

CALIFORNIA COASTAL COMMISSION

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STAFF REPORT: REGULAR CALENDAR

Consistency Determination No. CD-0003-24**Applicant:** Department of the Air Force – U.S. Space Force**Location:** Vandenberg Space Force Base (VSFB), Santa Barbara County**Project Description:** Increase in Space Exploration Technologies Corporation's (SpaceX) Falcon 9 launch and landing activities at VSFB to 36 and 12 per year, respectively, as well as the addition of offshore barge landing locations in the Pacific Ocean.**Staff Recommendation:** Conditional Concurrence

SUMMARY OF STAFF RECOMMENDATION

On May 5, 2023, the Executive Director of the Commission concurred¹ with a negative determination (Negative Determination No. ND-0009-23) by the Department of the Air Force (DAF), U.S. Space Force for the proposed expansion of the Space Exploration Technologies Corporation's (SpaceX) Falcon 9 space program. The SpaceX program's expansion included increasing launch activities from an existing launch and landing complex at Vandenberg Space Force Base (VSFB) from six to 36 per year as well as carrying out up to 12 landings per year of the rocket's first stage, associated payload

¹ The Energy, Ocean Resources and Federal Consistency Deputy Director reported the concurrence at the June 2023 Commission meeting.

and rocket processing activities and the addition of offshore landing locations in the Pacific Ocean.

Shortly after the Executive Director's concurrence with DAF's ND-0009-23, Commission staff learned through discussions with staff from Santa Barbara County's Parks and Recreation Department that the number of temporary closures and evacuations of the beach and campground at Jalama Beach due to SpaceX launches within the first seven months of the year had already surpassed the annual maximum that DAF committed not to exceed in its negative determination. Further, Commission staff learned that public coastal access and recreation at Jalama Beach was being affected by more than just the temporary closure and evacuation of the beach and campground.

These adverse impacts to public coastal access and recreation were not described or evaluated by DAF in its negative determination, and thus were also not considered by the Executive Director before issuing her concurrence. In addition, as noted by DAF in its negative determination and confirmed through review of publicly available SpaceX launch records by Commission staff, SpaceX carried out at least 13 launches from VSFB in 2022, more than double the six previously considered and concurred with by the Executive Director in a prior negative determination.

Commission and DAF staff worked collaboratively to understand and develop an approach to resolve these issues and, consistent with that approach, on December 15, 2023, the Commission approved a resolution² "re-opening" the Executive Director's prior concurrence,³ finding that the original negative declaration made by DAF for the subject SpaceX launch activity was no longer applicable to the project as it was being carried out. Approval of that resolution also authorized the Executive Director to prepare and send a letter to DAF requesting remedial actions, including preparation and submittal of a consistency determination for Commission review, to resolve the situation and provide the Commission with an opportunity to evaluate the activity with a more comprehensive understanding of how it was being carried out. As reflected in the testimony provided by DAF staff at the Commission's December 15 public meeting, DAF supported this approach.

After receiving notification of the Commission's action to "re-open" the Executive Director's prior concurrence and receiving the Executive Director's letter requesting remedial actions, DAF prepared and submitted a consistency determination (CD) on March 7, 2024.

² This was presented to the Commission at the December 2023 Commission hearing.

³ Under the Coastal Zone Management Act's federal consistency regulations, 15 CFR § 930.45, federal consistency review may be revisited in several circumstances, including where a project was "Previously determined not to be a Federal agency activity affecting any coastal use or resource, but which the State agency later maintains is being conducted or is having an effect on any coastal use or resource substantially different than originally described and, as a result, the activity affects any coastal use or resource and is not consistent to the maximum extent practicable with the enforceable policies of the management program."

This CD included a variety of measures negotiated with Commission staff to help “offset” the adverse impacts to public access and recreation that occurred as a result of SpaceX exceeding DAF’s commitment to limit closures of Jalama Beach and County Park by contacting Santa Barbara County directly and calling for closures and evacuations in advance of launches. These offset measures included implementation of an environmental education program for students in the Lompoc Unified School District, installation and operation of a digital information sign at the intersection of Highway 1 and Jalama Road, and establishment of “Starlink” satellite internet service for Jalama Beach County Park.

Commission staff prepared a staff report for the Commission’s April 10, 2024, meeting in which it memorialized DAF’s commitment to implement these offset measures and a variety of other coastal resource protection efforts (biological monitoring and reporting, marine debris offsets and a fisheries coordination plan) in a recommendation of conditional concurrence. However, public comment received prior to and at this Commission meeting raised another significant issue that had not previously been acknowledged or evaluated by DAF in its CD – sonic booms generated during SpaceX launches. In addition to this issue, the Commission also questioned other aspects of the project, including the appropriateness of DAF seeking the Commission’s authorization for launch activities carried out directly by SpaceX and the adequacy of DAF’s proposed marine debris offsets and biological resource monitoring efforts and contingency mitigation plans. The Commission ultimately decided not to vote on the staff recommendation and the item was continued to a subsequent meeting.

At the Commission’s June meeting, the DAF CD was again placed on the agenda and Commission staff brought forward a recommendation of objection due to the significant remaining questions and information gaps it had identified following the April meeting and subsequent continued review of the CD. Prior to this meeting, the item was postponed and DAF extended the review period provided to Commission staff (through the Commission’s August meeting) so that it could receive and review additional information from DAF and reschedule the item for August. Specifically, DAF provided (1) six years of annual biological monitoring reports; (2) extensive information about its sonic boom modeling efforts, results, and recent field verifications; (3) additional details about the weather balloons and scientific equipment lost into the ocean prior to launches and offset efforts from 2023; and (4) a variety of responses to individual questions and requests for clarification from Commission staff. Much of this information has been provided over the past few weeks and Commission staff has put its limited capacity and resources under significant strain in order to review it and reevaluate the project. Commission staff has also used this time to attempt to identify and negotiate reasonable and achievable coastal resource protective measures that could be implemented by DAF without putting at risk its stated objectives of promoting SpaceX’s commercial space launch activities and ensuring a reliable pathway to space is available for federal government payloads.

These protective measures integrate the coastal access and recreation offsets previously discussed in advance of the Commission’s April meeting and also include (1) development and implementation of a plan for avoidance and minimization of sonic

boom exposure to the mainland central coast and Channel Islands; (2) development and implementation of a plan for improved and enhanced biological monitoring – including for sonic boom effects outside of VSFb if avoidance cannot be achieved; (3) development and implementation of a lighting management plan for night launch and landing operations; (4) enhanced marine debris avoidance, minimization and offset efforts; and (5) development and implementation of a fisheries coordination plan. The identified deadline for developing and providing these plans for Executive Director review and comment is 30 days. While this is a limited amount of time, it was selected to ensure that the various plans are provided before Commission staff is required to complete its review of the consistency determination that DAF recently submitted to further increase SpaceX launches from 36 to 50 in 2024. In its submittal of this new CD, DAF stated that it must be brought before the Commission no later than its October meeting⁴.

Consistent with the timeline previously discussed with DAF, Commission staff shared these measures with DAF on July 19, 2024, and requested that they be integrated into the CD as commitments. However, as of the publication date of this report, DAF has not provided a response to this request or offered counter-proposals for any of the specific measures. As such, Commission staff is instead recommending that the Commission establish these measures through a conditional concurrence in order to help ensure that the proposed project proceed in a manner that provides protection for relevant coastal resources, including public access and recreation, environmentally sensitive habitat areas, coastal parks and recreation areas, the biological productivity of coastal waters, marine areas and species of special biological significance, and commercial and recreational fisheries.

Regarding the concerns previously raised by members of the Commission of the appropriateness of considering a CD by DAF for commercial space launch activities carried out directly by SpaceX, Commission staff agree that the proposed project is not a federal agency activity. However, staff also note that the Commission's action on the DAF CD does not affect its ability to also apply other aspects of its Coastal Act and Coastal Zone Management Act authority. Commission staff is actively evaluating if SpaceX is carrying out development activities within the Coastal Zone as part of its launches and resulting coastal development permitting requirements that may exist. Similarly, Commission staff is also building a better understanding of other federal authorizations that SpaceX is required to obtain, the effects to coastal resources that may result from these federal agency actions, and the resulting application of the Coastal Zone Management Act's consistency certification provisions. Further, it should be noted that if the Commission were to decline to act on the subject CD by DAF because it does not agree that it is the appropriate review mechanism, a likely outcome would be the expiration of the Commission's review period. Under the federal consistency regulations, if the review period expires prior to a state agency decision, the state agency would be deemed to have concurred with the CD. In light of these factors, Commission staff recommends that the Commission act on the subject CD in spite of its

⁴ This October deadline was selected by DAF to ensure that SpaceX can continue to launch at an accelerated pace through the remainder of the year.

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disagreement with DAF about the appropriateness of its characterization as a federal agency activity.

In conclusion, Commission staff recommends that the Commission **conditionally concur** with DAF consistency determination No. CD-0003-24 and find that the proposed project, with the recommended conditions, is consistent with the enforceable policies of the California Coastal Management Program. The motion is on **page 7**.

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I. FEDERAL AGENCY'S CONSISTENCY DETERMINATION

Space Launch Delta 30 (SLD 30) of the United States Department of the Air Force (DAF), United States Space Force, has determined the project is consistent to the maximum extent practicable with the enforceable policies of the California Coastal Management Program (CCMP).

II. MOTION AND RESOLUTION

Motion:

I move that the Commission **conditionally concur** with Consistency Determination CD-0003-24 on the grounds that, if modified in accordance with the conditions recommended by staff, the project described therein would be fully consistent, and thus consistent to the maximum extent practicable, with the enforceable policies of the CCMP.

Staff recommends a **YES** vote on the forgoing motion. Passage of this motion will result in a concurrence with the determination of consistency, provided the project is modified in accordance with the recommended condition(s), and adoption of the following resolution and findings. An affirmative vote of a majority of the Commissioners present is required to pass the motion.

Resolution:

The Commission hereby **conditionally concurs** with Consistency Determination CD-0003-24 on the grounds that the project is fully consistent, and thus consistent to the maximum extent practicable, with the enforceable policies of the CCMP , provided that DAF agrees to modify the project consistent with the recommended conditions, as provided for in 15 CFR §930.4.

Conditions:

1. **On-Base Enhanced Biological Monitoring Program.** Within 30 days of the Commission's consideration of Consistency Determination No. CD-0003-24, the Department of the Air Force (DAF) shall prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for Vandenberg Space Force Base (VSFB) focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF shall consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible. The enhanced biological monitoring program shall be implemented and include descriptions of how the following will be accomplished:
 - a. **Monitoring.** In addition to the monitoring required (1) by the United States Fish and Wildlife Service (USFWS) in their March 21, 2023,

Biological Opinion (2023 USFWS BO), including for western snowy plover, California least tern, California red-legged frog, and southern sea otter, and (2) by the National Marine Fisheries Services (NMFS) in their Letter of Authorization (LOA) dated April 9, 2024 (2024 NMFS LOA), for marine mammals, DAF shall implement the following supplemental monitoring activities and measures to maintain and improve ongoing monitoring:

- i. Continue the on-base marine mammal (by daylight or nighttime video recording or by at least one NMFS-approved Protected Species Observer trained in marine mammal science) and acoustic monitoring as required by the previous NMFS LOA (dated April 10, 2019), including:
 - (1) Pinniped activity at VAFB shall be monitored in the vicinity of the haulout nearest the launch and landing complex, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continued for a period of time not less than 48 hours subsequent to the launch and/or landings for (a) any launches of space launch vehicles or landings of the Falcon 9 First Stage occurring from January 1 through July 31, and (b) any landings of the Falcon 9 First Stage occurring from August 1 through December 31 that are predicted to result in a sonic boom of 1.0 pounds per square foot (psf) or above at VAFB;
 - (2) For any launches or Falcon 9 First Stage landings occurring from January 1 through July 31, follow-up surveys must be conducted within two weeks of the launch.
- ii. Monitoring of the on-base pallid bat and western red bat populations in a manner sufficient to assess potential changes in habitat use patterns and population levels;
- iii. Monitoring of the on-base monarch butterfly populations in a manner sufficient to assess potential changes in habitat use patterns and population levels;
- iv. Identification of data and appropriate ongoing monitoring of off-base reference site populations of western snowy plover, California least tern, and California red-legged frog that can be used as a basis of comparison for on-base monitoring results. If no such data and appropriate ongoing monitoring can be identified, it shall be established; and
- v. Identification of data and appropriate ongoing monitoring of off-base reference site populations of marine mammals that can be used as a basis of comparison for on-base monitoring results. If no such data and appropriate ongoing monitoring can be identified, it shall be established; and
- vi. Equipment redundancy and data-handling improvements to help ensure further loss of monitoring data is avoided.

- b. **Analysis of Monitoring Data.** DAF shall conduct analysis of the USFWS- and NMFS-required monitoring data and the supplemental monitoring data described above on an annual basis, in preparation of the annual reports described below, that shall include multivariate statistical analyses of the changes in population trends using: (a) relevant historical population data; (b) frequency of launches and on-base boost-back landings over different time scales; (c) seasonality of launches and sensitive times of year for respective species; (d) geospatial variability; (e) off-base reference site data; (f) climatic and oceanographic patterns (e.g. El Niño, Pacific Decadal Oscillation, storms, ocean temperature); (g) acoustic monitoring data; (h) and patterns of other variables including (as relevant to the respective species), but not limited to, pupping rates, breeding rates, beach width, behavior during launches, and forage base or food web trends. Relevant population trends to analyze include, but are not limited to, population sizes and locations, and for western snowy plovers and least terns, rates of breeding success (including number of hatched chicks and fledglings), nest/colony abandonment, injury, or mortality to eggs or chicks. Analysis of potential impacts from individual launches shall also include use of the results of the landscape-level camera monitoring for western snowy plover and California least tern required by the 2023 USFWS BO.
- c. **Reporting.** No later than July 1 of each year, DAF shall send an annual report to the Executive Director for the enhanced biological monitoring program. The annual report shall include the monitoring data and results collected over the previous year as well as any initial conclusions, including those from the analyses detailed above in part b of this condition, regarding potential effects to any monitored species as a result of space launch and landing activity at Vandenberg Space Force Base. If significant disruption or degradation of habitat values are identified from these conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of species population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF shall prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts.

The annual report submittal shall also include the following:

- i. Annual reports prepared for the 2023 USFWS BO on western snowy plover, California least tern, California red-legged frog, and southern sea otter (including any individual reports for those species referenced in the annual reports);

- ii. The results of marine mammal monitoring carried out consistent with the 2024 NMFS LOA and consistent with part a(i) of this condition;
- iii. The annual “Monitoring and Management of the Endangered California Least Tern and the Threatened Western Snowy Plover at Vandenberg Space Force Base” reports;
- iv. The results of on-base monarch butterfly monitoring;
- v. The results of pallid bat and western red bat monitoring; and
- vi. Modeled sonic boom conditions for each launch based on trajectory and atmospheric conditions.

Every three years, the third annual report shall include a summary of the previous three years of monitoring results as well as conclusions regarding potential effects to the monitored species as a result of space launch and landing activity at Vandenberg Space Force Base. Within 60 days of providing this three-year report of monitoring results to the Executive Director, DAF shall convene a meeting of relevant staff from the Commission, USFWS and NMFS to present and discuss the monitoring results and conclusions.

