to VSFB from the Pacific Gas and Electric Company substation north of VSFB, powered by the Diablo Canyon nuclear power plant, and can is expected to adequately support the proposed increase in annual cadence. The existing power infrastructure is sufficient to supply this electricity to SLC-4. During power outages, SpaceX would rely on existing portable backup generators for electricity for SLC-4. The existing communication system is sufficient to support increases in personnel and launch capacity.

At maximum cadence, the Proposed Action under would use up to 18.6 ac-ft of water per year, including increased water use for personnel and operations. The existing water systems are adequate to support increased water use, as discussed in Section 3.5.2.

The existing septic sewer systems at SLC-4 has sufficient capacity to support the increase in domestic wastewater associated with the Proposed Action (Pernell 2024). The septic system at Building 398 has planned improvements independent of the Proposed Action, thus would be able to support increased personnel use. Therefore, there would be no need to upgrade current sewer systems as a result of implementation of the Proposed Action and impacts on the domestic wastewater system would be negligible.

3.9.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on utilities beyond those described in the 2023 SEA.

3.10 Socioeconomics

3.10.1 Affected Environment

Socioeconomic resources include the population, income, employment, and housing conditions of a community or affected environment. VSFB has a large effect on population and employment in northern Santa Barbara County, which encompasses Vandenberg Village, the City of Lompoc, the unincorporated area north of Lompoc, the Santa Maria Valley, and portions of the Santa Ynez Valley. The full economic impact of VSFB on the surrounding communities and the state of California is significant (over $1.75 billion/year). VSFB directly contributes more than $500 million each year to the economies of Santa Barbara County and California and is the second largest employer in Santa Barbara County (6,800 employees as of 2014), including 2,924 military personnel, 1,143 civil servants, and 2,822 non-appropriated fund, contractor, and private business personnel (USAF 2020).

Southern California's west coast is a leading recreational and commercial fishing area. Commercial fishing off the coast of VSFB is largely conducted by vessels from the Santa Barbara Harbor, Port San Luis, and Morro Bay Harbor. Fishing in areas potentially affected by SpaceX VSFB launches is limited compared to other areas but is valuable for select species. In 2023, area overflown by SpaceX's potential azimuths landed fish with total value of $18,037,773, or 11.2% of the value of the state's total landings (CDFW 2023).

In 2019, the U.S. Census Bureau estimated the Santa Barbara County population at 444,829 people. Santa Maria and Lompoc, with 106,224 and 43,232 residents respectively (U.S. Census Bureau 2019), are the first and third largest cities in the County (California Department of Finance 2022). The Bureau of Labor Statistics reported August 2021 results for the Santa Barbara-Santa Maria area of 208,600 total civilians employed. Of those employed, there were approximately 184,800 non-agricultural wage and salary employments. The August 2021 unemployment rate of the area was approximately 5.5 percent, below the state average of 7.5 percent and above national average of 5.2 percent (Bureau of Labor Statistics 2021).

As discussed in Appendix I (Dudek 2024), every eight years the State of California determines the anticipated number of housing units needed in each region across California. The methodology for determining the housing need considers factors such as the makeup and condition of the existing housing stock, existing and forecasted jobs, the projected population, and the availability of housing. Specifically, the State allocates the housing need by region and regional agencies work with jurisdictions to develop a methodology for divvying up the allocated housing need per jurisdiction. As determined by the State, the Santa Barbara County Association of Governments (SBCAG), which is the Metropolitan Planning Organization responsible for regional planning activities for all incorporated and unincorporated areas in Santa Barbara County, has an anticipated housing need of 24,856 additional housing units to be built between 2023-2031. SBCAG's Regional Housing Needs Allocation (RHNA) Plan establishes the methodology for allocating shares of the 24,856 needed housing units between each local government in the region. SBCAG's RHNA Plan relies on SBCAG's Regional Growth Forecast (RGF), which serves as a tool

for long range regional planning. Specifically, the RGF provides input for the State Department of Housing and Community Development RHNA for the Santa Barbara County region.

The RGF captures existing and projected population, housing, and job growth for various industries in Santa Barbara County, its eight incorporated cities, and its major economic and demographic regions (i.e. VSFB), through 2050. Because the RGF forms the basis of the RHNA, job growth for the 2023-2031 RHNA projection period in all job industries is reflected in the calculation of the RHNA. Further, the RGF specifically projects anticipated employment at VSFB. In 2017, VSFB supplied an estimated amount of 6,250 jobs, accounting for about 3-percent of the region's total jobs. The RGF projects a total of 850 new jobs to be added in VSFB between 2017 and 2030, increasing the total to 7,100 jobs by 2030. The increase of 850 new jobs at the VSFB falls within SBCAG's RHNA Plan projection period of 2023-2031. This job growth at VSFB is captured by the SBCAG RGF and has been used to help determine and allocate housing needs in the region through the methodology used in the RHNA Plan. SBCAG's RHNA Plan divides the region into two subareas, the South Coast Housing Market Area and the North County Housing Market Area. The North County Housing Market Area includes the cities of Buellton, Guadalupe, Lompoc, Santa Maria, and Solvang, as well as the unincorporated areas of Orcutt, Guadalupe, Cuyama Valley, Lompoc Valley, and Santa Ynez within the jurisdiction of the County. Given the proximity to the base, many off-base employees of VSFB are likely to reside in the North County Housing Market Area. SBCAG's RHNA Plan has allocated portions of the regional housing need to each local jurisdiction in the region, including those in the North County Housing Market Area. Each of these jurisdictions has identified capacity to accommodate its housing need, demonstrating that there are sufficient development opportunities to meet the housing need.

IAW State law, local governments must demonstrate in their General Plan Housing Elements how they will accommodate their share of the regional housing need by identifying sites that are zoned for housing and can reasonably accommodate housing development. It should be noted that jurisdictions are only responsible for creating opportunities for the private market to build units specified in their RHNA and are not responsible for the actual construction of such units. The County's RHNA share is 5,664 total units for the 2023-2031 planning period. The County has divided its housing need of 5,664 into two subregions, the South Coast subregion and the North County subregion. Nearly three-quarters of the housing need (4,142 units) have been allocated to the South Coast subregion of the County, while the rest (1,522) were allocated to the North County subregion. Factoring in all vacant sites, future accessory dwelling unit development, pending projects, County-owned sites, and potential site rezones, the County's Housing Element identifies capacity for 13,986 units, far exceeding the total housing need. Of the County's identified housing capacity, capacity for 4,991 units is identified in the North County subregion. VSFB is located in the County's North County subregion and likely employees more households in the North County subregion than the South Coast subregion.

The City of Lompoc's housing need for the 2023-2031 planning period is 2,248 units. Their Housing Element identifies capacity through planned and approved projects, projected accessory dwelling unit development, and vacant and underutilized sites. Their total identified capacity is 2,407 units, an additional 7-percent beyond their housing need. The City of Santa Maria is the most populous city in the North County Housing Market Area and has a housing need of 5,418 units for the 2023-2031 planning period. The City of Santa Maria's Housing Element identifies capacity to accommodate 5,819 new housing units, which is 401 units beyond their housing need. Other cities in the North County Housing Market

Area, including Buellton, Guadalupe, and Solvang were allocated much fewer housing units due to their size. Buellton's capacity of 761 units, which includes both built and potential units, exceeds their housing need of 165 new housing units for the 2023-2031 period. Solvang's housing need for the same period is 191 housing units and their Housing Element identifies capacity for 343 units, which is 128 units beyond their need. The City of Guadalupe's Housing Element identified housing need is 431 new housing units for the same period, but the housing capacity is currently unknown as the City is in process of updating its housing element. If the City of Guadalupe is unable to identify adequate housing capacity, they are required by State law to rezone sites to ensure that adequate capacity will be made available to accommodate the entirety of the housing need.