2. **Off-Base Sonic Boom Minimization Measures.** Within 30 days of the Commission’s consideration of Consistency Determination No. CD-0003-24, the Department of the Air Force (DAF) shall submit, for Executive Director review and comment, a Sonic Boom Minimization Plan for limiting the spatial extent and severity (in terms of overpressure levels) of sonic booms caused by launches. This plan shall include measures for evaluating modeling for specific atmospheric conditions to anticipate sonic boom effects on the Northern Channel Islands and off-base areas of the mainland coast of Santa Barbara, Ventura, and Los Angeles Counties, and measures for making decisions on launch time and trajectory based on an analysis to minimize the spatial extent and severity of sonic booms experienced in those off-base areas. DAF shall consider comments provided by the Executive Director and address them through modifications to the Sonic Boom Minimization Plan and/or written responses as to why such modifications are infeasible. DAF shall implement the Sonic Boom Minimization Plan.
3. **Off-Base Acoustic and Biological Monitoring.** If implementation of the Sonic Boom Minimization Plan would not result in avoidance of sonic boom effects on the Northern Channel Islands and off-base areas of the coastal zone in mainland Santa Barbara, Ventura, and Los Angeles Counties, the Department of the Air Force (DAF) shall prepare and provide for Executive Director review and comment, an Acoustic and Biological Monitoring Program for affected coastal areas outside of Vandenberg Space Force Base that shall include: (a) monitoring that quantifies species response to sonic booms, including in areas of special biological significance, such as marine mammal haulout sites, and in Environmentally Sensitive Habitat Areas (ESHA), including dune ESHA and significant bird breeding, nesting, foraging, or roosting sites, which could be

affected by sonic booms; and (b) acoustic monitoring at those sites during launches to measure received sonic boom overpressure levels. DAF shall consider comments provided by the Executive Director and address them through modifications to the Acoustic and Biological Monitoring Program and/or written responses as to why such modifications are infeasible. DAF shall implement the Acoustic and Biological Monitoring Program.

4. **Lighting Management Plan.** Within 30 days of the Commission's consideration of Consistency Determination No. CD-0003-24, DAF shall provide, for Executive Director review and comments, a Lighting Management Plan for night launches that includes best management practices including, but not limited to, light shielding, luminaire color and temperature considerations avoidance of lights facing the beach where practicable, metrics for when lights are needed for operations, and monitoring of lighting on Surf Beach which shall include use of sky-quality camera(s). DAF shall consider comments provided by the Executive Director and address them through modifications to the Lighting Management Plan and/or written responses as to why such modifications are infeasible. DAF shall implement the Lighting Management Plan.
5. **Coastal Access and Recreation Enhancement.** Within 30 days of the Commission's consideration of Consistency Determination No. CD-0003-24, DAF shall provide, for Executive Director review and comments, a Coastal Access and Recreation Enhancement Plan. The plan shall include (1) specific details and schedules for implementation of the commitments DAF has made for the evacuation shuttle, satellite internet and Highway 1 digital signage projects for Jalama Beach County Park and the Lompoc Unified School District third grade beach field trip program; (2) details of measures that SpaceX and DAF will take to ensure that the proposed launch activities will not exceed DAF's commitment to cause more than 12 annual closures of Jalama Beach; and (3) a minimum notice period, coordinated with the Santa Barbara County Parks and Recreation Department, for any planned evacuations for Jalama Beach. DAF shall consider comments provided by the Executive Director and address them through modifications to the Coastal Access and Recreation Enhancement Plan and/or written responses as to why such modifications are infeasible. DAF shall implement the Coastal Access and Recreation Enhancement Plan.
6. **Marine Debris.** DAF shall ensure that annual payments by the Space Exploration Corporation (SpaceX) are made at a rate of \$20 (adjusted annually for inflation) for each pound of unrecoverable marine debris generated as a result of space launch and landing activities, including the release of weather balloons in advance of launch and/or landing activities. These payments shall be divided equally between the U.C. Davis Lost Fishing Gear Recovery Project (U.C Davis Program) and a public or non-profit organization for removal of hazardous waste from the marine environment or battery/electronic waste recycling and reduction efforts. In addition, DAF shall evaluate and implement measures to reduce the amount of marine debris released as part of launch activities, such as by minimizing the number of weather balloons released per launch, developing

alternatives to the released weather balloons, and modifying the radiosondes to eliminate or reduce hazardous materials. DAF shall also provide an annual report to the Executive Director that includes the amounts and types of marine debris released as part of each SpaceX launch and provides details about the amounts of plastics and hazardous materials within the released debris.

7. **Commercial and Recreational Fishing Coordination Plan.** Within 30 days of the Commission’s consideration of Consistency Determination No. CD-0003-24, DAF shall submit a Commercial and Recreational Fishing Coordination Plan to the Executive Director for review and comments. The Plan shall include the development and implementation of a communication protocol, including regular dialogue, developed in coordination with the commercial and recreational fishing industry mostly likely to be affected by launch and landing activities at Vandenberg Space Force Base as well as an email to local fishermen’s associations that include the date and time of the surveillance area, and the vessel hazard area that is also available in the Notice to Mariners, and for how long these will be in effect. DAF shall consider comments provided by the Executive Director and address them through modifications to the Commercial and Recreational Fishing Coordination Plan and/or written responses as to why such modifications are infeasible. DAF shall implement the Commercial and Recreational Fishing Coordination Plan.

III. APPLICABLE LEGAL AUTHORITIES

A. REVIEW PROCESS

It is the Commission’s position that SpaceX’s space launch activities are not a government program and are carried out solely by a private entity on a portion of Vandenberg Space Force Base (VSFB) leased to SpaceX by the Department of the Air Force (DAF). DAF nevertheless has determined that the proposed project is a “federal agency activity,” as defined in the Coastal Zone Management Act’s federal consistency regulations and has therefore prepared a consistency determination for the Commission’s review. While preserving its position, the Commission is also moving forward with its review of DAF’s consistency determination because failure to do so before August 10, 2024 – the review period deadline established by DAF - would result in a presumption of the Commission’s concurrence with DAF’s consistency determination. However, Commission staff is also continuing to evaluate the scope of the Commission’s authority to review the proposed activity under the Coastal Act and Coastal Zone Management Act. Pending the results of those efforts, SpaceX may be required to seek the Commission’s authorization through submittal of a coastal development permit application and/or consistency certification. The Coastal Zone Management Act and its regulations do not preclude a coastal management agency like the Commission from reviewing the same project through both a consistency determination and consistency certification if it requires a federal license or permit and would affect one or more coastal uses or resources.

Regarding what qualifies as a federal agency activity, the federal consistency regulations at 15 C.F.R. Section 930.31(a) state that:

The term “Federal agency activity” means any functions performed by or on behalf of a Federal agency in the exercise of its statutory responsibilities. The term “Federal agency activity” includes a range of activities where a Federal agency makes a proposal for action initiating an activity or series of activities when coastal effects are reasonably foreseeable, e.g., a Federal agency's proposal to physically alter coastal resources, a plan that is used to direct future agency actions, a proposed rulemaking that alters uses of the coastal zone. “Federal agency activity” does not include the issuance of a federal license or permit to an applicant or person (see subparts D and E of this part) or the granting of federal assistance to an applicant agency (see subpart F of this part).

Commission staff previously and consistently questioned this interpretation and the Commission’s review of consistency determinations for projects submitted by DAF rather than coastal development permit applications or consistency certifications since those are the standard mechanisms by which the Commission reviews activities proposed by private entities within the coastal zone and/or affecting any coastal use or resource. In response, DAF has previously stated that “All activities taking place on federally owned (Department of Defense) land, including those that utilize private entities, are done so in a manner exercising our statutory responsibilities.” Although the Commission has a long history of reviewing and authorizing development activities carried out by private entities on federally owned land, including VSFB, through the coastal development permit application or consistency certification processes, DAF maintains that the proposed project is different due to the unique partnership arrangement it has with commercial space launch companies like SpaceX. In short, because the federal government no longer carries out space launch activities, DAF now relies on private companies such as SpaceX to send government payloads to space and to establish and maintain satellite infrastructure and networks that are available to support DAF needs and priorities. Accordingly, while the project would be operated by a private company to serve its business objectives and would only occasionally launch materials at the behest of DAF, it would also help meet the needs of the federal government. Based on this mixed purpose and at the request of DAF, Commission staff agreed to bring forward the proposed project for the Commission’s consideration as a consistency determination from DAF. However, as stated above, this does not prevent the Commission from also exercising its statutory authority under the other provisions of the Coastal Zone Management Act and Coastal Act. Commission staff are continuing to explore those options and whether SpaceX is required to submit a CDP application and/or consistency certification in addition to the DAF consistency determination currently under review. In addition, future projects involving commercial space launch activities at VSFB will continue to be considered on a case-by-case basis and different review approaches will be used when appropriate.

B. CONSISTENT TO THE MAXIMUM EXTENT PRACTICABLE

The federal Coastal Zone Management Act (“CZMA”), 16 U.S.C. § 1451-1464, requires that federal agency activities affecting coastal resources be “carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State management programs.” *Id.* at § 1456(c)(1)(A). The implementing regulations for the CZMA (“federal consistency regulations”), at 15 C.F.R. § 930.32(a)(1), define the phrase “consistent to the maximum extent practicable” to mean:

...fully consistent with the enforceable policies of the management programs unless a full consistency is prohibited by existing law applicable to the Federal agency.

This standard allows a federal activity that is not fully consistent with California’s Coastal Management Program (“CCMP”) to proceed, if full compliance with the CCMP would be “prohibited by existing law.” In its consistency determination, the DAF did not argue that full consistency is prohibited by existing law or provide any documentation to support a “maximum extent practicable” argument. Therefore, there is no basis to conclude that existing law applicable to the Federal agency prohibits full consistency. Since the DAF has raised no issue of practicability, as so defined, the standard before the Commission is full consistency with the enforceable policies of the CCMP, which are the policies of Chapter 3 of the Coastal Act (Cal. Pub. Res. Code §§ 30200-30265.5).

Similar to what occurred in December 2023 with DAF’s Negative Determination No. ND-0009-23, the Commission also has the ability under the federal consistency regulations to re-open this consistency determination should the proposed federal activity have effects on any coastal use or resources substantially different from those originally described in DAF’s consistency determination. Should this scenario occur, the Commission’s finding that the project is “fully consistent” with the enforceable policies of the CCMP could be re-examined in light of new circumstances.

C. FEDERAL LANDS EXCLUDED FROM THE COASTAL ZONE

Under the federal CZMA, the Commission is authorized to review federal agency activities and actions that occur within or outside of California’s coastal zone and that affect any land or water use or natural resource of the coastal zone. However, the Coastal Zone Management Act (CZMA) excludes from its definition of the coastal zone “lands the use of which by law is subject solely to the discretion of or which is held in trust by the Federal Government.” (15 USC 1453(1)). Thus, in cases where a proposed federal agency activity that is being reviewed under the Commission’s federal consistency authority is to be located on federal land under the sole control of the federal government, the Commission’s CZMA review is limited to evaluating whether the activities will result in effects that extend outside of the federal property and will “spill over” into the coastal zone. For example, if the activities would adversely affect a coastal species such as western snowy plover while it is present on the federal property and put it at risk outside of that federal property within the coastal zone as well, it would be considered to have a “spill over” effect.

The proposed project is somewhat unique, however, in that while the SpaceX launch and landing complex is located on VSFB, the rockets pass outside of the base and result in development and effects directly within the coastal zone off of VSFB as well. For example, sonic booms generated by the proposed SpaceX rocket launches subject an extensive area of central and southern California's mainland coast and offshore islands to blast waves (also known as overpressure because they generate temporary spikes over and beyond natural atmospheric pressure) and elevated sound levels. Marine mammals and other coastal wildlife species outside of VSFB experience these sound and pressure effects from sonic booms and respond with startle responses and other behavioral changes. In addition, the public safety zones implemented during rocket launches such as those proposed in the current project would extend outside of VSFB and would result in the closure and evacuation of public beaches and campgrounds, including those at Jalama Beach County Park. This is another direct effect of the SpaceX rocket launches that would occur outside of VSFB and within the coastal zone. These closures and evacuations would adversely affect public beach access and recreation within the coastal zone. As such, the Commission has the authority to review the proposed SpaceX launch and landing activities because they would result in both "spillover" and direct effects within the coastal zone.

IV. FINDINGS AND DECLARATIONS

A. PROJECT DESCRIPTION

For a complete history of the subject project, please refer to the [staff report](#) that was published for the June 12, 2024, hearing. That June 2024 agenda item was requested by DAF to be postponed until the August 2024 hearing to allow additional coordination on outstanding information.

Launches

The proposed project would include launching the SpaceX Falcon 9 rocket from SLC-4E on VSFB up to 36 times per year. The launches would follow a southerly trajectory between 140 and 210 degrees intended to deliver payloads to a specific polar and geostationary orbit. Depending on the trajectory and atmospheric conditions, the launches may result in sonic booms affecting the counties of Santa Barbara, Ventura and Los Angeles. **Exhibit 3a** provides a general estimate of the affected area based on predictive models used by DAF and FAA. Beginning in May, DAF also partnered with scientists from Brigham Young University to carry out field verification that has confirmed these sonic boom effects from launches (DAF has stated that for field verification so far, "[o]n average over 18 data collection spots were strategically distributed across both densely populated residential areas and quieter regions to encompass a wide range of environments, enhancing the representativeness of the data". The monitoring sites for launches on June 18 (Starlink G9-1) and June 23 (Starlink G9-2), 2024, are shown in **Exhibit 4.**) The field verification program is discussed further below in the subsection for "Sonic Booms from Launches (Off-Base extent)".

After launching rockets, SpaceX lands the first stage either directly adjacent to their launch site at VSFb or on a dronship stationed offshore of Baja California in the international waters of the Pacific Ocean. No more than a total of 12 first stage landings would occur at VSFb on SLC-4W per year. These landings are also expected to generate sonic booms but due to the anticipated landing trajectory, the affected area would be limited to the area immediate surrounding SLC-4W (as shown in **Exhibit 5**). Each launch may be preceded by a static fire test of the engines lasting several seconds which would be conducted one to three days before the launch. The need to conduct a static fire test is mission dependent and there would be no more than 36 static fire events per year.

Launch operations are proposed to occur at any time, day or night. Existing fueling, loading, launch and landing pad infrastructure at the SLC-4E and SLC-4W launch and landing complex on VSFb would be used to support SpaceX's proposed increase in launch frequency and no construction activities are proposed. All of the first stage processing protocols that SpaceX currently uses for launching rockets from SLC-4E would remain the same. However, the frequency of processing protocols would increase in order to support the increased launch frequency. The locations of the launch and landing complex is shown in **Exhibits 1 and 2**.

Deluge Water and Vegetation Management

A deluge of water is flooded onto the launch pad following ignition of SpaceX Falcon 9 rockets to absorb or deflect the high levels of acoustic energy that are released as the rocket lifts off and to avoid damage to the vehicle and payload. The exhaust cloud is comprised of combusted fuel and water that largely consists of steam. In order to avoid and minimize adverse impacts to nesting migratory birds within Spring Canyon from hot steam produced as a result of the deluge curtain, SpaceX has been removing vegetation within a 1.121-acre area of arroyo willow wetland habitat adjacent to the SLC-4E launch complex (the area adjacent to the launch pad on the left in which flame and steam is directed into in the before/after images below⁵). Images of the steam are also included in **Exhibit 6**.



⁵ Images captured from video of May 2, 2024 SpaceX launch from SLC-4E, full video available at <https://x.com/i/broadcasts/1YqJDgypdRDGV>

Some vegetation clearance has historically happened around the SLC-4E location, and Commission staff previously reviewed vegetation clearance up to 30 feet beyond the fence line (the Executive Director previously concurred that this amount of vegetation clearance would not result in new or additional adverse effects to coastal resources beyond what was included in CD-049-98 and ND-055-10). However, this vegetation management activity has expanded well beyond what was previously reviewed and concurred with and now extends an estimated 300 feet beyond the launch complex fence line.

Additionally, after a launch, approximately 9,000 gallons of deluge water per Falcon 9 launch would remain in the existing retention basin after evaporation. Samples of the deluge water would be collected and analyzed. If the water is clean enough to discharge to grade (currently 90-95% of launches), it would be discharged from the retention basin via the spray field.

Payload Fairing Recovery Operations

The Falcon 9 system includes a fairing to protect payloads until they can be delivered to their designated orbit. The fairings consist of two halves which separate to release the payload into space. After separating, the fairing halves would fall back to earth, and a built-in parachute system would slow the descent of each fairing and enable a soft splashdown so that the two halves can be recovered. The splashdown site would be outside of California's state waters and United States territorial waters. The parachute system consists of a drogue parachute and a parafoil which are approximately 110 sq. ft. and 3,000 sq. ft. in size, respectively.

SpaceX would attempt to recover both halves of the fairing after each launch using a salvage ship stationed in the area of the anticipated splashdown site. For safety reasons, the salvage ship cannot be within 12 nautical miles of the splashdown site. Parachutes, parafoils, and their assemblies are made of Kevlar and nylon and would quickly sink once they become waterlogged after splashdown. SpaceX would attempt to recover all parafoils, but ocean conditions or weather conditions could prevent salvage operations from recovering the foil. As described in the CD, for the launches that took place in 2023 SpaceX was able to recover all fairing halves and approximately 75 percent of parafoils.

Weather Balloons

Prior to each launch, SpaceX would need to measure upper atmosphere windspeeds by releasing an average of six to ten weather balloons. Each balloon unit would consist of a radiosonde, which is an instrument approximately the size of a shoebox powered by a 9-volt lithium ion battery, attached to a weather balloon. The radiosonde would transmit data to SpaceX and the operating systems aboard the Falcon 9 rocket. The balloon is comprised of latex and would ascend to an altitude of 12 to 19 miles before the declining atmospheric pressures cause the balloon to expand and burst. The balloon fragments and radiosonde would then fall back to earth and are assumed to land in the ocean. The radiosonde does not have a parachute and would not be recovered. **Exhibit 7** provides an image of the weather balloon and radiosonde.

Landing

The SpaceX Falcon 9 rocket is reusable and includes a first stage section that would undergo a controlled descent and landing. Each landing of the first stage would occur either in the ocean atop the dronship offshore of Mexico or back at VSFb at SLC-4W, where it would produce a sonic boom that would affect VSFb and surrounding areas (as shown in the sonic boom estimate provided in **Exhibit 5**). Some payloads necessitate orbits or destinations which require additional transport from the first stage. In these instances, the use of additional propellant from the booster would prevent the first stage from being able to boost-back and land aboard the dronship or at VSFb. As such, first stages during these launches would be disposed of in the open ocean, outside of state and federal waters. These types of missions where the first stage is unable to boost back are rare and SpaceX has not done an expendable mission from VSFb since 2018, despite carrying out several dozen launches over that period. The CD submittal does not specify how many expendable missions may occur.

Booster Roll-On Roll-Off, Ground Operations, Support, and Transport

After salvage and landing operations are complete, any first stages, fairings and other materials would be transported via barge to the VSFb harbor. Transport would be accomplished via a “roll-on roll-off” (RORO) barge. The first stage would be transferred from the drone ship to SpaceX’s Self-Propelled Modular Transport (SPMT) that is positioned on a small, low draft barge. The first stage would be pulled by a tug using a Tier 3 (or higher) engine from the Port of Long Beach into the VSFb Harbor. A support tug would be launched from the Port of Hueneme and travel up the coast to assist the barge and primary tug in maneuvering into and out of the VSFb Harbor, the exact arrival time would depend on tide. On day two, the support tug would berth at VSFb harbor for 24 hours. On day three, SpaceX would perform the RORO operation, requiring approximately 15 hours for the primary tug to execute the operation. The support tug would assist the operation, then berth at the VSFb harbor for the remainder of the time. On day four, the support tug would remain at VSFb harbor for 24 hours. On day five, the support tug would travel back to the Port of Hueneme, with the exact departure time dependent on tide. The proposed project would include up to 36 events per year utilizing the RORO barge and tugs.

Once at the harbor, the rocket first stage, equipment and materials would be loaded onto trucks for transport back to processing facilities at VSFb. SpaceX would continue to use an existing fleet of specialized trucks for any overland transport of boosters and marine barges for transport of any boosters, fairings, and other materials.

To support the increased launch cadence, SpaceX would also add up to 100 personnel at VSFb.

Engine Noise and Sonic Booms

As described by DAF in its CD submittal, there are four components of the Falcon 9 launches that would generate significant, potentially disruptive sound and noise:

1) continuous engine noise created by the launch vehicle during static fire tests (lasting several seconds); 2) continuous engine noise created during ascent (lasting several minutes); 3) impulsive sonic boom created by the launch of the rocket as well as returning first stage (both lasting less than one second); and 4) continuous engine noise as the first stage lands (lasting approximately 60 seconds).

Engine Noise

During launch operations and static fire tests, the rocket engines would produce noise of up to 150 (decibels) dBA near SLC-4; maps showing the extent of modeled engine noise are included in **Exhibit 5**. For reference, sounds of 85 dBA are known to cause hearing loss in humans and sounds of 150 dBA exceed those generated during a fireworks show at close range. The engine noise estimates provided here are for in-air sound, and it is worth noting that a significant amount of sound energy (loudness) is lost when transmitting across the air-water interface, such that underwater sound is expected to be much lower during launches.

Additional information on engine noise is provided below in Sections IV.C and IV.D, in the context of potential impacts to marine mammals and ESHA on-base.

Noise associated with launches, static fire tests and landings occurs at and near multiple launch facilities across VSFB and may incrementally contribute to cumulative effects to sensitive species and ESHA. Prior to 2023, VSFB has supported an average of 6.2 launches per year with a maximum of 17 in 2022. During 2023 a total of 24 Falcon 9 missions were performed on VSFB. As of the date of this staff report Commission staff have counted a total of 23 SpaceX launches in 2024, with the most recent launch on July 11, 2024. For more information about cumulative VSFB launch activities and engine noise please refer to [Appendix B](#).

Sonic Booms

As described by DAF in its CD, ascent of the rocket and each landing of the first stage, either in the ocean atop the drone ship or back at VSFB at SLC-4W, would produce a sonic boom. The hearing sensation of an overpressure from sonic booms of 1.0 to 5.0 pounds per square foot (psf) is roughly equivalent to hearing a sound in the range of 128 to 140 decibels (dB). For reference, 120 dB is roughly the equivalent of a jet engine at close range.

Sonic Booms from Landings (On-Base)

During boost back to SLC-4W the descent of the first stage would create a sonic boom between 2.0 and 5.0 psf (roughly equivalent to hearing a sound in the range of 134 to 140 dB) that would extend approximately 10 miles from the landing pad (as shown in **Exhibit 5**). Up to 12 first stage landings out of the total proposed 36 launches are proposed to land on-base at the SLC-4W launch complex, the rest would land on an offshore barge. In an Environmental Assessment prepared by the Federal Aviation Administration for an Air Force program, a table was prepared to demonstrate the types

of structural damage that can be caused by sonic booms of various levels. This table is provided as **Exhibit 8**⁶.

Additional information on sonic booms from landings is provided below in Sections IV.C and IV.D, in the context of potential impacts to marine mammals and ESHA on-base. Background information on how sonic booms are generated and propagated through the environment is provided in [Appendix B](#).

Sonic Booms from Launches (Off-Base extent)

The original sonic boom modeling and information provided to Commission staff by DAF stated that sonic booms during launches would produce overpressures within a range of 1.0. to 5.0 psf. Based on the proposed southerly trajectory the footprint of the sonic booms during launches would only affect the Northern Channel Islands (Anacapa Island, San Miguel Island, Santa Cruz Island, and Santa Rosa Island). Originally, DAF recognized that although the modeling provided to Commission staff did not analyze other portions of the California coast outside of VSFB, certain unusual weather conditions could cause the sonic boom footprint to expand significantly to include other areas.

After publication of the staff report on March 28, 2024, for the April Commission meeting, however, a variety of public comments were received of observations that sonic booms were occurring much more frequently along the mainland coast during SpaceX launches and affecting areas far outside those identified in the initial modeling provided by DAF in its consistency determination and associated Supplemental Environmental Assessment. Multiple public comments submitted to the Commission for the April 10, 2024, hearing described experiencing sonic booms in Santa Barbara and Ventura County coastal communities and also inland Ventura County and western Los Angeles County, on the order of 100 miles from the launch site.

Although DAF publicly rejected these comments and stated that no such sonic booms could be generated during launches that would affect the mainland coast, it has more recently carried out additional modeling and field verification that confirms the public comments received before and during the April Commission meeting on the full extent of the sonic booms generated from launch activities at VSFB. On May 17, 2024, DAF provided Commission staff with initial estimates from the first of these recent modeling and field verification efforts. This was the first formal acknowledgement by DAF that sonic booms are indeed affecting Santa Barbara, Ventura and Los Angeles counties on a consistent basis and directly contradicts the information provided to the Commission at its April hearing and to Commission staff in the consistency determination. DAF has also continued to provide supplementary information to Commission staff following the Commission's April hearing that demonstrates the two most significant determinants of the spatial extent and magnitude of sonic booms from SpaceX launches are the rocket's trajectory and weather conditions.

⁶ Source: Haber, J. and D. Nakaki, 1989. Sonic Boom Damage to Conventional Structures, HSD-TR-89-001, April 1989

Additional sonic boom modeling (using PCBoom⁷ software) carried out by DAF with the atmospheric parameters of the central coast area provided the following results:

In eastern Santa Barbara County, 15% of the model runs resulted in sonic booms and approximately 50% of these were less than 0.25 psf, pounds per square foot (psf) which is similar to distant thunder. Approximately 32.7% of the modeled sonic booms were between 0.25 and 1 psf. The highest predicted overpressure level was 2.13 psf, and 0.3% of the modeled booms were above 2 psf.

In Ventura County, 97% of the model runs predicted sonic booms and approximately 65% were less than 0.25 psf. Approximately 25.9% of modeled sonic booms were between 0.25 psf and 0.50 psf while 7.2% were between 0.5 psf and 1 psf. Approximately 1.4% of modeled sonic booms were above 1 psf and 0.04% were above 2 psf. The highest modeled overpressure level was 2.03 psf.

In Los Angeles County, 94% of model runs resulted in sonic booms and approximately 95% were less than 0.25 psf. Approximately 4.1% of modeled sonic booms were between 0.25 and 0.50 psf and no modeled sonic booms were above 0.75 psf.

It should be noted that these percentages are based on a limited set of 125 model runs conducted⁸ along only four different trajectories with an average of approximately 31 runs each, using different atmospheric conditions for each trajectory. Atmospheric variables used as model inputs include elevation, air temperature, and wind vector, over profiles from ground level to ~115,000 feet at approximately 100-foot intervals). However the atmospheric data used in these modeling efforts comes from a 10-year dataset of approximately daily weather balloon radiosonde data from 1984 to 1994. It is unclear exactly what subset of historical atmospheric data was used to produce the figures provided by DAF shown in **Exhibits 3a, 3b, and 3c**, or how well the selected data represent the full range of historical atmospheric conditions experienced along the launch trajectories.

In other words, the results (impact percentages by county) cited above reflect a range of modeled conditions, but it is unclear how completely or accurately they reflect the range of actual launch conditions and potential overpressures produced during launches. These atmospheric condition inputs represent only approximately 1% of available daily atmospheric data from the past 10 years. A figure depicting the updated sonic boom

⁷ DAF has stated: “ PCBoom software, developed by the National Aeronautics and Space Administration (NASA), is a sophisticated tool that uses vehicle, trajectory, and atmospheric characteristics to calculate three-dimensional overpressure ray paths to predict sonic boom footprints and noise levels on the ground during supersonic vehicle flight. PCBoom, which was originally developed in the 1990’s and has been under continuous development and improvement since, has been used to predict sonic boom characteristics of space launch vehicles, including the Falcon 9, on VSBF for more than two decades. It is currently the only software approved by the Federal Aviation Administration to model sonic booms for a suite of aircraft and space launch vehicles.”

⁸ These 125 model runs are not necessarily representative of the conditions most likely to occur over a given year or time of year.

footprint (with psf levels predicted by model outputs over the 125 runs discussed above) for the areas along coastal Santa Barbara, Ventura and Los Angeles Counties is provided in **Exhibit 3a**⁹, but only show modeling results over the mainland areas of Santa Barbara, Ventura and Los Angeles Counties. **Exhibit 3b** shows the same set of model outputs, broken into several overpressure ranges, and includes model outputs over the Pacific Ocean and the northern Channel Islands. Additionally, **Exhibit 3c** shows the outputs of 8 individual model runs¹⁰.

DAF has provided the following explanatory information, as well as more information about how the models are run¹¹, to discuss the findings of their modeling efforts thus far:

The inputs that primarily drive the model results are the size, weight, and thrust of the vehicle and the trajectory (azimuth, vehicle path, vehicle elevation, and speed). Generally speaking, the larger, faster, and lower the vehicle is to the ground, and travelling more horizontally, will create larger booms on the earth's surface. When an ascending rocket produces a sonic boom that impacts the surface of the earth, the impact area occurs over a conical sonic boom "carpet" across the ground. Where those booms intersect the ground is dependent on the vehicle azimuth, path, and maneuvers. Typically, the highest overpressure levels are along the centerline of the flight path and the apex of the sonic boom carpet. As you move away from the centerline and towards the base of the carpet, the received noise levels generally decrease. Therefore, the trajectory (azimuth,

⁹ DAF explained: "Each data point is the estimated peak (aka maximum) overpressure level that PCBoom predicted would be received at that location from a single model run output (i.e., one possible scenario). [...] Figure 6 is showing the overlay of 125 model run outputs (each output is a conical shaped carpet of points) that were produced using 4 example Falcon 9 easterly trajectories. Each of the four trajectories was modeled (i.e. "run") between 29 and 34 times, each run with a different randomly selected meteorological profile that captured potential weather conditions throughout the year..."

¹⁰ Figures 1 through 8 depict examples of outputs for four Falcon 9 trajectories across a range of launch azimuths from 140 to 189, each under two example meteorological profiles to illustrate the potential variation due to weather conditions.