3.10.2 Environmental Consequences

3.10.2.1 Alternative 1

The public's safety during launch operations is of upmost importance to DAF, FAA, USCG, and SpaceX, which includes the protection of maritime users near the launch vehicle's flight trajectory. The USCG notifies the public of the maritime hazard upon request by the range authority or by the launch operator if a Letter of Intent has been signed by USCG and SpaceX. As discussed in detail in Section 3.12, the USCG issues various types of NOTMARs that notify the public of the time and location of potential hazardous operations and do not explicitly prohibit vessels from entering the identified areas. FAA is also required to notify the public of all maritime hazard areas for each launch. If the risk, as calculated by SLD 30, within a portion of the maritime hazard area exceeds a threshold determined by the FAA, access to this smaller area, known as the "surveillance area" may be restricted in order for launch to be allowed to proceed.

Due to Falcon's reliability, SpaceX's surveillance areas for launches from VSFB have minimal impacts to maritime activities. For many missions, this closure area does not even leave land. Accordingly, only a small subset of fishing blocks within the vicinity of VSFB have the potential to be closed by each launch and for a relatively short period of time. The area within the hazard area, but not closed to vessel traffic, is approximately two blocks wide along each given trajectory. The DAF and SpaceX are committed to maintaining communication with fishermen to avoid and minimize any potential impacts to this industry, as discussed in detail in Appendix I. SpaceX plans to add up to 400 permanent staff over time at VSFB to support the Proposed Action. This increase in permanent personnel is a fraction of the civilian workforce of VSFB and Santa Barbara County and would not be expected to alter the existing levels of service for housing and social services on VSFB and the surrounding communities. The increase in personnel is expected to occur over time and SpaceX expects to hire a mix of local and non-local people. The Military Housing Office and VSFB leadership have been actively engaged in meeting with developers and local officials to inform them of housing needs for the base in the hopes it will encourage future housing development to address both current and future housing needs for both the local communities and the base.

A Housing Impact Study was completed for the Proposed Action (Appendix I) assessing the proposed job growth through the lens of regional housing need and available capacity to accommodate needed housing. As indicated in Table 3.10-1, all jurisdictions in the North County Housing Market Area with an approved housing element for the 2023-2031 planning period have identified adequate housing capacity that not only meets but exceeds the identified housing need. The County's North County subregion and Buellton in particular have identified housing capacity that is more than triple and quadruple the

respective housing needs. In general, the North County Housing Market Area has more than enough housing capacity to meet the housing need. Not only have these jurisdictions provided capacity that captures expected growth at VSFB, as identified by the SBCAG RHNA Plan, but the jurisdictions that house the largest numbers of those employed at VSFB have capacity well beyond the housing need.

Table 3.10-1. Housing Capacity in North County Housing Market Area

Jurisdiction[1]	Total RHNA	Total Identified Capacity	Surplus	% of RHNA Planned
County of Santa Barbara - North County Subregion	1,522	4,991	3,469	327.9%
Lompoc	2,248	2,407	159	107.1%
Santa Maria	5,418	5,819	401	107.4%
Buellton	165	761	596	461.2%
Solvang	191	343	152	179.6%
Total	**9,544**	**13,321**	**4,777**	**139.6%**

[1] The City of Guadalupe is not included in this table since it has not updated its housing element to reflect the 6th Cycle RHNA.

The SBCAG RHNA Plan considers an anticipated growth at VSFB of 850 new jobs by 2030 in the determination of the housing need. Further, local jurisdictions surrounding the VSFB have identified adequate housing capacity to meet and far exceed the 2023-2031 housing need. The anticipated increase of 400 new permanent staff roles needed to support the Project will not have a housing impact beyond the Santa Barbara County existing and projected housing need, and further will not create a housing need beyond identified capacity. Additionally, depending on the proportion of local people hired, the need for housing new staff moving into the region from other areas would further decrease. While the Proposed Action would not significantly affect the demand for local housing and the need for social services and support facilities, the addition of added economic activity would result in a small but positive impact to the local economy. The indirect effects of material purchases and sub-contract labor force growth would also be a positive impact.

Potential socioeconomic impacts from re-routing aircraft due to commercial space operations would be similar to re-rerouting aircraft for other reasons (e.g., weather, runway closures, wildfires, military exercises, etc.). These include additional airline operating costs for increased flight distances and times resulting from re-routing aircraft and increased passenger costs as a result of impacted passenger travel, including time lost from delayed flights, flight cancellations, and missed connections. Alternatively, restricting or preventing a launch event would have socioeconomic impacts on SpaceX, commercial payload providers, and consumers of payload services. Operations would not result in closing any public airport or so severely restrict using surrounding airspace to prevent access to an airport for extended time. Given existing airspace closures for SpaceX operations are temporary and the FAA's previous analyses related to the NAS have concluded minor or minimal impacts on the NAS from commercial space launches, the FAA does not expect airspace closures would result in significant socioeconomic impacts. Local air traffic controls would coordinate with airports and aircraft operators to minimize launch operations effects on airport traffic flows, as well as traffic flows in en-route airspace. Therefore, the Proposed Action would not generate negative socioeconomic impacts on the region and would generate a small positive impact.

3.10.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on socioeconomics beyond those described in the 2023 SEA.

3.11 Transportation

3.11.1 Affected Environment

The ROI for transportation includes railway, highway, arterial, and local roads that provide service to VSFB, the surrounding area, and the ROI. Existing roadway conditions are evaluated based on roadway capacity and traffic volume. The capacity reflects the ability of the network to serve the traffic demand of a roadway and depends on the roadway width, number of lanes, intersection control, and other physical factors.

VSFB is a federal military installation located approximately 5 mi west of the City of Lompoc. The main access route is Highway (Hwy) 101, a coastal four-lane divided freeway connecting Northern California to Southern California. Hwy 1, State Route (SR) 135, and SR 246 (Ocean Avenue) connect Hwy 101 to VSFB. When used with Hwy 101, SR 246, provides access to Lompoc to the east, and Santa Barbara to the southeast. SR 135 and SR 246 are primarily two-lane highways with four-lane expressway portions. The Caltrans traffic count for SR 246 at the western Lompoc city limit, the closest count to south VSFB, indicated an annual average daily traffic volume of 3,100 vehicles per day (Caltrans 2024), which is well below the capacity for a two-lane highway.

Most of VSFB can only be accessed by authorized military personnel and their families, Base civilian employees with approved identification, visitors with pre-approved authorization, and authorized contractors. There is no public access to the roadways within the ROI. Most roads on VSFB are in good operating condition or better with zero to minor, tolerable delays experienced by motorists. The ROI is located on south VSFB and is accessible by paved roads from the Solvang Gate. Project personnel would access the location by entering VSFB through the Solvang Gate from West Ocean Avenue, travel south on Arguello Road, west on Bear Creek Road, south on Coast Road, and to the destination on Kelp Road (Figure 3.11-1). There are no readily accessible alternate routes to SLC-4, although Surf Road would be a suitable egress road to the east during emergencies. Oversized transports utilize the Coast Gate rather than Solvang Gate to reduce impacts to vehicular traffic on south VSFB.

The Union Pacific Railroad (UPRR) operates a railway line that runs through VSFB and under the proposed flight path of the Falcon 9 launch vehicle. Up to 12 freight trains and 6 Amtrak passenger lines travel through VSFB daily (Envicom Corporation 2012; Amtrak 2022). Trains that would pass through a launch vehicle's flight path from VSFB are temporarily stopped at safety hold points during launches to reduce potential risk to people and property. The self-propelled modular transporter (i.e. the truck used to transport the first-stage booster) route from the VSFB Harbor to SLC-4 crosses the UPRR railway at the intersection of Tow Road and Coast Road (Figure 3.11-1).

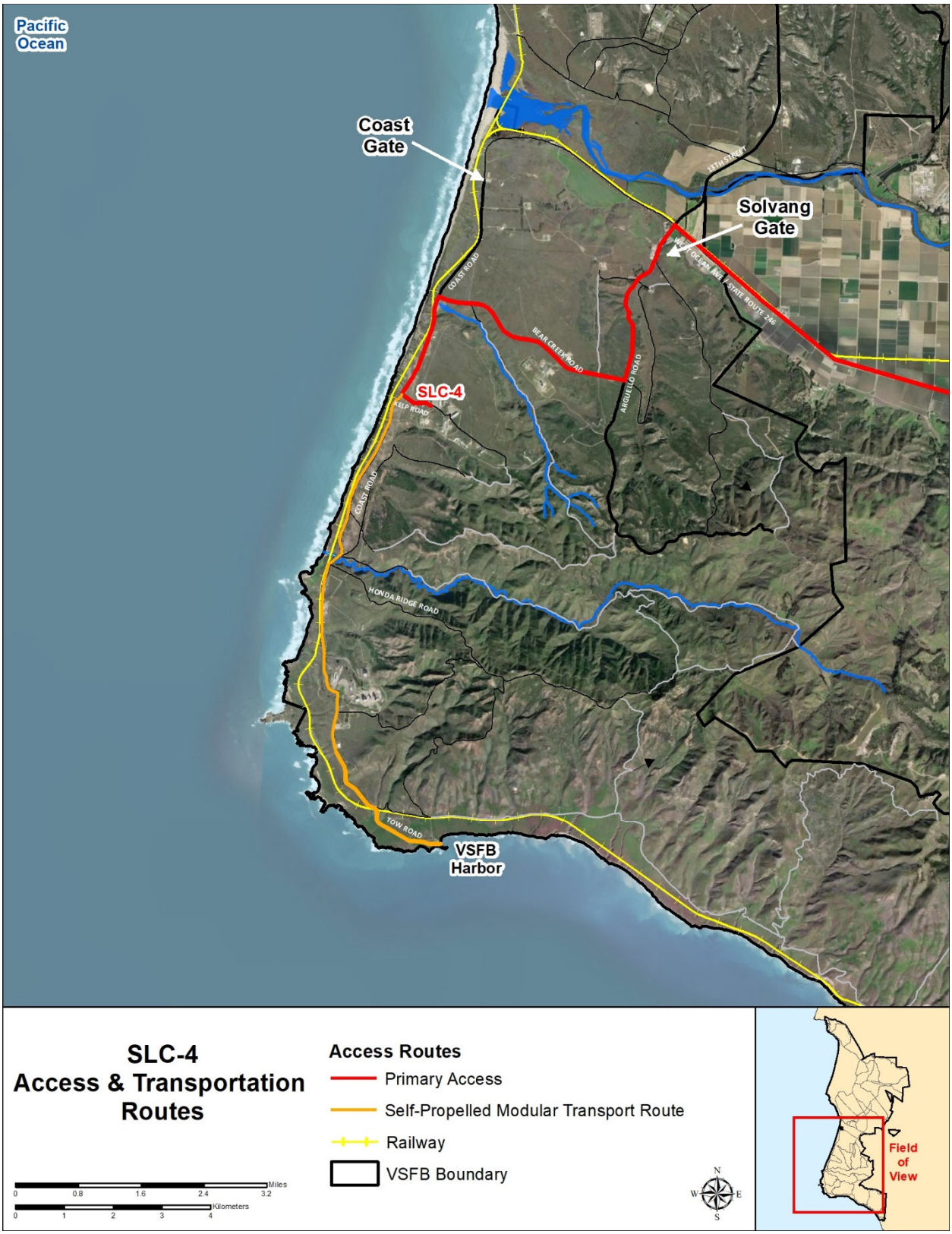

Figure 3.11-1. Main Access and Transportation Routes Associated with the Proposed Action

3.11.2 Environmental Consequences

3.11.2.1 Alternative 1

Given the low traffic volumes projected from increased operations, good level of service currently experienced on the roadways that would be affected by project activities on VSFB and nearby, and the relatively small increase in daily vehicle traffic that the Proposed Action would generate, no adverse effects to capacity would occur in the ROI roadways. Additionally, increased personnel would be anticipated to be working in shifts thus there is no anticipated adverse impacts to peak hour traffic.

Increased vehicle activity affects the integrity of roadway sections by increasing the flexures of the pavement. The design life for asphalt pavement, generally selected as either 10 or 20 years, drives engineering specifications for the road based upon the strength of the base soil and estimated number of truck trips that are expected during the design life of the pavement. If the number of truck trips is increased, the life of the pavement is shortened. While the current pavement condition on all affected roads is fair to good, added project-related vehicle traffic could cause faster-than-estimated pavement surface deterioration and require additional maintenance. Although an adverse effect, it would not be considered significant given that the number of vehicle trips per day anticipated from the Proposed Action is not high and the speed of pavement deterioration is influenced by more than truck traffic.

Increased oversized load transport is not expected to have a significant impact on operations on south VSFB, as these transports would utilize Coast Gate rather than Solvang Gate. SpaceX will continue to coordinate with SLD 30 to reduce operational impacts on VSFB staff and resources to support and conduct these operations.

Trains that would pass through a launch vehicle flight path from VSFB would be temporarily stopped at safety hold points during launches to reduce potential risk to people and property. SLD 30 2nd Range Operations Squadron (2 ROPS/DON), notifies a dedicated UPRR point of contact (POC) of launch date, times, and train hold point locations, typically 10 days before launch. At approximately 3 days prior to launch, UPRR's POC provides 2 ROPS/DON a schedule of impacted trains and in collaboration discusses if the trains must hold or can continue through. At 3 hours before launch, 2 ROPS/DON establishes phone communication with the UPRR POC to provide updates to the train schedule. After a launch has been completed 2 ROPS/DON notifies the UPRR POC that trains may continue on the route. The UPRR POC is on standby during each launch for any notifications needed for a launch anomaly that may impact the railroad track system. UPRR attempts to adjust schedules to avoid train delays due to launches; however, launch windows are typically minimal (typically instantaneous or several minutes) and during longer launch delays 2 ROPS/DON communicates with the UPRR POC to allow trains to move through the affected area; thereby minimizing potential impacts to train schedules.

The self-propelled modular transporter would need to cross the UPRR railway at the Tow Road and Coast Road intersection. The SLD 30 easement to cross the railway (DACA-09-5-82-35) states that crossing "will not obstruct or interfere with the passage of Railroad trains." The UPRR requires a UPRR employee to contact approaching train engineers via radio to alert the engineer of the Tow Road crossing. SpaceX would coordinate with the UPRR to ensure easement proper procedures are followed for each railway crossing event.

Therefore, the Proposed Action will not create any significant impacts to transportation.

3.11.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts to transportation resources beyond those described in the 2023 SEA.

3.12 Human Health and Safety

3.12.1 Affected Environment

The ROI for Human Health and Safety resources includes all areas where activities associated with the Proposed Action may impact human health and safety. This includes SLC-4, where current launch cadence would increase and workers would potentially be exposed to conditions that could adversely impact their health and safety, and all areas potentially impacted during launch operations. All VSFB activities are subject to Federal OSHA, Air Force Occupational Safety and Health (AFOSH), or California OSHA regulations and procedures requirements. SLC-4 is within a federal exclusive jurisdiction area; however, commercial entities may also comply with California OSHA and/or AFOSH requirements. The affected environment for Human Health and Safety includes all established regulations to minimize or eliminate potential risk to the general public and personnel involved in the proposed project. The Proposed Action would not involve construction activities.