¹¹ DAF also stated: "PCBoom utilizes meteorological parameters in the model that affect where and at what level a sonic boom may impact the surface of the earth. In the late 1990's, SRS Technologies, Inc. assembled a series of daily meteorological profiles across 10 years (1984-1994, one per day for 10 years) from radiosonde data for weather balloons released by the VFSB Weather Squadron. These data include pressure, temperature, wind speed, and wind direction along an elevational profile from ground, every 1,000 feet (ft), to 110,000 ft. To assess the variability and range of potential sonic boom scenarios, meteorological profiles that correspond to a two-week window surrounding projected launch dates are randomly selected from the 10-year set of daily meteorological profiles and the same mission trajectory is run for each meteorological profile. Typically, around 25 to 35 meteorological profiles to give us a wide array distribution of historical meteorological data. The model produces a series of spatially referenced points that represent estimated peak (aka maximum) overpressure levels that would be received at each location for each model run output (i.e., each possible scenario under each meteorological profile). Note that the geographic impact locations generated by PCBoom are limited by the temporal resolution of the model output, which is calculated at 1 second intervals. This is resolved by producing contour lines from the point outputs, but some variability in predicted overpressure levels is lost in the process of contouring and therefore we prefer to use the point output format for the purposes of examining variability due to meteorological conditions."

flight path, and maneuvers) plays the largest role in determining where the boom intersects and what levels are received on the ground.

Trajectories that take the vehicle further East, launch azimuths from approximately 160 to 140 degrees, bring the sonic boom carpet closer to the California mainland coast and have the highest probability for impacts on the mainland. Even with identical trajectories, atmospheric conditions create considerable variation in where sonic booms impact and the level at which they impact.

In addition to working to improve the data being provided to the predictive computer models so that they more accurately reflect public observations and reports of sonic booms, DAF has also begun collecting field measurements¹² in select locations within the potential sonic boom footprint in order to verify and further improve the accuracy of the modeling. Field verification sites for two launches in June 2024 are shown on **Exhibit 4**. Regarding site selection for field measurements, DAF has explained:

The team utilized data from prior simulations on PCBoom to choose ideal locations for the [acoustic measurement devices], focusing on parks and open spaces within the Ventura/Oxnard region. These areas were selected to avoid noise contamination from loud roads, construction sites, interstate highways, and beaches, which could interfere with the data integrity. On average over 18 data collection spots were strategically distributed across both densely populated residential areas and quieter regions to encompass a wide range of environments, enhancing the representativeness of the data.

DAF has stated, after analyzing the results of field monitoring for two launches on June 18 and 23, 2024, that “Analysis of the measured data... when overlaid with simulation results from PCBoom, demonstrates that PCBoom's predictions are sufficiently close to real-world observations.” While it appears the early field verification efforts in May only included four monitoring locations, there were 19 and 28 monitoring locations used during the June 18 and 23, 2024, launches, respectively. However, the number of launches with these monitoring measurements are limited at this point and do not represent a very wide range of weather conditions. In addition, field verification methods, including for site selection, are still evolving. DAF noted that if atmospheric conditions at the time of a launch differ from the parameters entered in the updated modeling, there would be discrepancies between the projected and actual sonic boom footprint.

Between 2017 - 2021, VSFb supported an average of 4.4 rocket launches per year from all launch operators combined, with a maximum of 7 launches in both 2017 and 2018. The total launch frequency increased to 21 launches in 2022, and again to 36 launches

¹² DAF explained: [S]tations were set up several hours prior to the launch (T-0 time) and remained operational until approximately 45 minutes after the rocket had landed. This extensive data collection window not only captured the sonic boom events but also allowed for an adequate assessment of the average ambient noise levels. This approach was essential for isolating the sonic boom impacts from the background noise in subsequent analyses.

in 2023. Over the first seven months of 2024, so far, there have been a total of 23 SpaceX rocket launches from VSFb, putting it on pace to exceed 36 by the end of the year. The subject CD requests a launch cadence of up to 36 SpaceX launches per year. Even assuming a scenario in which all of the previously authorized launches from and landings at VSFb resulted in sonic booms within the same area of the coast as the project, the proposed increase in launch cadence represents an approximately eight-fold increase in the number of launches per year and resulting sonic booms as compared to the 2017 - 2021 period.

The areas within the range of off-base sonic boom effects from the proposed southern launch trajectories (140 degrees to 210 degrees) include the Santa Barbara Channel, the Gaviota Coast, dozens of marine mammal haul outs, several ecologically sensitive estuaries and lagoons, and over a hundred miles of coastline with sensitive dune habitats, seabird colonies and nesting areas, marine protected areas, state and national parks, rocky outcrops and reefs. Each of these locations is known to host or provide habitat for a number of sensitive species. Aside from these known biodiversity hotspots, any number of sensitive species may be migrating or inhabiting other portions of the coastline from Santa Barbara County down to northern Los Angeles County. Additional information and discussion on sonic booms from launches is provided below in Sections IV.C and IV.D, in the context of potential impacts to marine mammals and ESHA off-base.

Public Notification for Sonic Booms

To notify the public about when to expect sonic booms from launch and landing activities, DAF has recently implemented a system for members of the public to sign up for text or email “Launch Alerts”¹³ via the Vandenberg Space Force Base website¹⁴. DAF has also noted that SLD 30 will continue to make launch information available to the public by releasing launch information prior to each launch on their Vandenberg Space Force Base Instagram¹⁵ and Facebook social media accounts. In addition, SLD 30 Public Affairs also uses the “Air Force Connect” app (available for free) for push notifications before launches and DAF has note that users can download the app and “favorite” Vandenberg Space Force Base to receive push notifications about upcoming launches.

B. OTHER AGENCY APPROVALS

United States Fish and Wildlife Service

DAF has completed a formal consultation with the U.S. Fish and Wildlife Service (USFWS) for federally listed species protected under the federal Endangered Species Act that may be affected by the proposed project. The Biological Opinion issued by the USFWS, dated March 21, 2023, found that the proposed project “may affect but is not likely to adversely affect” marbled murrelet, southern sea otter, California condor, unarmored threespine stickleback and tidewater goby. The USFWS further found that

¹³ <https://public.govdelivery.com/accounts/USDODSFVANDENBERG/signup/41755>

¹⁴ <https://www.vandenberg.spaceforce.mil/>

¹⁵ @vandenberg_sfb

the proposed project is likely to adversely affect but would not likely jeopardize the continued existence of California red-legged frog, western snowy plover and California least tern. The USFWS made these determinations due to the protection and mitigation measures that DAF has agreed to implement. These protection and mitigation measures are provided in **Exhibit 9**. However, since the USFWS was not provided information on sonic booms occurring outside of VSFB and the Northern Channel Islands, the Biological Opinion issued did not analyze how sonic booms extending into Santa Barbara, Ventura, and western Los Angeles Counties might affect federally listed species. USFWS has subsequently been made aware of the geographical extent of off-base sonic booms from launches over the mainland areas of these counties and will consider that information in any future reviews of launch programs from VSFB.

National Marine Fisheries Service

DAF also consulted with the National Marine Fisheries Service (NMFS) regarding rocket and missile launches and aircraft operations at VSFB under the Marine Mammal Protection Act and received a Letter of Authorization (LOA) from NMFS in 2019. The LOA was valid for five years and allowed for up to 110 rocket launches annually across all launch facilities at VSFB. DAF indicates in its consistency determination that the proposed project falls within the scope of the activities covered by the LOA. Additionally, DAF has more recently consulted with the NMFS and completed Section 7 consultation. NMFS provided a Section 7 concurrence letter on January 20, 2023. On April 10, 2024, DAF received a new LOA superseding the previous LOA. The new LOA is set to expire on April 9, 2029. Since then, DAF has officially incorporated the new LOA into the DAF's consistency determination as of the expiration of the previous LOA and issuance of the new LOA and has stated: "There is no effect to the project scope submitted in the CD. SpaceX will continue to comply with the requirements of the current LOA". A copy of the new LOA is included in **Exhibit 10**. Like for the USFWS biological opinion, DAF's LOA application to NMFS did not include information on sonic booms occurring outside of VSFB and the Northern Channel Islands. As such, the NMFS 2024 rulemaking and LOA does not include an analysis of how sonic booms extending into coastal Santa Barbara, Ventura, and western Los Angeles Counties, might affect marine mammals in these areas.

Federal Aviation Administration

The Federal Aviation Administration (FAA) has a role in licensing commercial space launch operations and approving airspace closures for launch operations. FAA issues launch licenses that can cover multiple years of launches and can be amended to reflect changes in launch operations – including increases in cadence or revisions to safety protocols following a launch mishap. SpaceX has been launching Falcon 9 vehicles from SLC-4E under a launch license that was most recently modified on September 29, 2023. Based on discussions with FAA staff, it is Commission staff's understanding that the scope of activities authorized under this launch license are established by the associated document prepared by the U.S. Space Force (USSF) under the National Environmental Protection Act. In June of 2023, a Final Supplemental Environmental Assessment (SEA) was approved by FAA and USSF for an increase in

SpaceX launches from VSFB from 12 to 36 per year.¹⁶ As such, the launch license SpaceX received from FAA also covers this level of activity. However, it is unclear how the continuing lack of CZMA concurrence from the Commission for this activity and the absence of acknowledgement or evaluation in the SEA of the effects of launch-related sonic booms on the mainland coast of central and southern California may affect SpaceX's FAA license. In addition, it is also unclear how the recent failure of a SpaceX Falcon 9 launch from VSFB to successfully deploy its payload and ongoing FAA investigation may affect SpaceX's license. Commission staff is continuing to explore these questions with FAA directly.

Regional Water Quality Control Board

Wastewater discharges that may occur during project activities, including accumulated stormwater and non-stormwater discharges, would continue to be managed in accordance with the Regional Water Quality Control Board (RWQCB) letter for Enrollment in the General Waiver of Waste Discharge Requirements for SLC-4E Process Water Discharges.

Santa Barbara County Air Pollution Control District

The Santa Barbara County Air Pollution Control District (SBCAPCD) has locally adopted air emissions thresholds that are used to evaluate a project's impacts and applicable regulatory requirements under the District's rules and regulations. The project received two Authorities to Construct (ATC) on June 6, 2023, for the project's proposed increases in launch-related operations.

Tribal Outreach and Consultation

Pursuant to the National Historic Preservation Act and Section 106, DAF carried out government-to-government consultation with the Santa Ynez Band of Chumash Indians but did not receive an official response within the 30-day review period of CFR 800.3(c)4.

Consistent with the Commission's Tribal Consultation policy, Commission staff received a list of Tribes with potential cultural connections to the project area from the Native American Heritage Commission and completed outreach to those Tribes in March of 2024 after receipt of the DAF consistency determination. Consultation invitations were mailed to the Barbareño/Ventureño Band of Mission Indians, the Chumash Council of Bakersfield, the Coastal Band of the Chumash Nation, the Northern Chumash Tribal Council, the San Luis Obispo County Chumash Council, and the Santa Ynez Band of Chumash Indians.

Commission staff received a request for consultation from the Coastal Band of the Chumash Nation. Commission staff carried out this consultation with the Coastal Band of the Chumash Nation on Wednesday, March 27, 2024. Further discussion of this tribal

¹⁶https://www.faa.gov/space/environmental/nepa_docs/20230605_SpaceX_Falcon_9_VSFB_Cadence_Increase_FONSI_ROD.pdf

consultation and potential project effects on cultural resources is available below in the Cultural Resources section of this report.

After the project was continued and rescheduled for the June 12, 2024, Commission meeting, Commission staff completed additional outreach to Tribes. Tribes contacted in May of 2024, include the Barbareño/Ventureño Band of Mission Indians, the Coastal Band of the Chumash Nation, the Northern Chumash Tribal Council, and the Santa Ynez Band of Chumash Indians. As of the date of this staff report Commission staff have not received any requests for additional consultation from the Tribes.

C. COASTAL WATERS AND MARINE RESOURCES

Section 30230 of the Coastal Act states:

Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

Section 30231 of the Coastal Act states (in relevant part):

The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through...controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, [and] maintaining natural vegetation buffer areas that protect riparian habitats.

The proposed project has the potential to adversely impact marine resources, including the biological productivity of marine waters and marine areas and species of special biological significance such as marine protected areas, national marine sanctuaries, and marine mammal breeding and haul-out sites, due to marine debris and noise from rocket engines and sonic booms. The proposed project also has the potential to negatively affect water quality in Spring Canyon and the Pacific Ocean due to the use of deluge water during launch events and the ocean disposal of the rockets' fairing and weather balloons. The project will use existing infrastructure at Space Launch Complex 4 (SLC-4) so there is no potential for adverse impacts to water quality from construction activities. The proposed project has the potential to contribute to the depletion of groundwater supplies and interfere with surface water flow due to its water supply needs. Finally, the proposed project also has the potential to adversely affect marine resources due to artificial night lighting from rocket engines and illumination of the SpaceX launch complex.

Section 30230 of the Coastal Act requires areas and species of special biological significance to be provided with special protection. Section 30231 of the Coastal Act

requires development to maintain the biological productivity and quality of coastal waters and wetlands by various means including preventing depletion of ground water supplies.

Regional Context

VSFB is located in unincorporated Santa Barbara County and encompasses 42 miles of coastline and an area of nearly 100,000 acres. The western side of VSFB is bordered by the Pacific Ocean. The Channel Islands National Marine Sanctuary (CINMS) is located approximately 40 miles south of the SLC-4 launch complex and the coastline adjacent to VSFB from Purisima Point to south of Point Arguello has been designated the Vandenberg State Marine Reserve. The proposed Chumash National Marine Sanctuary would also fully extend across the waters offshore of VSFB.

There are approximately 14 marine mammal haul outs located along the VSFB coastline that are known to provide refuge for multiple species of pinnipeds including California sea lions (*Zalophus californianus*) and Pacific harbor seals (*Phoca vitulina*). More recently, increasing populations of northern elephant seals (*Mirounga angustirostris*) have been recorded at the haul outs. In addition to these species, the Channel Islands are known to support populations of northern fur seals (*Mirounga angustirostris*) and more rarely Guadalupe fur seals (*Arctocephalus townsendi*) and Stellar sea lions (*Eumetopias jubatus*). Southern sea otters (*Enhydra lutris*) occupy the nearshore ocean along the VSFB coastline and are often found within the kelp beds located at the southern end of VSFB.

The Vandenberg State Marine Reserve (SMR) includes coves, rocky reefs, undersea pinnacles and sandy seafloor areas. Vandenberg SMR contains a variety of fishes, invertebrates, seabirds, and marine mammals typical of northern and central California¹⁷. Beyond the boundaries of VSFB and the Channel Islands, the area of the California coast and Pacific Ocean within the area of the launch trajectory includes the Santa Barbara Channel, and the coastal zones of Santa Barbara County, Ventura County, and western Los Angeles County. The Santa Barbara Channel (Channel) is known as a region of remarkably high biodiversity of marine organisms including marine mammals, seabirds, fish, invertebrates, plankton and algae. This high biodiversity is in part a result of the Channel being a transition zone between the cold nutrient rich waters of the California Current and the warmer waters of southern California¹⁸.

Notable areas along the Santa Barbara County coastline include Point Conception, where the California coast makes a dramatic turn to the east, the largely uninhabited Gaviota coastline, Devereux slough, Carpinteria marsh, and the Carpinteria harbor seal rookery. The Ventura County coastline includes the Ventura river estuary, the Santa Clara river estuary, Ormond beach and lagoon, and Mugu lagoon, that are of global importance for over 270 migratory bird species, including five endangered species.

¹⁷ <https://wildlife.ca.gov/Conservation/Marine/MPAs/Vandenberg>

¹⁸ <https://sbclter.msi.ucsb.edu/about/>

Southern Ventura County and western Los Angeles County include miles of coastline with rocky outcrops and reefs.

Engine Noise and Sonic Booms

The proposed project has the potential to adversely affect marine biological resources through exposure of marine species and habitats to noise. Marine mammals are sensitive to sound and are often considered to be indicator species to understand noise impacts on the marine environment. Marine mammals that may be present in the nearshore environment, particularly those that spend time above the water line, include southern sea otters, sea lions, and seals.