Hazards associated with some past and present mission activities and operations on VSFB can limit locations where projects can be sited to ensure the health and safety of workers. Hazard zones and areas have been established on VSFB to protect workers from various hazards. Because of the existence of these zones and areas, personnel at SLC-4 may be exposed to hazardous materials and hazardous waste. In addition to these more obvious risks to human health and safety, the following physical features may be present nearby the Proposed Action and may adversely impact site personnel's health and safety:

- Physical hazards, including road traffic, confined spaces, holes and ditches, uneven terrain, sharp or protruding objects, slippery soils or mud, unstable ground, and falling equipment/objects (e.g., nuts, bolts, equipment, boxes, containers, and other miscellaneous light-construction tools and materials).
- Biological hazards such as animals and plants (ticks, black widow spiders, rattlesnakes, and poison oak) and disease vectors (ticks, rodents, and common contagions).

3.12.1.1 General Public and On-Base Personnel Safety

The SLD 30 Safety Office is responsible for ensuring launch support personnel and the general public are safe from all launch operations and potential emergency public health risks as defined in Air Force Instruction (AFI) 91-202 (U.S. Air Force Mishap Prevention Program), Department of Defense Instruction (DODI) 6055.17, and 6200.03. AFI 10-2501 and AFI 10-2519 provide further guidance for DAF emergency management readiness and response to public health and safety issues. The SLD 30 Safety Office personnel would assess proposed mission profiles to ensure public safety criteria are met. Their evaluation would assess hazards associated with debris, toxics, and blast distant focusing overpressure for a normal launch. All launch, high-risk offshore, and airspace areas would be controlled and monitored to ensure public safety during launch operations. Launch day meteorological conditions would also be accounted for to ensure compliance with acceptable risk criteria.

3.12.1.2 Debris Impact Corridors

All VSFB launch programs are required to establish debris impact corridors as a part of their program's safety review in case of a launch anomaly that requires flight termination (14 USC Section 504, 14 CRF Part 450.147). When any launch, including a commercial launch, is scheduled to take place from VSFB, the SLD 30, Launch Safety (SLD 30/SEL) notifies the 2nd Range Operations Squadron (2 ROPS) of the associated hazard areas. SpaceX performs a debris analysis for the Falcon 9 before launching. SLD 30/SEL reviews and approves these analyses prior to authorizing any launch activities. Impact debris corridors would be established off the Santa Barbara County coast to meet security requirements and reduce hazards to persons and property during launch activities. Based on a mission's specific trajectory, specific debris impact areas would be determined for each launch. Once SLD 30/SEL notifies the 2 ROPS of hazard areas, 2 ROPS notifies the FAA so that appropriate airspace restrictions are in place during launches.

In addition, SLD 30 and USCG District Eleven review each SpaceX trajectory IAW the MOA (Appendix J) to develop risk plots and other materials for 14 CFR Part 450 compliance, including: (1) operating area and impact locations, (2) maritime vessel risk assessment and Ec/Pc plots, and (3) all materials necessary to develop a NOTMAR. The USCG would be responsible for issuing NOTMARs that provide hazard area locations before each mission event with ocean impacts. A NOTMAR provides notice of temporary changes in conditions or hazards in navigable waterways with maritime traffic to assist in mitigating risks for dangers associated with waterway users. This tool provides both an established and reliable line of communication with the maritime public. The NOTMAR would include the operations dates and times and coordinates of the hazardous operation area. The USCG issues a NOTMARs 30 days before launches from VSFB that defines the times and locations of avoidance areas related to launch activities. Local NOTMARs are broadcast via radio, posted in harbors along the coast, and published weekly by the USCG.

Offshore oil rigs located west of VSFB also have evacuation or shelter-in-place procedures in place for use during launch operations. The 2 ROPS notifies the Bureau of Safety and Environmental Enforcement to notify oil rig personnel of launch operations.

On south VSFB, the UPRR track passes approximately 0.5 mi west of SLC-4 and would be overflown by the launch vehicles. To reduce potential risk to people and property, railroad schedules and close coordination between train engineers and VSFB personnel would ensure that trains are never overflown. SLD 30/SEL defines appropriate railroad mile -markers to 2 ROPS, who coordinates with the Manager Road Operations to ensure trains are kept clear of debris area.

3.12.1.3 Security and Anti-Terrorism

Site security requirements, including those for security lighting and intrusion detection, are part of the requirements integral to launch program safety and detailed in DOD Manual 5220.22-M. Minimum Antiterrorism Standards for Buildings 4-010-01 was issued in July 2022 under the authority of DOD Instruction 2000.16, Antiterrorism Standards. This guidance requires DOD components to adopt and adhere to common definitions, criteria, and minimum construction standards for building to mitigate vulnerabilities and terrorist threats.

3.12.1.4 Existing Noise Environment

For a detailed description of noise as it relates to the Proposed Action, please see Section 3.2 and Appendix F. In addition to the information provided in that section, on VSFB, general ambient L_{eq1H} (the

continuous sound level that would contain the same acoustical energy for 1 hour as the fluctuating sound levels during the same period) measurements have been found to range from around 35 to 60 dB (Thorson et al. 2001). Noise associated with launch and static fire events would be short term (seconds to minutes).

3.12.2 Environmental Consequences

An impact to Human Health and Safety would be considered significant if it were to create a potential public health hazard or to involve the improper use, production, or disposal of materials that pose a hazard to people in the affected area. An impact would also be considered significant if project activities were to pose a serious risk of fire, especially wildland fires, or were to involve potential obstruction of emergency response or evacuation routes in and around the project area.

3.12.2.1 Alternative 1

3.12.2.1.1 Launch Operations

Base personnel and general public safety during Falcon 9 launches would be ensured by federal emergency management readiness and response protocols detailed in Section 3.12.1.2. SLD 30 Range Safety would individually review launch trajectories to determine what areas would be affected since the hazard risk analysis is unique to each vehicle, history of reliability, and mission trajectory. The USCG would review and advise SLD 30 on all launch and reentry site evaluation risk assessments with focus on vessel navigation safety. The USCG supports SLD 30 with early warning communication to the maritime industry with NOTMAR, as discussed in Section 1.5, to assist with maritime safety and space operational review that have a maritime nexus. USCG District Eleven would evaluate SpaceX and SLD 30 navigation risk assessments with launch and reentry activities associated with commercial and recreational vessels on the high seas off the California Coast. The USCG evaluates every launch and reentry activity for risk to waterway users and the environment under this process. Security and anti-terrorism requirements outlined in Section 3.12.1.3 would provide launch program safety compliance.

To issue a Vehicle Operator License, the FAA requires all launch and reentry operations to comply with the necessary notification requirements, including issuance of NOTAMs, as discussed in Section 2.1.2. NOTAMs assist general aviation pilots in scheduling around any temporary disruption of flight activities in the area of operation and provide notice of unanticipated or temporary changes to components of, or hazards in, the NAS. The FAA issues a NOTAM at least 24 hours prior to a launch or reentry activity in the airspace to notify pilots and other interested parties of temporary conditions. Advance notice via NOTAMs and the identification of Aircraft Hazard Areas would assist pilots in scheduling around any temporary disruption of flight activities in the area of operation to reduce risk to human safety.

While adhering to these safety measures and procedures and EPMs described in Appendix L, there would not be significant impacts to human health and safety as a result of the Proposed Action.

3.12.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on human health and safety beyond those described in the 2023 SEA.

3.13 Hazardous Materials and Waste Management

3.13.1 Affected Environment

The ROI for hazardous materials and waste management resources includes all areas potentially impacted during launch operations, where activities associated with the Proposed Action may be impacted by using hazardous materials and generating hazardous waste. Hazardous materials and wastes are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (42 USC Chapter 103), as amended by the Superfund Amendments and Reauthorization Act (26 USC Section 9507); the Environmental Health Standards for the Management of Hazardous Waste (California Code of Regulations [CCR] Title 22); the Toxic Substances Control Act (15 USC Sections 2601–2671); the Solid Waste Disposal Act (42 USC Section 6903), as amended by the Resource Conservation and Recovery Act (RCRA; 42 USC Sections 6901-6992); and as defined in Title 8 CCR Section 5161. In addition, federal and state OSHA regulations govern protecting workplace personnel. In general, the definitions within the citations include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health and welfare, to workers, or to the environment.

3.13.1.1 Hazardous Materials at Vandenberg Space Force Base

Hazardous materials are compounds with the potential to harm human health and the environment through improper use, treatment, transportation, storage, or disposal in commercial, military, and industrial applications. They are harmful to life due to their concentrations and amounts, or physical and chemical attributes. Component hazardous materials, or hazardous constituents, are hazardous materials with low concentrations that will not cause acute adverse effects. Hazardous constituents are present in propellants, batteries, fuels, hydraulic fluids, and munitions, and may harm human and environmental health through water, soil, or air contact.

Operations at VSFB require military personnel and on-Base contractors to use hazardous chemicals in varying quantities throughout the Base. Using hazardous material on VSFB is regulated by the Hazardous Materials Management Process (HMMP; DAF 2020), per Air Force Manual (AFMAN) 32-7002, Environmental Compliance and Pollution Prevention, and 40 CFR Part 112, Spill Prevention, Control, and Countermeasure Plan. Emergency response procedures for hazardous materials spills are established in SLD 30's Installation Management Plan (SLD 30 Plan 10-2). SpaceX has prepared its own Emergency Response Plan per the SLD 30 Installation Management Plan. This Plan ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all installation personnel and commercial entities. For a spill, SpaceX would also be responsible for completing a Community Awareness and Emergency Response reporting form per local Santa Barbara County hazardous material and hazardous waste spill reporting requirements.

3.13.1.2 Hazardous Materials Transportation Safety

Hazardous materials such as propellants, ordnance, chemicals, and other hazardous material payload components must be transported to and on VSFB per DOT regulations for interstate and intrastate shipment of hazardous materials (Title 49 CFR Parts 100–199).

3.13.1.3 Hazardous Waste at Vandenberg Space Force Base

Hazardous wastes contain hazardous materials that may exist as any state of matter, which may cause, or significantly contribute to, an increase in the likelihood of mortality or serious illness. Substantial human and environmental risks may be present when hazardous waste is improperly used, stored, transported, or disposed. Hazardous waste at VSFB complies with RCRA Subtitle C (40 CFR Parts 260-273) and with California Hazardous Waste Control Laws as administered by the California Environmental Protection Agency Department of Toxic Substances Control (22 CCR Section 66260.10; 8 CCR Section 5192). These regulations require that hazardous wastes be handled, stored, transported, disposed of, or recycled according to defined procedures. The SLD 30 Hazardous Waste Management Plan (HWMP; SLD 30 Plan 32-7043-A; DAF 2022a) details hazardous waste packaging, turn-in, transportation, storage, recordkeeping, and emergency procedures. SpaceX follows all federal, state, and local laws regulating generating, storing, transporting, and disposing hazardous waste for current operations at SLC-4 and would continue to do so. SpaceX has also obtained a USEPA Generator identification number to manage and dispose hazardous waste generated from its site operations on VSFB.

3.13.1.4 Environmental Restoration Program at Vandenberg Space Force Base

In 1975, DOD facilities began implementing the Installation Restoration Program (IRP). The IRP was established under the Defense Environmental Restoration Program (ERP) to identify, characterize, and restore hazardous substance release sites, and provide a method of management under Section 211 of Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The ERP is comprised of three programs: IRP, Military Munitions Response Program (MMRP), and building demolition and debris removal (AFI 32-7020). Once areas and constituents have been identified, the IRP is tasked to remove or monitor the hazards in an environmentally responsible manner. IRP sites are remediated through the Federal Facilities Site Remediation Agreement, a working agreement between the DAF and the RWQCB Central Coast Region and the Department of Toxic Substances Control Region 3. In addition to IRP sites, there are identified Areas of Concern (AOC), where potential hazardous material releases are suspected; and Areas of Interest (AOI), defined as areas with the potential for use or presence of a hazardous substance. To ensure the health and safety of personnel on VSFB, an analysis of MMRP and IRP sites, including AOCs and AOIs, within the Proposed Action area was performed in Sections 3.8.5 and 4.8.1.3 of the 2016 EA. The Proposed Action has not changed in a manner that would change the environmental consequences for the ERP program, thus this resource is not considered further in this EA.

3.13.2 Environmental Consequences

Factors considered in determining if implementing an alternative may have significant adverse impacts on hazardous materials and waste management include the extent or degree to which implementing an alternative would result in non-compliance with applicable regulatory requirements; or human exposure to hazardous materials and wastes, or environmental release above permitted limits. The FAA has not established a significance threshold for hazardous materials and pollution prevention. Potential impacts resulting from hazardous materials and hazardous waste are evaluated using federal, state, and local regulatory requirements, contract specifications, and Base operating constraints, as outlined in Section 3.13.1. Non-compliance with applicable regulatory requirements, human exposure to hazardous materials and wastes, or environmental release above permitted limits, would be considered adverse impacts.

3.13.2.1 Alternative 1

Compliance with all pertinent federal, state, and local laws and regulations, and applicable DAF and SLD 30 plans would govern all actions associated with implementing the Proposed Action and would minimize the potential for significant impacts. Launch support operations would use a small amount of products containing hazardous materials, including POLs, paints, solvents, oils, lubricants, acids, batteries, and chemicals. SpaceX would also generate a small number of waste tires each year through RORO operations and other pad support equipment during routine launch support. Payload processing would generate a small amount of empty containers, spent solvents, waste oil, spill cleanup materials (if used), and lead-acid batteries.

Fuels (i.e., rocket propellant-1) and oxidizers (i.e., liquid oxygen) would be the most significant hazardous materials onsite during operations. Loading and unloading operations would take place over appropriately designed and sized containment basins, with spill prevention and emergency response procedures in place. Proper handling practices of liquid fuels would adhere to 14 CFR Section 420.67 (*Separation distance requirements for handling incompatible energetic liquids that are co-located*) for liquid fuels and limit the risk of hazardous material releases due to leaking storage tanks, tanker trucks, delivery lines, or other infrastructure.

SpaceX would continue to identify, label, and accumulate any hazardous wastes IAW all applicable federal, state, and local regulations. Hazardous materials and wastes would be properly contained, manifested, and managed per applicable federal, state, and local regulations, AFIs, AFMANs, DOD Directives, the site-specific health and safety plan, and associated EPMs. Accidental releases of petroleum, oil, and lubricants from vehicles, equipment, and transformer leaks would generate hazardous wastes, resulting in potential adverse impacts on the ROI. All hazardous wastes and spills would be properly managed and disposed of per applicable federal, state, and local hazardous waste regulations and the HWMP (DAF 2022a). Hazardous materials and waste management regulations would follow procedures outlined in the HMMP (DAF 2020) and the HWMP DAF (2022). SpaceX and any contractors working at the site would make all reasonable and safe efforts to contain and control any spills or releases that may occur. For a spill or accidental release, SpaceX would implement an Emergency Response Plan and complete a Community Awareness and Emergency Response reporting form per local Santa Barbara County hazardous material and hazardous waste spill reporting requirements.