The literature synthesis of effects of aircraft noise and sonic booms on domestic animals and wildlife (Manci et al. 1998)¹⁹ by the U.S. Fish and Wildlife Service National Ecology Research Center (from which background information on sonic booms was provided in [Appendix B](#), below) provides the following general information regarding the effects of elevated and sudden noise on pinnipeds:

A number of field, laboratory, and library investigations were undertaken between 1978-1980 to assess the potential for adverse effects on biological and physical resources of the Channel Islands resulting from intense sonic booms from launches of the space shuttle (proposed for southern California) (Jehl and Cooper 1980)²⁰. Low-flying helicopters, humans on foot, sonic booms, and loud boat noises were the most disturbing influences to pinnipeds. "Loud" sonic booms (80-89 dBA) elicited more startle reactions in animals than "soft" booms (72-79 dBA). Duration of startle responses to loud booms was shorter than to other disturbances. Among the pinnipeds, harbor seals (*Phoca vitulina*) were most likely to startle; no serious disturbance was recorded among northern elephant seals (*Mirounga angustirostris*). Historical data indicated that the [1998] level of disturbance on San Miguel Island does not measurably affect pinniped populations. Sonic booms from the space shuttle launches may increase the disturbance level by 10%-20%. Avoiding launches during the pupping season (March-July) was recommended to minimize disturbances. During this season, launches and returns during the noon hours should be avoided to prevent exposure of pups to heat. Temporary decreases in hearing sensitivity of marine mammals could occur following the few intense booms directly over the islands caused by launches of the space shuttle [...]. Jehl and Cooper (1980) recommended careful observation of behavioral effects of space shuttle booms on Channel Island marine mammals, coupled with long-term population monitoring.

¹⁹ Manci, K.M., D.N. Gladwin, R. Villella, and M.G. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: a literature synthesis. U.S. Fish and Wildl. Serv. National Ecology Research Center, Ft. Collins, CO. NERC-88/29. 88 pp.

²⁰ Jehl, J.R., and C.F. Cooper, eds. 1980. Potential effects of space shuttle booms on the biota and geology of the California Channel Islands: research reports. Center for Marine Studies, San Diego State University, San Diego, CA, Tech. Rep. 80-1. 246 pp.

On San Nicolas and San Miguel Islands in California, breeding elephant seals and sea lions were exposed to loud impulse noise created by a carbide pest control cannon to simulate actual sonic booms (Stewart 1982)²¹. Distances of seals from the sound source varied from 5-100 m. Sound pressure level was 145.5 dB(A), 146.9 dB(flat), 20 uPa at 5 m from the cannon and 115.6 dB(A), 125.7 dB(flat), at 50 m from the cannon. The intensity and duration of behavioral responses of each species varied by sex, age, and season. More male elephant seals (74%) reacted with alert behavior than females (65%); only 26% of the nursing pups reacted. Animals returned to normal activity within a few minutes and no habituation to the sound, movement, trampling of pups, or increase in threat displays were observed. Alert reaction from human intrusion lasted longer than reactions from simulated booms. During the nonbreeding season over 70% of the sea lions left the haul-out areas and went down to the surfline after a simulated boom. During the breeding season, 60%-95% of the females were alert for about a minute after a boom; few males reacted to the noise. No trampling of pups was observed and females moved less than 1 m from their pups.

Although this discussion provides a useful point of reference, it should be noted that the historic launch frequencies achieved from VSFB and discussed above in 1998 were significantly lower than those currently being carried out by SpaceX and considered in DAF's consistency determination. As such, past observations are useful for demonstrating the types of effects generated by single launches and noise exposure events – alert behavior, flushing into the water, decreases in hearing sensitivity - but cannot provide an accurate indication of long term or cumulative effects from the 36 launches, 36 engine tests and 12 landing events currently proposed by DAF. More recent monitoring carried out on VSFB, in particular that summarized in the annual reports from 2022 and 2023 when the number of SpaceX launches began to increase sharply, provides another useful reference as to the types of effects that can be expected within marine mammal habitat areas of special significance such as haul outs. Similar to historical reports, those from recent years demonstrate that flushing of animals into the water is a common occurrence immediately following exposure to launch noise, in particular for those haul out sites located within the areas exposed to the highest levels of noise from engines and/or sonic booms. Although animals have been shown to return to the haul out site and resume previous behavior within a short time, flushing into the water is disruptive to individual animals and the colony, energetically expensive, and carries a risk of injury, particularly to young and smaller animals that may be trampled. Young animals may also become separated from their mothers and suffer stress and injury as a result. The severity of these effects is heavily influenced by the frequency of disturbance. The more frequent the disturbance, the more substantial the effect or risk. Although very few studies have been carried out on the long-term effects to marine mammals and habitat areas of exposure to sonic booms,

²¹ Stewart, B.S. 1982. Studies on the pinnipeds of the southern California Channel Islands, 1980-1981. Hubbs-Sea World Res. Inst., San Diego, CA, Tech. Rep. No. 82-136. 117 pp.

engine noise or other elevated, short duration sounds, research into other sources of disturbance demonstrates that a threshold exists beyond which the animals and/or colony will abandon the area.

As noted in the report prepared by Commission staff in advance of the June Commission meeting, several known marine mammal haul out sites on VSFB have been abandoned in recent years. These abandonments have been attributed to other causes – primarily coastal erosion that may have limited the available beach areas – but only limited documentation of this has been provided. However, observations of these haul out abandonments appear to go back several years to when SpaceX was launching only once every several months and predate the recent increase in launch frequency.

Engine Noise and On-Base Sonic Booms

Engine noise generated by launches and landings at SLC-4 is described in the project description provided in Section IV.A, above. Each launch event generates in-air noise up to a maximum of 150 decibels (dB) for several minutes in the immediate area of the launch pad (**Exhibit 5**). This sound level would be generated during engine testing, rocket liftoff and boost-back landings. Based on modeling conducted by DAF, in-air noise levels directly off the coast where marine mammals could be located would be roughly 130 dB and would attenuate outward in all directions, reaching 100 dB up to 14.5 miles away. To the human ear, 120 dB would be as loud as a jet taking off, 110 dB would be as loud as amplified music at a concert, and 65 dB is the sound level of normal conversation. However, marine mammal hearing differs from human hearing in the frequencies they are receptive to and their sensitivity to loud sounds. Rocket landing would also create sonic booms in the range of one to five psf on VSFB, where there are several marine mammal haulouts.

Off-Base Sonic Booms

Off-base sonic booms are described in the project description provided in Section IV.A, above. Vehicle launches would also create sonic booms in the range of up to four psf at the northern Channel Islands, and in the range of up to approximately 2 psf along the off-base mainland areas of Santa Barbara, Ventura, and Los Angeles Counties (**Exhibit 3a and 3b**). There are dozens of known marine mammal haulout sites located over the Channel Islands and the mainland areas that experience sonic booms from launches, that may be adversely impacted by sudden noises and overpressures associated with these sonic booms.

Cumulative Noise Impacts

To help evaluate potential adverse impacts to marine mammal hearing from elevated sound, Southall et al. (2019)²², identifies threshold levels for various marine mammal species beyond which temporary threshold shifts (i.e. temporary hearing loss) would be

²² Southall, Brandon & Finneran, James & Reichmuth, Colleen & Nachtigall, Paul & Ketten, Darlene & Bowles, Ann & Ellison, William & Nowacek, Douglas & Tyack, Peter. (2019). Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals. 45. 125-232. 10.1578/AM.45.2.2019.125.

expected to occur. Although elevated, the sounds anticipated to be produced by the proposed project are expected to fall below these threshold levels. To confirm this and evaluate the levels of disturbance and behavioral response triggered by launch noise, DAF has conducted monitoring of pinniped (seal and sea lion) responses to launch activities and previously found that launch activities have not had any observable long-term consequences for the pinniped populations on VSFB or their use of habitat at and around VSFB. Specifically, the Supplemental Environmental Assessment (EA) prepared for the project found:

The USSF 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 there are generally no substantial behavioral disruptions or anything more than temporary effects to the number of pinnipeds hauled out on VSFB. Reactions between species are also different. For example, harbor seals and California sea lions tend to be more sensitive to disturbance than northern elephant seals. Normal behavior and numbers of hauled out pinnipeds typically return to normal within 24 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. As a result, the Proposed Action's potential impacts on MMPA-protected pinnipeds are expected to be limited to brief behavioral reactions.

Similarly, DAF has also monitored southern sea otters during launches to document their reaction to sound. According to that monitoring, no abnormal behavior, mortality, or injury effects have been previously documented from launch-related noise. According to DAF, one reason that pinnipeds and sea otters are not significantly affected by noise is because of their ability to dive under water when exposed to launch noise generated from launches at SLC-4. Since less sound is transmitted across the air-water interface, DAF has concluded that in-air sound would not physically damage or deafen pinnipeds and otters that are below the water surface. In summary, it is DAF's position that on-going monitoring indicates that past levels of launch activities have not resulted in injury or mortality to pinnipeds or sea otters in the project vicinity, but may result in short-term behavioral changes, such as movement away from on-land haul-out areas and/or increased diving. DAF has repeatedly stated that under past launch cadences, there has been no indication that behavioral responses have translated into longer-term changes in habitat use or population levels.

Monitoring and Reporting for Noise Impacts (Overall)

As stated by DAF in its CD, if the monitoring demonstrates that launch activity results in injury or mortality to marine mammals, DAF would report the incident to NMFS. NMFS previously issued a Letter of Authorization (LOA) dated April 10, 2019 (**Exhibit 11**). NMFS issued a new LOA on April 10, 2024. Since then, DAF has officially incorporated the new LOA (**Exhibit 10**) into its consistency determination in place of the previous one. DAF has stated: "There is no effect to the project scope submitted in the CD. SpaceX will continue to comply with the requirements of the current LOA." However, the new LOA conditions for mitigation, monitoring, and reporting requirements differ significantly from the LOA included in the CD submittal.

In the CD and as part of its consultation with NMFS on the LOA dated April 10, 2019, DAF committed to monitoring pinnipeds located on VSFB and the northern Channel Islands during all launches, including those proposed by SpaceX. The 2019 NMFS LOA required DAF to avoid launches that are predicted to produce a sonic boom over the northern Channel Islands during the harbor seal pupping season from March through June, whenever possible. The 2019 LOA required DAF to conduct launch-specific pinniped monitoring at southern VSFB haul out locations, as well as additional acoustic and biological monitoring at the Northern Channel Islands based on modeled sonic boom thresholds.

However, the 2024 NMFS LOA, no longer includes a requirement to conduct on-base marine mammal monitoring (and take acoustic measurements) during launches using the Falcon 9 at SLC-4 (such monitoring is now required only for specific instances of new, larger, or louder, rockets, or those launched from new facilities). The 2024 NMFS LOA also revised the launch scheduling and monitoring requirements for the northern Channel Islands (NCI).

While the 2024 NMFS LOA has, on the whole, significantly weakened the launch restrictions and marine mammal monitoring requirements contained in the prior LOA, it does include more specific requirements than the previous LOA to conduct semi-monthly surveys (two surveys per month) to monitor the abundance, distribution, and status of pinnipeds at VSFB, with data collection for species, number, general behavior, presence and number of pups, age class, gender, and any reactions to natural or human-caused disturbances, as well as environmental conditions, including visibility, air temperature, clouds, wind speed and direction, tides, and swell height and direction.

Monitoring and Reporting for On-Base Noise Impacts

To ensure consistency with Section 30230 and 30231 of the CCMP, the Commission is requiring **Condition 1** for DAF to continue its marine mammal monitoring program during launches, including monitoring of long-term habitat use and local species populations. More specific detail regarding the sub-parts of this condition are discussed below. Within 30 days of the Commission's consideration of this CD, DAF would be required to prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for VSFB focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

Part (a) of **Condition 1** would require DAF to continue monitoring pinnipeds at on-base haulouts during launches (with associated acoustic monitoring), consistent with the 2019 NMFS LOA (and as provided for in the minimization, monitoring, and avoidance measures, in the CD), while also incorporating the revised monitoring required by the new 2024 NMFS LOA (which has now been incorporated into the CD). The continued on-base monitoring consistent with the previous NMFS LOA, for which data has been collected for recent years with fewer launches, will allow for ongoing comparison of on-base marine mammal populations as the launch cadence increases.

An outstanding concern of Commission staff is that equipment failure has resulted in incomplete monitoring. Pre-launch modeling predicted that sonic booms could impact the northern Channel Islands as a result of two launches during the 2023 reporting period (June 22nd and July 7th). Equipment failure resulted in the inability to capture the intensity of the actual sonic boom during these events. Equipment failure also occurred during monitoring of southern sea otters on two occasions (April 2nd and 14th). As a result of those failures, no recordings of sea otters were obtained during the monitoring. Neither of the monitoring reports that documented equipment failure discussed how the loss of data could affect the analysis and conclusions drawn from monitoring. DAF stated the following in response to these concerns:

Acoustic recordings for two sonic booms that modeling predicted could impact the North Channel Islands were attempted. In one successful recording, the boom was lower than expected, and in the other, there was equipment failure, and the boom level could not be accurately assessed (Falcon 9 Starlink G5-13). Regardless, behavioral observations were performed during each event, and results indicated that this launch did not create abnormal disturbance and had no effect on our ability to accurately describe the post-launch behavior of the pinnipeds.

Given these concerns, to ensure consistency with Section 30230 and 30231 of the CCMP, the Commission is requiring part (a)(vi) of **Condition 1** for DAF to implement measures for equipment redundancy and data-handling improvements to help ensure further loss of monitoring data is avoided.

Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its enhanced biological monitoring program to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to relevant resource agency staff to discuss the monitoring results and conclusions. The annual reports would have initial conclusions, including those from the analyses detailed below for part (b) of the condition regarding potential effects to any monitored species and if adverse impacts to on-base species populations are identified from these conclusions.

If significant disruption or degradation of habitat values are identified from those conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of species population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF would be required to prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts. The proposal shall include some combination of operational changes (e.g., reduced launch/landing cadence, modified launch timing or trajectory), minimization (noise reduction measures) and meaningful mitigation (e.g., habitat enhancements). These conditioned requirements are particularly important to ensure consistency with Sections 30230 and 30231 of the CCMP given the uncertainty about how marine mammals will react to and

whether adverse impacts to these species will result from the proposed significant increased frequency of launch events.

Analysis for On-Base Noise Impacts

On May 17, 2024, Commission staff received from DAF the marine mammal monitoring results from the prior year (LOA annual report for 2023). At the time, these were the first and only monitoring results provided to Commission staff in support of DAF's statements and conclusions that no adverse impacts have occurred as a result of launch activities. On June 20, 2024, DAF submitted the LOA annual reports for the years of 2018 through 2022. Those reports included similar information to the 2023 LOA annual report, with varying degrees of launch numbers by year and observed behaviors of marine mammals during monitoring. Commission staff have reviewed DAF's marine mammal monitoring program (including the annual reports provided to NMFS for the years 2018-2023) and have outstanding concerns about the efficacy of the monitoring and the conclusions being drawn from it. Specific concerns with the pinniped monitoring program, as it has been conducted and reported in recent years, are that (1) there are limitations in the extent to which observations through monitoring (during and on either side of launches) can be affirmatively tied to noise impacts from an individual launch, (2) while there is abundant historical data for pinniped populations on VSFB, a rigorous statistical analysis of the changes in population trends using this data to analyze potential impacts from changes in launch activities has not been conducted nor has this on-site data been compared to historical data of pinniped populations nearby but outside the influence of launches and sonic booms, and (3) there are uncertainties about how more frequent noise events from the proposed increase in launch cadence might have unprecedented impacts on pinniped populations on-base. These three points are discussed with some specific examples below.