To protect water resources, any potentially contaminated wastewater would be collected, analyzed, and disposed of per CCR Title 22 & Title 27, Division 2, and the RWQCB General Waiver for Specific Discharges. Additional EPMs described in Appendix L would further ensure that the Proposed Action would not have a significant impact on water resources.

The amount of hazardous materials needed and the waste generated by the Proposed Action would have little to no impact on waste processing capacity. The EPMs described in Appendix L would be implemented. Therefore, the Proposed Action would not have a significant impact due to using and generating hazardous materials and hazardous wastes. With adherence to existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well as the EPMs described in Appendix L, impacts from using hazardous materials associated with the Proposed Action under would not be significant.

3.13.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on hazardous materials and waste management beyond those described in the 2023 SEA.

3.14 Solid Waste Management

3.14.1 Affected Environment

The ROI for solid waste management is VSFB. The regulatory environment for solid waste management establishes control of solid waste and promotes pollution prevention associated with the Proposed Action. Solid waste is generally defined as any discarded material that is not characterized by other specific regulatory requirements detailed in the RCRA (40 CFR Part 261.2). Solid waste is subject to corrective action under RCRA (42 USC Section 6901 et seq.). The regulatory environment for solid waste management reflects comprehensive federal, state, and local approaches to minimize waste generation and increase reuse and recycling.

Solid waste management on VSFB is directed by DODI 4715.23, Integrated Recycling and Solid Waste Management, and implemented in SLD 30's Integrated Solid Waste Management Plan (ISWMP; DAF 2015). AFMAN 32-7002, Environmental Compliance and Pollution Prevention, details requirements and programs that installations must comply with to successfully divert as much solid waste as economically feasible. The SLD 30 ISWMP requires source segregation of recyclable materials to the greatest extent possible. In 1989, the California Integrated Waste Management Act (Assembly Bill [AB] 939) has a policy goal of a 50% reduction of the quantity of solid waste disposed of in California landfills from a 1990 baseline, to be accomplished by 1 January 2000. To bolster the positive effects of AB 939, the Mandatory Commercial Recycling Regulation (AB 341) became law in 2012 and has a policy goal of CalRecycle to increase statewide solid waste diversions to 75% by 2020. The DOD Strategic Sustainability and Performance Plan listed a solid waste diversion goal of 50% and a C&D debris diversion rate of 60%. The DAF is committed to achieving these goals.

3.14.1.1 Pollution Prevention

The Pollution Prevention Act of 1990 (42 USC Sections 13101-13109) focused the national approach to environmental protection toward pollution prevention (P2). Implementing the USAF Environmental Management System (EMS; DODI 4715.17) carries P2 a step further toward mission sustainability principles. The P2 program is detailed in the SLD 30 HMMP and is aimed at achieving SLD 30 EMS objectives and targets, through documented practices, procedures, and operational requirements. SLD 30 implements EMS and its associated P2 program elements by the P2 hierarchy shown in Table 3.14-1.

Table 3.14-1. Pollution Prevention Hierarchy

1) Reduce (source reduction to prevent the creation of wastes)
2) Reuse (keep item or material for its intended purpose)
3) Recycle (use item or material for some other beneficial purpose)
4) Disposal (in an environmentally compliant manner, only as a last resort)

3.14.2 Environmental Consequences

Solid waste impacts are evaluated using federal, state, and local laws and regulations; permit conditions; and contract specifications. Adverse impacts would occur from noncompliance with applicable regulatory requirements or an increase in the amount of waste disposal that would exceed available waste management capacities. The FAA has not established a significance threshold for solid waste and pollution prevention.

3.14.2.1 Alternative 1

During launch operations and facilities maintenance, solid waste (cardboard packaging, wood, rags, plastic and aluminum bottles and cans, etc.) would be disposed of on a routine basis. Solid waste would be collected in on-site refuse containers and transported to the Santa Maria Transfer Station for waste disposal, diversion, and recycling. Solid waste would be minimized by strict compliance with VSFB's ISWMP. All materials that are disposed of off-base would be reported to the CEI Solid Waste Manager. The Santa Maria Regional Landfill would receive waste for disposal. The current remaining capacity of the landfill is 1,477,580 tons with a weekly throughput limit of 6,006 tons (CalRecycle 2023). The City of Santa Maria has also initiated development of a new landfill, the Santa Maria Integrated Waste Management Facility (Facility No. 42-AA-0076), located approximately 8 mi southwest of the City of Santa Maria. The new facility will have a design capacity of approximately 131 million CY of waste with an estimated closure date of 2105 (City of Santa Maria 2021). Therefore, there is adequate capacity to accommodate the additional solid waste that would be generated during launch operations.

Compliance with all applicable federal, state, local laws, and regulations, applicable SLD 30 plans and policies, and EPMs (Appendix L), would govern all aspects of the Proposed Action, and would avoid or minimize potential impacts related to solid waste or pollution prevention. Therefore, the Proposed Action would not have a significant impact on solid waste management.

3.14.2.2 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no impacts on solid waste management beyond those described in the 2023 SEA.

4 CUMULATIVE IMPACTS

Cumulative impacts are defined by CEQ as "effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR Part 1508.1). The FAA analyzes the potential cumulative impacts IAW CEQ regulations and FAA Order 1050.1F. The effects of the Proposed Action, in combination with the effects of other relevant past, present, and reasonably foreseeable future projects, are evaluated in this cumulative effects analysis. The depth of this analysis is commensurate with the potential for significant impacts. Any future federal agency actions modifying the launch program would be subject to environmental review.

Spatial boundaries were delineated to determine the area and projects the cumulative impacts analysis would address. The spatial boundary is VSFB, the city of Lompoc, the NCI, and the broad ocean area, which accounts for all potential cumulative impacts. Past, present, and reasonably foreseeable actions at VSFB and the surrounding area include current and future aircraft operations at the airport, rocket launches, rocket engine testing, development in the local area related to activities at VSFB, and any other development that may occur as a result of economic growth in the area. The projects identified in the following sections include those that had or have the potential to affect the environmental impact categories analyzed in this EA. The No Action Alternative is not analyzed because it would have no cumulative effects on the environment. As noted in Section 1.1, DAF will analyze a proposal to modify SLC-6 at VSFB to launch Falcon 9 and Falcon Heavy launches and increase cumulative launch cadence of Falcon 9 and Falcon Heavy on VSFB to 100 launches per year. That proposal is not additive to the Proposed Action, thus there would be no contemporaneous cumulative effects. Potential significant impacts of cumulative impacts of that proposal will be analyzed in the forthcoming EIS (which will include impacts from the Proposed Action).

4.1 Past Actions

Past actions at VSFB, the city of Lompoc, and the NCI are primarily tied to commercial and military rocket launches, construction on VSFB's launch pads, regular military, and commercial use of VSFB (e.g., takeoffs, landings, launches), and Lompoc community development projects (Table 4.1-1).

Table 4.1-1. Past Actions Recently Completed at or around VSFB

- Military and commercial rocket launches and regular aircraft take-offs and landings at VSFB
- Voluntourism restoration project on San Nicolas Island[1]
- Completion of a 22.5 megawatts solar farm on VSFB[2]
- Completion of Building 7000 on VSFB with LEED Gold certified[3]
- Kids Motorsports Park at River Park[4]

Sources: [1]Kleist 2018, [2]VSFB 2018, [3]Balance Green Consulting 2022, [4]City of Lompoc 2016

4.2 Present Actions

Present actions at VSFB include military and commercial rocket launch programs and several residential developments in the adjacent City of Lompoc (Table 4.2-1).

Table 4.2-1. Present Actions at or around VSFB

- SpaceX commercial rocket launches and landings[1]
- Firefly commercial rocket launches[2]
- Boeing X-37B Spaceplane landings by DAF[3]
- Regular aircraft take-offs and landings, at VSFB
- Approved private development projects in Lompoc[4] including:
    - Community Health Centers of the Central Coast
    - Summit View Homes
    - Mosaic Walk - 13 Unit Residential Project
    - Burton Ranch
    - Coastal Meadows 42-Unit Residential Infill Project
    - River Terrace Residential Development
- Construction of Strauss Wind Energy Project in Lompoc[5]
- Lompoc Valley Parks, Recreations and Pool Foundation Project - Lompoc Motorsport Park[6]
- Pier Construction on Santa Cruz Island[7]
- Maintenance, repair, minor construction/alteration and renovation work and/or design or design/build on real property at VSFB[8]

Sources: [1]DAF 2023, [2]Gray 2022, [3]DAF 2022b, [4]City of Lompoc 2024, [5]Department of Planning and Development Santa Barbara County 2019, [6]City of Lompoc 2016, [7]National Park Service 2024, [8]GovTribe 2019

4.3 Reasonably Foreseeable Actions

Reasonably foreseeable future actions at VSFB include continued launches of both commercial and military launch vehicles, regular military aircraft takeoffs and landings, and the development of residential and community real estate in Lompoc (Table 4.3-1).

Table 4.3-1. Reasonably Foreseeable Actions

- Regular aircraft take-offs and landings, at VSFB
- Modification of SLC-6 on VSFB to support Falcon 9 and Falcon Heavy launches and increase cumulative launch cadence of Falcon 9 and Falcon Heavy on VSFB to 100 launches per year.
- Up to 110 space vehicle launches annually (inclusive of the proposed 100 Falcon 9/Falcon Heavy launch cadence above) with DOD and commercial payloads from VSFB
- Further infrastructure development for expanded commercial space launch capabilities at VSFB[1]
- Approved private development projects in Lompoc[2]
    - Community Health Centers of the Central Coast
    - Summit View Homes
    - Mosaic Walk - 13 Unit Residential Project
    - Burton Ranch
    - Coastal Meadows 42-Unit Residential Infill Project
    - River Terrace Residential Development

Sources: [1]Erwin 2022, [2]City of Lompoc 2024

4.4 Alternative 1

The impacts of the Proposed Action were analyzed for their potential to result in cumulative impacts when added to other past, present, and reasonably foreseeable future actions. The Proposed Action would result in less than significant impacts related to the resources analyzed in this EA. The potential cumulative impacts on those resources are described below.

4.4.1 Air Quality

Past, present, and reasonably foreseeable future actions have resulted and will result in air emissions in the ROI. Construction of residential and commercial projects in and around VSFB, along with air and space craft operations, would result in increased emissions. All emissions would be temporary and not likely to result in an exceedance of air quality standards, including the NAAQS. Additionally, ecological restoration projects and renewable energy projects, including the Strauss Wind Energy Project, in and around VSFB would result in improved air quality and net-negative GHG emissions.

The Proposed Action would result in air emissions during projectile transport activities, site preparation, mobilization activities, and static fire and launch events. These emissions are relatively small and temporary in nature. When combined with other past, present, and reasonably foreseeable future actions, the Proposed Action is not expected to result in exceedance of any air quality standards, including the NAAQS thresholds, because of the low amount of emissions and the temporary nature of the emissions. Therefore, the Proposed Action is not expected to result in significant cumulative impacts on air quality.

4.4.2 Noise

Noise effects associated with launch and missile activities on VSFB are relatively short (typically no more than several minutes per event). Appropriate environmental analyses are conducted for these activities. Noise produced during the additional launches under the Proposed Action would not contribute a significant cumulative impact to the noise setting within the ROI. Each noise event from launches would last less than two minutes. The anticipated offshore sonic boom events resulting from launches would be infrequent. Therefore, the Proposed Action, with other past, present, or reasonably foreseeable projects, would not result in significant cumulative noise impacts.

4.4.3 Terrestrial Biological Resources

The Proposed Action would potentially impact wildlife and special status resources within the ROI, these impacts would not be significant and overall long-term consequences are unlikely. All avoidance and minimization measures presented in Appendix L would be implemented as required. Therefore, the incremental contribution of the Proposed Action, when added to the impacts of all other past, present, and reasonably foreseeable future actions, would not result in significant cumulative impacts on terrestrial biological resources, including impacts on ESA-listed species.

4.4.4 Marine Biological Resources

General threats to marine mammals include water quality degradation (chemical pollution), commercial industries (fisheries bycatch, explosive pest deterrents, and other interactions), noise, hunting, vessel strike, marine debris, disease and parasites, power plant entrainment, and climate change. Potential

impacts of actions that affect marine mammals include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success. The susceptibility of marine mammals to these outcomes often depends on proximity, severity, or vulnerability to the stressor and vulnerability can be increased as multiple stressors compound on an individual.

The Proposed Action would potentially impact pinnipeds hauled out within the ROI, as presented in Section 3.4.2. Pinnipeds hauled out on land would be affected by noise and visual disturbance during launch, landing, and static fire events. The analysis indicates the Proposed Action would not have a significant impact on pinnipeds within the ROI. Overall, long-term consequences for hauled out pinnipeds are unlikely given the long history of monitoring that has documented pinniped reactions at haulouts to similar events. Therefore, the incremental contribution of the Proposed Action, when added to the impacts of all other past, present, and reasonably foreseeable future actions, would not result in significant impacts on marine mammals in the ROI or beyond.

4.4.5 Water Resources

Projects on VSFB, including the Proposed Action, are required to utilize site-specific BMPs and conduct site restoration, as necessary, to minimize impacts on water quality. Any potential adverse effects should be avoided or minimized through implementing measures described in Appendix L, identified in environmental documents completed for other projects, in environmental documents for future projects, and/or identified and established by VSFB for Operations and Maintenance projects. Therefore, the Proposed Action, when added to the impacts of all other past, present, and reasonably foreseeable future actions, would not result in significant cumulative impacts on water resources.

4.4.6 Cultural Resources

General threats to cultural resources in the ROI include construction, demolition, infrastructure development, and maintenance projects. Cumulative impacts would result if project activities caused major ground disturbances in areas of high paleontological sensitivity, or that may contain intact subsurface prehistoric or historic archaeological resources, or incremental changes that collectively and over time impact the NRHP eligibility or listing status of a historic property. All projects on VSFB are evaluated for potential cultural resources impacts. Evaluation for NRHP eligibility, Section 106 consultation, and Native American consultation are conducted. These processes stipulate avoidance and minimization measures to protect sensitive archaeological resources. Therefore, the incremental contribution of the Proposed Action, when added to the impacts of all other past, present, and reasonably foreseeable future actions, would not result in significant cumulative impacts on cultural resources.

4.4.7 Coastal Zone Management

The Proposed Action would not adversely affect land use or CZMA and CCA policies. Past, present, and reasonably foreseeable actions would conform to DAF regulations and planning principles or comply with County and State requirements. Cumulative projects would be modified during the project review process to ensure compatibility with existing land uses and consistency with management plans. These projects have been and would be assessed separately under NEPA and the effects would be analyzed and disclosed. Therefore, implementing the Proposed Action, with other past, present, or reasonably foreseeable projects would not result in significant cumulative impacts on the coastal zone.