First, the monitoring reports consistently conclude that there are no impacts on pinnipeds from launch activities, despite observations showing pronounced behavior responses. The 2023 Annual Report provided to Commission staff includes video observations of 19 SpaceX Falcon 9 launches in 2023. The report concludes that there was no impact to harbor seals, California sea lions, or elephant seals from any of the launches. However, the report does not include a discussion as to why it determined no impact when on multiple occasions some or all of the harbor seals fled the beach during a launch and didn't return until some time after²³. Also, elephant seals routinely reacted with head lifts and in some instances erratic movement, but this reaction is not analyzed as a response to launches. In particular, during the surveys conducted for the April 2, 2023, launch, observers noted dead harbor seal pups that didn't exhibit any symptoms of emaciation. As such, it appears unlikely they were previously abandoned and died of starvation. The report documents harbor seals flushing during the launch when these dead seal pups were noted, so it is possible they were injured or killed during flushing. However, the report provides no in-depth analysis regarding the death of these pups.

²³ January 19, 2023 Starlink G2-4 launch; March 3, 2023 Starlink G2-7 launch; April 2, 2023 SDA-0A launch; April 27, 2023 Starlink G3-5 launch; May 10, 2023 Starlink G2-9 launch; May 20, 2023 Iridium OneWeb; July 7, 2023 Starlink G5-13; November 11, 2023 Transporter 9 launch; December 1, 2023 EROISat Launch.

Additionally, the report contains no substantial analysis of the potential for adverse impacts resulting from more frequent disturbance and behavioral responses (e.g., more frequent flushing) under the proposed higher launch cadence.

In response to these concerns raised by Commission staff, DAF has stated:

Nineteen rocket launches required monitoring in accordance with the LOA during CY 2023, and in several of the launch-specific events, it notes “Results indicate that there was no impact on pinnipeds by the launch”. The intention of this statement is to indicate that neither permanent nor long-lasting behavioral changes were attributed to launch-specific events. We acknowledge that this can be confusing as written. NMFS differentiates between Level A harassment (injury or death) and Level B harassment (minor disturbance to behavior). Level A is prohibited under our LOA. The report concluded that “...no abnormal behavior, injuries, or mortalities resulted from the launch of any rocket, landing of Falcon 9 first stages, and their associated sonic booms. In prior years, consistent results have been obtained showing no indications of significant disturbances, abnormal behavior, injury, or mortality as a result of launch or aircraft operations. Responses to launches, when they did occur, were short-lived and insignificant.” Elephant seals in only some reports lifted their heads, and with all species, animals resumed typical behavior shortly after launches, as they would if they, for example, encountered minor human presence or some other mild stressor.

In response to the dead harbor seal pups, 1 of these pups was observed deceased prior to launch and was noted 2 weeks prior outside of launch events and was therefore unrelated. The other harbor seal pups were assessed by NMFS-approved monitors and reported to NMFS via their Marine Mammal Health and Stranding Response Program. There was no evidence found suggesting that this death was attributable to the launch mission. While we cannot categorically state that there was no general impact from a launch, there is no indication that the deaths were caused by abandonment and may have been due to some other undetermined cause of death such as disease, etc. Harbor seal pup mortality at this time of year (Mar-April being breeding months) is not generally abnormal throughout their range. In California and abroad, estimates of naturally-occurring, first-year pup mortality used in population models can be 20% to upwards of 50-65% of all pups born. Total annual numbers of deceased pups on Vandenberg are in line with those found range-wide. It is also important to note that pup mortality is more often found on Vandenberg during launch-specific monitoring because that is when survey effort is highest (72 hours of consecutive personnel hours pre- and post-launch) and there are more opportunities to find deceased marine mammals during these efforts. On a larger scale, Vandenberg coastline is also affected by environmental abnormalities such as annual patterns of ocean warming or domoic acid outbreaks that directly tie into pinniped stranding numbers throughout California. Our stranding data often mirrors those found at rescue facilities (The Marine Mammal Center, pers comms) and is reported to NMFS to contribute to range-wide understanding of these oceanographic events.

While DAF has drawn specific conclusions about the lack of adverse impacts from noise during individual launches from launch-specific monitoring, continued monitoring by launch event remains critical component to observing behavioral trends of pinnipeds during launches and for identifying direct impacts to marine mammals if they are conclusively captured by the monitoring. Furthermore, the uncertainty around the potential significant adverse cumulative impacts (e.g., regarding pup survival, breeding success, site abandonment, etc.) of increasing launch and sonic boom frequency is an important reason for on-going monitoring. Second, Commission Staff has concerns that the monitoring lacks any kind of rigorous statistical analysis of the changes in population trends and other indicators using the historic data that DAF has been collecting for decades. For example, the LOA annual report for 2023 identifies that the number of harbor seals using haul outs on VSFB is declining and that several haul outs have been abandoned entirely (although those haul-out abandonments have been attributed to erosion of bluffs and landslides reductions in beach width). The report anecdotally ascribes this change in haulout usage to several possible factors including predation risk from coyotes, increase in white shark (*Carcharodon carcharias*) predation, and increasing numbers of elephant seals in the region. Based on Commission staff's review of the monthly monitoring data included in the 2018-2023 LOA annual reports, there was some indication of a general decrease in peak pacific harbor seal and northern elephant seal population counts observed at haul outs base-wide, corresponding to a marked increase in SpaceX launch frequency (from an average of 2.75 launches per year in 2018-2021, to 13 launches to 28 launches in 2023). For California sea lions, there was a sharp decrease in peak population counts base-wide between 2019 and 2020, however that was before the rapid increases in launch frequency and the populations observed in 2018 and 2019 may be outliers.

A comprehensive statistical analysis that considers physical (oceanographic conditions, climate, storms, beach width, etc.), biological (population size, population location, behavior, etc.), temporal (frequency and time between launch events for species to recover, seasonal timing of launches and sensitive times of the year such as pupping), and anthropogenic (launches) variables that would be required to more accurately evaluate the likely causes of population trends was not included or completed. While such a multivariate statistical analysis for changes in population trends has not yet been conducted, those historical data sets are a valuable resource to conduct such analyses. In addition, comparing the historical data of on-base pinniped populations to historical data of nearby off-base pinniped populations, outside the influence of launches and sonic booms, would contribute to the evaluation of likely causes behind population trends. As discussed previously, DAF has been monitoring marine mammals for decades and a thorough multivariate statistical analysis could allow for a more comprehensive evaluation of launch activities and their effects.

In response to these concerns raised by Commission staff, DAF has stated:

A multivariate statistical analysis has never been requested by NOAA/NMFS or the CCC. Within the LOA report, trends regarding monthly haul-out patterns are noted. Terms such as "significant variation" in animals observed or site changes were used in the colloquial sense, however, we are exploring future statistical

analyses for population-level monitoring. We have starting to investigate using integrated population models that can tie in variables such as oceanographic conditions or pupping rates to assess our abundance metrics with reasonable accuracy.

Monitoring of pinnipeds during individual launch events has been conducted historically at VSFB, in addition to monthly counts, by species, at known haul outs. The 2024 NMFS LOA would require similar counts twice a month. These historical and ongoing data sets are valuable resources for conducting statistical analyses as part of an enhanced monitoring program.

Third, Commission Staff has concerns about the potential for adverse effects from the increase in launch cadence. Between 2017 - 2021, VSFB averaged approximately 4.4 launches per year from all launch operators combined, with an increase to 21 and 36 launches in 2022 and 2023, respectively. Of these, SpaceX rockets accounted for 13 and 28 launches in 2022 and 2023, respectively. So far in 2024, there have been a total of 23 SpaceX rocket launches. The proposed project requests an increase of SpaceX launches to 36 launches per year, which is an approximately eight-fold increase over the 2017 – 2021 baseline of total launches (all operators) at VSFB. The proposed 36 SpaceX launches would continue the accelerated launch cadence beyond the past two years of more frequent launches; this increase would be effective immediately. Under a more controlled and cautious scenario, such a significant increase in launch cadence would be spread out over a longer period of time with defined, stepwise increases in cadence along with thorough monitoring and evaluation to assess adverse impacts, including those that may emerge over time from the accumulation of individual behavioral disturbances (e.g., flushing) occurring in response to more frequent launches. At a minimum, this approach would provide sensitive species in the area a greater opportunity to adjust to the increase in launches. Crucially, this more measured approach could also be structured to provide sufficient time for monitoring to assess how species are reacting to the increase in disturbance and whether the increase is resulting in any significant adverse impacts. If significant impacts are detected, project changes and/or mitigation measures could be implemented and analyzed to determine whether they are effective, before continuing to increase the cadence.

When asked by Commission staff why a more cautious and measured increase in launch cadence is not feasible, DAF stated:

Launch rate has been increasing gradually over time at VSFB. SpaceX launched one time in 2020, three times in 2021, 13 times in 2022, and 28 times in 2023. This escalation in launch frequency is driven by the contracted manifest. Additionally, SpaceX's rideshare missions containing multiple payloads in a single launch have reduced the total number of launches that otherwise would be required for dedicated small satellite missions.

Given the concerns and uncertainty discussed above, it is possible that marine mammal monitoring is not effectively recording and analyzing potential adverse impacts to marine mammals without an enhanced biological monitoring program, including the use

of statistical analyses. It may be necessary to collect multiple years of monitoring data at a given launch cadence in order to adequately assess the effects of launch noise and sonic booms over time, while accounting for natural variability. In order for the Commission to thoroughly analyze potential adverse impacts and determine the consistency of the proposed activity with the relevant policies of the CCMP, DAF should continue monitoring for noise impacts to marine mammals, with improvements, as discussed above. However, additional analyses should be conducted by DAF and provided as part of annual reporting to corroborate DAF's conclusions that launch activities have not adversely affected marine mammals or their sensitive haul out areas on VSFB, the northern Channel Islands, or the off-base areas of Santa Barbara, Ventura, and Los Angeles, Counties.

Therefore, To ensure consistency with Sections 30230 and 30231 of the CCMP, Commission staff recommends requiring Part (b) of **Condition 1** to require DAF to conduct multivariate statistical analyses of the changes in population trends using: (a) relevant historical population data; (b) frequency of launches and on-base boost-back landings over different time scales; (c) seasonality of launches and sensitive times of year for respective species; (d) geospatial variability; (e) off-base reference site data; (f) climatic and oceanographic patterns (e.g. El Niño, Pacific Decadal Oscillation, storms, ocean temperature); (g) acoustic monitoring data; (h) and patterns of other variables including (as relevant to the respective species), but not limited to, pupping rates, beach width, behavior during launches, and forage base or food web trends. Relevant population trends for these analyses include population sizes and locations. These analyses would also require identification of data and ongoing monitoring and, if necessary, establishment, of off-base reference site populations of marine mammals, as required in Part (a)(v) of **Condition 1**. Additionally, the reporting requirements in Part (c) of **Condition 1**, as described above, would include any initial conclusions from these statistical analyses and avoidance, minimization and mitigation measures, if significant disruption or degradation of habitat values are identified.

While monitoring and data analysis conducted by DAF to-date have not definitively demonstrated adverse impacts during similar launches over the past roughly 20 years of monitoring marine mammal populations along the shoreline of VSFB, it is important that historical data be analyzed more thoroughly along with ongoing monitoring. However, it is also true that until very recently, the total number of launches occurring at VSFB was low, and that a lack of observed impacts under a low launch cadence may not be predictive of the effects of the current/proposed higher launch cadence, especially over time. Thus, the continued, improved monitoring and additional statistical analyses required of DAF in the preparation of an enhanced biological monitoring program will be critical in determining if the more frequent noise effects of the proposed increase in launch cadence from SLC-4 would avoid adverse impacts to pinnipeds using haulouts on VSFB. If impacts are identified, mitigation would be required to be implemented. Therefore, the Commission finds that, with the requirements in **Condition 1**, the on-base impacts of engine noise and sonic booms from the proposed project would not adversely affect the biological productivity of coastal waters or adversely affect marine mammal species of special biological significance.

Minimization of and Monitoring for Off-Base Sonic Booms Impacts from Launches

There are dozens of known pinniped haulout sites located across Channel Islands National Park and the mainland areas exposed to sonic booms from launches. Rookeries and haulout sites are commonly in isolated locations relatively free from land predators and frequent harassment by humans, and are essential areas for pinnipeds for reproduction and rest.²⁴ Haulouts are therefore considered by the Commission to be areas of special biological significance under Section 30230 of the CCMP. These areas may be adversely affected by sudden noises and overpressures associated with sonic booms. Given the presence of these sensitive species and the uncertainties in the extent and severity of regional effects of off-base sonic booms from launches (see Section IV.A, above), as well as uncertainty associated with how marine mammals experience sonic booms and the degree to which they may be affected over time under an increased launch frequency, the proposed project raises concerns that sound and pressure waves generated by sonic booms could adversely affect pinniped habitat on the Channel Islands and mainland coast. This would be inconsistent with the requirements of Section 30230 of the CCMP that areas and species of special biological significance be provided with special protection and marine resources be protected and enhanced.

As discussed above in the general information regarding the effects of elevated and sudden noise on pinnipeds from (Manci et al. 1998), sonic booms may result in startle or flushing (towards the surfline) reactions by pinnipeds at haulouts and potentially temporary decreases in hearing sensitivity of marine mammals. Additional information from that literary synthesis is included below in Section IV.D, in a sub-section providing general information regarding noise and wildlife. While that information is discussed below in the context of ESHA, it also applies to the potential for noise and pressure waves to adversely affect the biological productivity of coastal waters, streams, wetlands, and estuaries because they can lead to impacts to wildlife that inhabit these areas, including direct physical auditory changes and other stress, behavioral, and reproductive changes, that may cumulatively result in adverse impacts to species at a population or habitat scale. Through those potentially wide-ranging adverse effects, strong sonic booms that may cause these impacts would therefore be inconsistent with the requirements of Section 30231 of the CCMP.

Given the uncertainties related to off-base sonic booms from launches and to ensure consistency with Sections 30230 and 30231 of the CCMP, the Commission is requiring **Condition 2**, which would require DAF to submit and implement a Sonic Boom Minimization Plan for limiting the spatial extent and severity (in terms of overpressure levels) of sonic booms caused by launches. Within 30 days of the Commission's consideration of this CD, DAF would be required to submit the plan for Executive Director review and comment. The plan would be required to include measures for evaluating modeling for specific atmospheric conditions to anticipate sonic boom effects on the Northern Channel Islands and off-base areas of the mainland coast of Santa Barbara, Ventura, and Los Angeles Counties, and measures for making decisions on launch time and trajectory based on an analysis to minimize the spatial extent and

²⁴ <https://montereybay.noaa.gov/sitechar/mamm2.html>

severity of sonic booms experienced in those off-base areas. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the Sonic Boom Minimization Plan and/or written responses as to why such modifications are infeasible.