4.4.8 Department of Transportation Act Section 4(f) Properties

The DAF would comply with the closure agreement with Santa Barbara County and would not exceed or increase the current cumulative allowable annual evacuations of Jalama Beach County Park across all present and reasonably foreseeable launch programs on VSFB. SLD 30 Range Safety would individually review future launch programs to determine if additional closures are necessary and what areas would be affected since the hazard risk analysis is unique to each vehicle, launch location, and mission trajectory. SLD 30 is working to avoid restrictions to public access while accounting for risk to human health and safety and has determined there is no need to restrict access to Ocean Beach County Park or Surf Beach for launches with downrange first stage landing on a droneship and launches with first stages expended in the Pacific Ocean that do not fly over or pass within close proximity these locations. Ocean Beach County Park closures would not exceed 12 times per year as previously described in the 2018 SEA. Therefore, implementing the Proposed Action with other past, present, or reasonably foreseeable projects would not result in significant cumulative impacts on Section 4(f) properties.

4.4.9 Utilities

Past, present, and future projects on VSFB would contribute to increases in demand for utility resources; however, utility capacity would be required to be greater than demand. SLD 30 will extend utilities to reach launch facilities, but the existing utility capacity is greater than the anticipated demand to support launch facilities for 110 cumulative launches and supporting infrastructure. The substation that supports south base launch facilities is capable of supporting over 1,000 amps of distribution loads. SLD 30 profiles the loads for every launch, and has not exceeded 100 amps of usage. The existing system can support 10 times the current load, well within the requirements for cumulative launches. If existing utility capacity is not greater than the anticipated demand, SLD 30 would improve utility capacity during infrastructure development for expanded commercial space launch capabilities at VSFB and thus help offset cumulative impacts to utility resources. Additionally, American Water Operations & Maintenance, which operates the water distribution and wastewater collection systems at VSFB, is saving approximately 22 million gallons/year by re-introducing potable water into the system during fire-hydrant flushing instead of disposing of the water in storm drains (Air Force Civil Engineer Center [AFCEC] 2015). Therefore, implementation of the Proposed Action in conjunction with other past, present, or reasonably foreseeable projects would not result in significant cumulative impacts to utilities in the ROI.

4.4.10 Socioeconomics

The long-term employment for personnel supporting the Proposed Action would be considered positive and would augment other local community businesses and industries. SpaceX and VSFB are major employers, and the presence of these employers can cause a chain of economic reactions throughout the local region. VSFB launch operations would not result in closing any public airport or so severely restricting using surrounding airspace to prevent access to an airport for extended time. Given existing closed airspace surrounding VSFB and the FAA's previous analyses related to the NAS have concluded minor or minimal impacts on the NAS from commercial space launches, the effects from airspace closures would result in insignificant socioeconomic impacts. As a result, the overall cumulative effect of the Proposed Action, when considered with other past, present, and reasonably foreseeable future actions on socioeconomics is considered beneficial and less than significant.

4.4.11 Transportation

Impacts to the local and regional transportation network due to the Proposed Action, along with past, present, and reasonably foreseeable projects in the ROI would contribute to increased traffic volumes in the region. However, traffic volumes in the ROI are low and the roadways operate at acceptable levels of service. The Proposed Action would generate a relatively small and temporary increase in daily vehicle traffic that would not have a cumulative adverse effect on capacity. Trains that would be stopped at safety hold points for launch activities or railway crossings would only experience minor delays of short duration that are relatively infrequent. Launch windows are typically minimal (typically instantaneous or several minutes but could last a few hours) and during longer launch delays 2 ROPS/DON communicates with the UPRR POC to allow trains to move through the affected area; thereby minimizing potential impacts to train schedules. As a result, we expect no significant cumulative adverse effects to capacity to occur as a result of the Proposed Action.

4.4.12 Human Health and Safety

The Proposed Action and other concurrent projects on VSFB could result in increased risks to human health and safety. Implementing the Proposed Action and other similar actions at VSFB would slightly increase the short-term risk associated with personnel performing work at project locations. SLD 30 has developed hazardous areas that constrain project sites to ensure the health and safety of workers (Section 3.14); these hazard areas have been in use for decades' worth of launch and military activities and applied to many on-base projects. DOD and DAF emergency management readiness and response to public health and safety issues are detailed in DODI 6055.17, DODI 6200.03, AFI 10-2519, and AFI 10-2501. These DOD and DAF instructions have been established for a wide variety of DOD operations and projects and require compliance to mitigate impacts to human health and safety. Any potential contractors would be required to establish and maintain safety programs that would provide protection to their workers and limit the exposure of personnel to work hazards. The safety program would include coordination with the AFCEC MMRP manager and contact with the weapons safety specialist for SLD 30 for information on DAF and SLD 30 policies on unexploded ordnance safety for construction work at VSFB. Projects on VSFB are regulated by the same policies and processes to prevent significant impacts on human health and safety from launch activities, weapons testing, and other military actions on VSFB. By implementing the required safety measures, there would be no significant cumulative impacts resulting from the Proposed Action and other anticipated projects. Therefore, implementation of the Proposed Action, with other past, present, or reasonably foreseeable projects would not result in significant cumulative impacts on human health and safety.

4.4.13 Hazardous Materials and Waste Management

Past, present, and future projects on VSFB are subject to the same protocols and procedures for the management of hazardous materials and waste. In addition to federal, state, and local rules, installation management of any hazardous materials would occur by complying with Base-specific manuals and protocols such as the HMMP, the Hazardous Materials Emergency Response Plan, and the ISWMP. Slight variances in protocols may occur in contractors' or project proponents' project-specific Emergency Response Plan as it pertains to the unique requirements and processes of individual Proposed Actions. Additionally, EPMs like the prescribed EPMs for this Proposed Action in Appendix L, would be implemented to minimize impacts to hazardous materials or hazardous waste management from similar

Proposed Actions. Impacts to hazardous materials and waste management from launch activities, weapons testing, and other military actions on VSFB are closely monitored and controlled by the same policies and procedures to ensure impacts are mitigated or minimized and do not result in significant cumulative detrimental effects to hazardous materials and waste management resources. Therefore, implementing the Proposed Action, with other past, present, or reasonably foreseeable projects would not result in significant cumulative impacts on hazardous materials and waste management.

4.4.14 Solid Waste Management

The cumulative projects listed above, including the Proposed Action, will result in an overall increase in solid waste generation produced during the increased launch operations. All operations and activities on VSFB are required to comply with all applicable federal, state, local laws, and regulations, and applicable SLD 30 plans. Local landfills have adequate capacity to process the projected temporary increases in solid waste, especially with the development of the Santa Maria Integrated Waste Management Facility. Therefore, with adhering to disposal and recycling requirements and EPMs described in Appendix L, the Proposed Action would not have a significant cumulative impact on solid waste management.

4.5 Summary and Conclusion

To ensure that no significant cumulative impacts result from projects on VSFB that occur either concurrently or sequentially with the Proposed Action, SLD 30 includes environmental contract specifications and protective measures, when necessary, in all projects. Preventive measures are identified and defined by resource managers and project proponents and SLD 30 take actions during the planning process to ensure adverse impacts are minimized, or avoided all together, as projects are reviewed under NEPA. Prior projects are also considered to ensure no levels of acceptable impacts are exceeded.

All projects on VSFB are designed and implemented to fully comply with applicable statutes and regulations. SLD 30 develops EPMs in coordination with appropriate regulatory agencies throughout the NEPA process. With these practices in place, the activities included under the Proposed Action, would not result in significant cumulative impacts. That said, the impacts from current Proposed Action will be included in the upcoming increased launch EIS as a past action in the cumulative impacts analysis section to further analyze the potential impacts of the Proposed Action combined with foreseeable future proposals.

4.6 No Action Alternative

Under the No Action Alternative, increased launch cadence on VSFB would not occur, resulting in no contributions to cumulative impacts beyond those described in the 2023 SEA.

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