DAF has explained that for modeling expected sonic booms prior to launches, “[m]eteorological profiles from prior years are sampled from a two-week period surrounding the launch date to characterize potential variability in atmospheric conditions on the launch date.”²⁵ The atmospheric data to be used for pre-launch modeling would come from the same 10-year (1984 - 1994) dataset of daily weather balloon radiosonde readings discussed for the modeling efforts described in Section IV.A. DAF also has stated:

The SLD 30 Commander and USSF staff will continue to assess launches with predicted impact zones that affect the mainland coast of California and with predictions of 1.0psf levels or higher. The requirements of the specific mission and its value to the Government will be weighed when making determinations for launch approvals. Each mission will be managed on a case-by-case basis.

Current policies put in place will persist unless the USSF determines a need that requires a change. If the USSF determines that circumstances require a change, the USSF will engage the CCC to discuss the change.

DAF has further explained this policy on the basis that:

... current data has shown that the predicted probabilities [of overpressures exceeding 1.0 psf along the mainland coast] are a worst-case scenario. All real time data collected for this effort has been below 1.0 psf even when the model predictions show the potential for higher.

However, DAF also states that under its current policies, “it cannot be definitively stated that launches with a prediction to affect the mainland coast of California with over 1.0 psf rating will be avoided with or without Government priority but will be considered on a case-by-case basis”. Given the relatively limited sonic boom modeling and ground-truthing that has been completed thus far (and including the caveat, discussed above in Section IV.A, that the current model results provided to Commission staff may not be representative of the full range of atmospheric conditions, times of year, and potential launch trajectories and characteristics), and DAF’s refusal to commit to an objective threshold (e.g., 1.0 psf predicted overpressure) for making launch approval decisions, the potential for strong sonic booms (> 1.0 psf overpressure) occurring along the mainland coast and over the northern Channel Islands would persist. This indicates the need for further detail and clarification of the protections/avoidance and minimization

²⁵ DAF also noted: “Note this is not the same as “predicting” the atmospheric conditions on launch date. The goal is to produce a range of potential boom footprints based on the variability of the meteorological conditions.”

measures DAF would implement. This detail and clarification would best be provided through the Sonic Boom Minimization Plan called for in Condition 2.

Further, to ensure consistency with Sections 30230 and 30231 of the CCMP, Commission is requiring **Condition 3** to require that if implementation of the Sonic Boom Minimization Plan would not result in avoidance of sonic boom effects on the Northern Channel Islands and off-base areas of the coastal zone in mainland Santa Barbara, Ventura, and Los Angeles Counties, DAF would be required to prepare and provide for Executive Director review and comment, an Acoustic and Biological Monitoring Program for affected coastal areas outside of Vandenberg Space Force Base. That plan would be required to include: (a) monitoring that quantifies species response to sonic booms, including in areas of special biological significance, such as marine mammal haulout sites, which could be affected by sonic booms; and (b) acoustic monitoring at those sites during launches to measure received sonic boom overpressure levels. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the Acoustic and Biological Monitoring Program (prepared pursuant to the requirements in **Condition 1**) and/or written responses as to why such modifications are infeasible. DAF would be required to implement this off-base monitoring as part of the Acoustic and Biological Monitoring Program.

This requirement for an expanded monitoring program would provide additional assurance that launches that do proceed with minimized sonic booms would still prevent the off-base adverse impacts to marine mammal species discussed above and provide protection for the areas and species of special biological significance, consistent with Sections 30230 and 30231 of the CCMP.

Conclusion for Impacts from Engine Noise and Sonic Booms

From the information provided by DAF on the potential effects of engine noise on nearshore marine mammals, there is an absence of data or analyses definitively demonstrating a positive or negative finding of adverse impacts during similar launches over the past roughly 20 years of monitoring marine mammal populations along the shoreline of VSF. However, given the potential for impacts as a result of the proposed increase in launch cadence from SLC-4, DAF would be required to continue monitoring of marine mammals in the areas affected by noise generated from launches and landings. DAF would also be required to implement improvements to the monitoring program as part of the proposed project, with additional statistical analyses to be conducted moving forward. DAF would also be required to work with NMFS and the Executive Director to address any unexpected impacts on marine mammals. Therefore, the Commission finds that, with the requirements in **Conditions 1 (On-Base Biological Monitoring Program), 2 (Off-Base Sonic Boom Minimization Measures), and 3 (Off-Base Acoustic and Biological Monitoring)**, engine noise and sonic booms from the proposed project (including up to 36 SpaceX launches per year) would not adversely affect the biological productivity of coastal waters or adversely affect marine mammal species of special biological significance.

Launch Operations At SLC-4

Launching operations at SLC-4, as described in the project description above, include deluge water, steam, and flames, and associated vegetation management. These project aspects have the potential to impact water quality, water supply, and wetlands, and are discussed in more detail below.

Water Quality

VSFB is divided into northern and southern halves by the Santa Ynez River. The two launch facilities (SLC-4E and SLC-4W) where SpaceX would be operating are located on South VSFB (**Exhibit 1**). Major drainages in the area of South VSFB include Bear Creek, Cañada Honda Creek, and Jalama Creek. There are also several unnamed minor drainages with intermittent ephemeral streams. All of these creeks and streams flow west and ultimately release into the Pacific Ocean. The two most proximal water bodies to SLC-4E and SLC-4W are Spring Canyon and the Pacific Ocean (**Exhibit 2**). Spring Canyon, which contains a seasonal, ephemeral stream, is located immediately adjacent to the southern perimeter of SLC-4E and SLC-4W, while the Pacific Ocean is approximately 0.5 miles to the west. The project would make use of existing launch and landing facilities and no new construction is proposed. However, the proposed rocket launches and daily operations have the potential to result in release of sediment and various contaminants which could eventually migrate to the aforementioned water systems.

The DAF's water quality analysis in its CD submittal focused on potential water quality effects from launch operations. The DAF concluded that:

Launch activities at SLC-4 would create exhaust clouds; however, Falcon does not use solid fuels. Wastewater discharges that may occur during project activities, including accumulated stormwater and non-stormwater discharges, would continue to be managed in accordance with the Regional Water Quality Control Board (RWQCB) letter for Enrollment in the General Waiver of Waste Discharge Requirements for SLC-4E Process Water Discharges. After a launch, approximately 9,000 gallons of deluge water per Falcon 9 launch would remain in the existing retention basin after evaporation. Samples of the deluge water would be collected and analyzed. If the water is clean enough to go to grade, it would be discharged from the retention basin via the spray field. Currently, the water can be discharged to grade via the spray field approximately 90-95% of the time. It would then percolate into the groundwater system and flow down gradient into Spring Canyon. Therefore, impacts to surface water from launch operations under the Proposed Action would not be significant.

Commercial space companies are independently responsible for compliance with provisions of the Clean Water Act and its requirements for development of site-specific Spill Prevention, Contingency, and Countermeasures (SPCC) plan under 40 C.F.R. 112. Inspection and enforcement of each SPCC and any permitted tanks are delegated to the Santa Barbara County Certified Unified Programs Agency. The SPCC requirements for commercial space companies do not fall

under the jurisdiction of SLD 30. SpaceX maintains and operates under an SPCC with Santa Barbara County CUPA. Under 40 C.F.R. 112, the SPCC includes elements that the Commission considers critical for these plans, including: an oil spill risk and worst-case scenario spill assessment, response capability analysis of the equipment, personnel, and strategies (both on-site and under contract) capable of responding to a worst-case spill, including alternative response technologies, oil spill preparedness training and drills, and evidence of financial responsibility demonstrating capability to pay for costs and damages from a worst-case spill. SpaceX's secondary containment is sized to capture all materials contained within any tanks present and the SPCC includes the necessary specifications on the spill response supplies needed at the site during operations.

The propellant for the Falcon 9 rocket would not include any solid fuels and would instead use liquid fuels consisting of rocket grade kerosene (RP-1) and liquid oxygen. Combustion of solid fuels release greater amounts of reactive chemicals and other pollutants compared to liquid fuels. Also, the Falcon 9 rocket would use oxidizer-rich staged combustion engines that produce a diminutive amount of soot. After ignition, a deluge of water would be flooded onto the launch pad. The purpose of this deluge of water is to absorb or deflect the high levels of acoustic energy that are released as the rocket lifts off and avoid damage to the vehicle and payload. The exhaust cloud comprised of combusted fuel and water from the deluge would largely consist of steam with insignificant amounts of hazardous materials due to the oxidizer-rich staged combustion engines. Any deluge water that is not converted into steam would remain in the retention basin and would only be discharged after it meets the required certifications. As such, the launching of the Falcon 9 rocket would not result in adverse impacts to surface water quality.

Water Supply

Water use for SpaceX launches would include water for personnel and operational activities as well as deluge water for the launches, as discussed above. At the full proposed cadence of up to 36 launches per year, the annual amount of deluge water needed for SpaceX operations would be up to 7.2 million gallons. However, DAF reports that SpaceX has, over time, greatly reduced the amount of water needed for launch activities:

Since the original project's implementation, SpaceX has reduced the amount of water needed in the flame duct per launch from 200,000 gallons to 70,000 gallons. In November 2022, SpaceX also replaced the former deluge water system with a closed loop system for cooling water that eliminates the need to utilize launch pad water for cooling.

By incorporating this closed loop system, the total annual requirement of water for the deluge system is reduced by 65 percent to 2.52 million gallons. In addition, up to 2.1 million gallons annually would be required to support the personnel and operational activities at the launch complex. The total maximum water supply need for the SpaceX

launches is up to 4.28 million gallons annually, which is roughly the equivalent water use of twenty-three American households annually.

Section 30231 of the Coastal Act states that proposed projects should prevent depletion of groundwater supplies and prevent substantial interference with surface water flow. The water supply for VSFB includes four wells in the San Antonio Creek Valley Groundwater Basin. According to the 2022 Annual Report for the San Antonio Basin Groundwater Sustainability Agency (SAGSA), VSFB used up to 2,600 acre-feet of water in 2022. The majority of water users of the groundwater basin are agricultural. SAGSA found that the cumulative levels of groundwater storage in the San Antonio Creek Valley Groundwater Basin have decreased by 147,700 acre-feet between 2015 and 2022. Overall, San Antonio Basin Groundwater Sustainability Agency states:

Current basin conditions, comparison of current and historical groundwater elevation contour maps, and the basin historical water budget presented in the [Groundwater Sustainability Plan], indicate groundwater pumping in excess of the sustainable yield has created challenging conditions for sustainable management.

However, DAF has indicated in its consistency determination that the proposed project would not increase DAF pumping or water use from the San Antonio Creek Valley Groundwater Basin and is within the normal fluctuation of water demand at VSFB. This is due to the low water needs of the project, estimated to be approximately 0.7% of total base-wide water use. In its consistency determination, DAF states:

The Proposed Action's water usage would therefore be negligible and not result in any measurable impacts to flow rates, hydration periods, or water levels in San Antonio Creek and not contribute in any measurable way to the collective effects of water extraction requirements for all VSFB operations.

In essence, DAF has concluded that the impacts to surface water in San Antonio Creek as a result of SpaceX launches would not be significant.

Wetlands

A water deluge of the launch area during Falcon 9 launches is carried out to reduce the potential for damage from vibration during liftoff. SLC-4E currently has a civil water diversion structure to help capture and divert any water from this deluge that could potentially flow overland and into Spring Canyon. However, even with this diversion structure, approximately 25,000 gallons of steam could reach Spring Canyon during each launch event. As discussed above, any water discharged into Spring Canon would meet the water quality thresholds identified by the California State Water Resource Control Board (SWRCB) in the statewide low threat discharge to surface waters permit.

The hydrology of Spring Canyon is described by DAF as follows:

Spring Canyon Creek originates approximately 1.4 miles inland and flows toward the Pacific Ocean. Lower Spring Canyon is an ephemeral creek that occasionally

has intermittent standing water upstream from Surf Road. Surface flow percolates into the groundwater to pass beneath road embankments and eventually enters the Pacific Ocean (USAF, 1987) ... the physical connectivity in Spring Canyon is blocked at Coast Road.

Vegetation types within Spring Canyon consist of: Central Coast Arroyo Willow Riparian Forest and Scrub; non-native trees such as Tasmanian bluegum eucalyptus (*Eucalyptus globulus*) which is a documented monarch butterfly roost; maritime chaparral with chamise (*Adenostoma fasciculatum*), La Purisima manzanita (*Arctostaphylos purissima*), and Santa Barbara mountain lilac (*Ceanothus impressus*); central coastal scrub; and invasive non-native plant cover.

Bird species within Spring Canyon consist of common species such as finch (*Carpodacus mexicanus*) and Brewer's blackbird (*Euphagus cyanocephalus*). No special status bird or reptile species have been documented in Spring Canyon. Spring Canyon may contain upland habitat for amphibians. However, due to the ephemeral nature of the drainage and lack of standing water during most years, Spring Canyon is considered only marginal habitat for the California red-legged frog.

In order to avoid and minimize adverse impacts to nesting migratory birds within Spring Canyon from hot steam produced as a result of the deluge curtain, SpaceX would remove all vegetation within a 3.3-acre area consisting of arroyo willow riparian habitat **Exhibit 12**. Since Spring Canyon is a relatively short, 1.4-mile, ephemeral creek with intermittent flows and standing water, and the area of the vegetation removal is outside of the creek corridor and would consist of arroyo willow riparian habitat that does not host any sensitive or listed species, the area of the vegetation removal does not meet the definition of ESHA pursuant to 30107.5. However, arroyo willow riparian vegetation is wetland vegetation - one of the parameters indicative of wetland habitats - and as such, the area of arroyo willow riparian vegetation constitutes coastal wetlands.

Removal of the vegetation would be performed by mowers and hand equipment prior to nesting bird season, and attempts would be made to reduce impacts to the drainage as much as possible. Additional vegetation removal (e.g., mowing) of the impact area would be performed outside of nesting bird season (15 February to 15 August) annually as needed to maintain low stature vegetation. Vegetation removal would result in an estimated 1.121 acres of permanent impacts to arroyo willow habitat. The vegetation clearance within this area would not maintain optimum populations of wetland species consistent with 30231.

During the course of Commission staff's review of this CD, DAF staff noted that vegetation clearance in this area has occurred at least as far back as 2010 and that it was their understanding that this activity was considered by the Commission in negative determination (ND) No. ND-055-10. However, in the concurrence letter associated with that ND the vegetation clearance activities were described as extending approximately 30 feet beyond the perimeter of the facility. At present, and as described in the subject CD, however, vegetation clearance extends approximately 300 - 450 feet beyond the perimeter of the facility and into wetland habitat.

Several other agencies also appear not to have been initially aware of this expanded vegetation clearance activity, and in December 2017, the Regional Water Quality Control Board (RWQCB) provided after-the-fact authorization to SpaceX for it. Additionally, DAF chose to prepare and implement a wetland habitat restoration and monitoring effort. This wetland habitat enhancement has been occurring at a nearby location within Spring Canyon on VSFB at a ratio of 2:1 (2.6 acres restored:1.1 acres impacted).

However, the Commission has historically required mitigation for adverse impacts to wetlands at ratios greater than 2:1, particularly in cases where mitigation consists of the enhancement of existing habitats rather than the creation of new wetlands. In the present case, the current wetland enhancement at a 2:1 ratio, pursuant to the RWQCB and USFWS approved plan, appears insufficient to compensate for the loss of wetland habitat associated with the vegetation removal. Commission staff raised the issue of the increased vegetation management with DAF.

In response, DAF provided additional information questioning the area's identification as a wetland (essentially stating that while the area supports arroyo willow vegetation, this wetland vegetation is mixed with upland vegetation and may not be present in sufficient quantity/percent coverage to qualify as a wetland under the Commission's regulations, title 14 CCR section 13577(b)(1), which requires a showing that an area consists of "predominantly hydrophytic cover"). DAF also clarified that despite its position that the area does not appear to be a wetland, DAF nevertheless developed and implemented an approximately two-acre wetland habitat enhancement project in 2017 within the Spring Canyon watershed to offset the mowing of approximately an acre of vegetation at a ratio of 2:1 (area of habitat enhanced: area of vegetation management). Although the habitat enhancement effort was focused on an area of wetland, the corresponding area of vegetation management included a mix of arroyo willow (a wetland plant species) and upland plant species. A formal wetland delineation was not carried out to determine if the percent coverage of arroyo willow was sufficient for some or all of the area to be identified as a wetland under the Commission's regulations. As such, it's unclear if and how much wetland habitat under the Commission's regulations may have been present in the area of vegetation management.

Prior to its implementation, the DAF wetland enhancement project was considered and approved by staff of the Central Coast Regional Water Quality Control Board and U.S. Fish and Wildlife Service as adequate to address the removal of arroyo willow and upland vegetation within the area exposed to steam during launch activities. However, because no wetland delineation was carried out at the area prior to the vegetation removal activities that began roughly seven years ago, and DAF is contesting that the area currently supports wetland habitat, sufficient evidence is not currently available to indicate that the measures previously taken to offset the vegetation removal through over two acres of wetland habitat enhancement efforts provide sufficient mitigation for the adverse impacts to coastal wetlands.

However, DAF and Commission staff are continuing to evaluate the situation and working to determine if and how much wetland habitat is within the vegetation

management area. These efforts include the collection and evaluation of information from 2017 and now about the plant species present and their relative percent coverage. Given the mixed presence of both upland plants and wetland plants within the vegetation management area, including areas fully dominated by upland plants, if wetland habitat is indeed present, it would be likely be substantially less than one acre, meaning that the ongoing DAF wetland enhancement project would be providing wetland mitigation at a ratio of greater than 2:1 already.

Marine Debris

Several elements of the proposed project could result in the release of marine debris. These include the release and eventual abandonment into the ocean of weather balloons and atmospheric monitoring equipment called radiosondes (**Exhibit 7**), parafoils from payload fairings, and potential mishaps during a launch that lead to some or all of the rocket falling into the ocean, and the intentional abandonment into the ocean of the rocket first stage and fairings. It should be noted, however, that SpaceX has not had any mishaps during any of its Falcon 9 launches from VSBF since it began launch operations at the base.

Prior to launches, SpaceX would release approximately six to ten weather balloons to monitor upper atmosphere wind conditions. Attached to the latex weather balloon would be a plastic-encased electronic device to measure atmospheric data and transmit it by radio to a ground receiver. The device is roughly the size of a shoe box and is powered by a 9-volt lithium ion battery. Upon reaching an altitude of 12-19 miles above sea-level and providing the necessary data, the balloon would pop due to the reduction in atmospheric pressure. The likelihood of recovering the weather balloons and instrumentation is small due to the extreme height at which the balloon destruction would be triggered, the trajectory of its descent and the potential for it to sink or become lost in the ocean. Due to these factors, the balloon and associated materials would be expected to deposit in the ocean and become marine debris.

The Falcon 9 system includes a fairing to protect payloads until they can be delivered to their designated orbit. The fairings consist of two halves which separate to release the payload into space. After separating the fairing halves would fall back to earth and each half contains a parachute system to slow the descent of the fairing and enable a soft splashdown so that the two halves can be recovered. The splashdown site is expected to be outside of California's state waters and United States territorial waters. The parachute system consists of a drogue parachute and a parafoil which are approximately 110 sq. fr. and 3,000 sq. ft. in size, respectively.

SpaceX would attempt to recover both halves of the fairing after each launch using a salvage ship stationed in the area of the anticipated splashdown site. For safety reasons the salvage ship could not be within 12 nautical miles of the splashdown site. Parachutes, parafoils, and their assemblies attached to the fairings to control their descent and aid in recovery are made of Kevlar and nylon and would quickly sink once they become waterlogged after splashdown. SpaceX would attempt to recover all

parafoils, but ocean conditions or weather conditions could prevent salvage operations from recovering the foil.

Additionally, launches could contribute to marine debris if a mishap occurs, the rocket fails to launch successfully, and it instead lands in ocean waters. Finally, SpaceX could decide to release its first stage into the ocean rather than landing it. These marine debris inputs could, depending on where they land, negatively affect areas of special biological significance, such as Channel Islands National Park, Channel Islands National Marine Sanctuary, and state-designated marine protected areas. As discussed in DAF's CD, SpaceX's objective is to land and recover the first stage boosters for reuse. However, some missions may require orbits and fuel usage that make recovery and reuse impossible, in which case the first stage booster is intentionally disposed of. The first stage is expected to break up upon atmospheric reentry, and upon making impact with the ocean surface the booster is expected to sink. SpaceX has not conducted an expendable booster mission from SLC-4E since 2018.

If the first stage booster is intentionally disposed of it would be expected to break up upon reentering the atmosphere and land in international waters. As described by DAF in the CD, any propellant remaining in the booster would be less than one percent of the booster's capacity and would consist of "very light oils" which have a low viscosity, low specific gravity and are highly volatile. Since the oils have high volatility, they would completely dissipate within one to days and would spread into a thin layer which would evaporate quickly. Although it would require a total of one to two days for the propellant to completely dissipate, over 90 percent of the overall mass of the propellant would evaporate within the first seven minutes and within the first hour over 99 percent of the mass would evaporate.

SpaceX makes use of a reusable rocket that undergoes a controlled landing, however, so these types of first stage abandonments in the ocean would be very rare. Based on information in recent news articles, SpaceX has achieved over 380 successful launches without loss of a first stage into the ocean, for example. As a result, and due to the limited quantity of fuel likely to be remaining in the booster after an accidental splash down, its anticipated quick evaporation, and the location in international waters where the booster would likely land, the Commission finds that it is not expected to adversely affect the quality of waters upon landing nor is it expected to enter California's coastal zone.

To address potential adverse impacts from marine debris resulting from the weather balloons and fairing decent systems, however, DAF would be required to ensure that SpaceX provide contributions to the California Lost Fishing Gear Recovery Project, with the intention of offsetting the release of unrecoverable debris in state and federal waters.

U.C. Davis' California Lost Fishing Gear Recovery Project has removed lost or discarded commercial fishing gear from California waters since 2005. Its work now focuses on gear removal from the waters of Southern California, ensuring that gear recovery is occurring close to the areas that would be affected by the proposed project.

Lost fishing gear such as nets, traps and lines are hazardous to wildlife, including seabirds, fish, turtles, sea otters, whales and other marine animals. It is anticipated that the entanglement hazards posed to wildlife by the weather balloons are similar to those posed by lost fishing gear. Lost fishing gear, specifically traps, typically have a buoy attached to several dozen feet of nylon line; similarly, the weather balloon, which is relatively buoyant, is attached with lightweight lines to heavier scientific instruments. Thus, lost gear recovery would provide a reasonable means of offsetting the entanglement impacts associated with weather balloons. However, as discussed below, it is not clear that the recovery of lost fishing gear would provide meaningful offsets for other marine debris types generated by launch activities, in particular the electronic and battery components of the radiosondes attached to the weather balloons.

On an annual basis, the amount of material potentially released into the ocean would be recorded and, for every one pound of such material, DAF has stated that SpaceX would continue to make a compensatory donation of \$10.00 to the California Lost Fishing Gear Recovery Project for each pound of marine debris generated as part of launch operations. The administrators of the U.C. Davis program previously confirmed this contribution would be sufficient to recover approximately one pound of lost fishing gear but that confirmation was provided several years ago and likely does not reflect increases due to inflation. SpaceX has paid the U.C. Davis Lost Fishing Gear Recovery Project a total of \$10,580.33 donation for 28 launches from January 2023 to December 2023 detailed in Table 1 below, provided by DAF. SpaceX recovered all fairings and first stage boosters during that time period. DAF notes that a total of 383 weather balloons were released for all launches and launch attempts (including missions that were scrubbed and rescheduled).

Table 1: Marine Debris Offsets for 2023 Launches

Item	Total Unrecovered	Individual Weight (lbs)	Total Weight (lbs)	Landed California/U.S. Territorial Waters?
Weather balloon with radiosonde^	383	1.5	574.5	Potentially
Drogue parachute + assembly	52	10.8	561.6	No
Parafoil + assembly	13	150	1,950	No
MVac skirt ring	22	4	88	No
Fairing half	0	4,900	0	No
First stage booster	0	65,000	0	No
Total Weight			3,174.1	
Total Annual Contribution (28 launches)			\$10,580.33	

^ND states that “The actual contribution would be based on the actual amount of material released”

To address the increased costs of fishing gear recovery efforts due to inflation, Condition 6 would require SpaceX to adjust its payment amounts annually for inflation. Further, Condition 6 would also help address the inclusion of lithium ion batteries and electronic materials consisting of circuit boards with heavy metals like lead or mercury in the radiosonde by increasing the amount of the annual marine debris offset payment from \$10 per pound to \$20 per pound and having it split between the Lost Fishing Gear Recovery Project and a public or non-profit organization for removal of hazardous waste from the marine environment or battery/electronic waste recycling and reduction efforts.

In addition, **Condition 6** calls for DAF to evaluate and implement measures to reduce the amount of marine debris released as part of launch activities, such as by minimizing the number of weather balloons released per launch, developing alternatives to the released weather balloons, and modifying the radiosondes to eliminate or reduce hazardous materials. Finally, Condition 6 would require DAF to provide an annual report to the Executive Director that includes the amounts and types of marine debris released as part of each SpaceX launch and provides details about the amounts of plastics and hazardous materials within the released debris.

Artificial Night Lighting

In its CD, DAF also provided information about operations in the VSFB harbor and use of lighting at night. After salvage and landing operations are complete, any first stages, fairings and other materials would be transported via barge to the VSFB harbor. Once at the harbor, the equipment and materials would be loaded onto trucks for transport back to processing facilities at VSFB. Several marine species including pinnipeds and the federally threatened southern sea otters are known to frequent the area in and around the VSFB harbor. Any stage one offloading operations at the harbor occurring at night would require the use of artificial lighting to help facilitate project operations. The effects of artificial night light on marine species have been documented in recent years and include effects on physiology, navigation, reproductive behavior, predation success, and community structure. Likely effects of artificial night lighting on mammals include avoidance, disorientation, disruption of foraging patterns, increased predation risk, disruption of biological clocks, increased mortality on roads, and disruption of dispersal movements through artificially lighted landscapes²⁶. In order to minimize adverse effects to marine species from artificial night lighting, the project incorporates several measures, including entering the harbor at night when pinnipeds are not present and limiting and restricting nighttime activities and the use of artificial night lighting.

To ensure consistency with Sections 30230 and 30231 of the CCMP, the Commission is requiring **Condition 4** for DAF to develop a light management plan for the SpaceX launch complex which would include Best Management Practices (BMPs) such as shielding, modifying the direction of lights to avoid sensitive receptors, and outlining parameters when lighting at night would be necessary. DAF would keep Commission staff informed on the progress of this investigation and to work with the Executive Director to address any unexpected impacts to sensitive species from artificial night

²⁶ J. Engel & N. Sadrpour memo: Pepperdine University, CLP; Component 5 August 23, 2013

lighting. This condition would require DAF to submit a Lighting Management Plan (discussed in more detail below in Section IV.D) within 30 days of the Commission's consideration of the consistency determination.

Conclusion

VSFB is located immediately adjacent to the Pacific Ocean and the VSFB SMR, while the Santa Barbara Channel and multiple other marine biodiversity hotspots are located further south within the range of the possible trajectories for the Falcon 9 launches. Falcon 9 launches have the potential to adversely impact sensitive species within the marine environment in several ways including loud noises and sonic booms, as well as by the generation of various forms of marine debris.

Coastal Act Section 30230 requires new development to protect, and where feasible enhance, the marine environment. Coastal Act Section 30231 requires the biological productivity and quality of coastal waters appropriate to maintain optimum populations of marine organisms to be maintained and, where feasible, restored.

Although the Commission finds that the proposed project has the potential to adversely impact coastal waters and marine resources, with the Commission's requirements for DAF's to implement a variety of marine resource protective measures and **Conditions 1 (On-Base Biological Monitoring Program), 2 (Off-Base Sonic Boom Minimization Measures), 3 (Off-Base Acoustic and Biological Monitoring), 4 (Lighting Management Plan), and 6 (Marine Debris)**, the project would be carried out in a manner in which would provide special protection to areas and species of special biological significance and maintain the biological productivity and the quality of coastal waters. The Commission therefore finds the proposed project, as conditioned, consistent with the marine biological resource policies of the CCMP, specifically Sections 30230 and 30231.

D. ENVIRONMENTALLY SENSITIVE HABITAT AREAS

Section 30240 of the Coastal Act states:

- (a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.
- (b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.

Section 30107.5 of the Coastal Act Defines Environmentally Sensitive areas as:

"Environmentally sensitive area" means any area in which plant or animal life or their habitats are either rare or especially valuable because of their special

nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.

Environmentally Sensitive Habitat Areas, or ESHA, are areas where plant communities or wildlife habitats are rare or especially valuable and easily disturbed or degraded by human activities. There are several types of ESHA adjacent to the project site. Section 30240(b) requires development adjacent to ESHA and park and recreation areas be sited and designed to prevent impacts that would significantly degrade such areas and ESHA and be compatible with continued use of ESHA and park and recreation areas. In addition, aspects of the project, including the sounds generated during launch and landing activities and pressure waves from sonic booms, extend dozens of miles outward from the launch site and rockets and directly into ESHA. For a more detailed discussion of sonic booms refer to Section IV.C above.

In evaluating the potential effects of the proposed launch activities on an ESHA and its constituent species, it is crucial to recognize that a “habitat” consists not just of its solid, liquid and biological components (e.g. soil and substrate, hydrological and chemical processes, plants and animals) but also the surrounding atmosphere and aural environment. Noise and extreme changes in air pressure, such as associated with launch activities and sonic booms, represent disturbances to the habitat itself, with potentially significant effects on organisms. Similarly, perturbations to the light environment can have impacts on both plant and animal species. The project has the potential to adversely affect ESHA on-base due to engine noise during launches, as well as from sonic booms during on-base landings. Similarly, noise and blast waves from launch-related sonic booms could result in impacts to off-base ESHA over a broad area spanning the Santa Barbara, Ventura and Los Angeles County coasts and the Channel coasts, and to numerous parks and coastal recreation areas such as Jalama Beach County Park, Channel Islands National Park, and numerous state beaches. The project also has the potential to adversely affect ESHA on-base through impacts from artificial lighting at night.

DAF states in its consistency determination that the proposed project is consistent with Section 30240. Since the launch operations would take place within an existing launch facility at SLC-4 the project would not require any construction within ESHA. DAF has also proposed monitoring and reporting to help determine if unexpected adverse impacts occur to sensitive habitat areas outside of the launch complex.

Types of Environmentally Sensitive Habitat Areas

Western Snowy Plover Habitat

The coastal dunes and beaches of western Santa Barbara County, including within and adjacent to VSFB, provide breeding and foraging habitat for western snowy plover (plover (*Charadrius nivosus nivosus*) (‘snowy plover’), a rare, vulnerable shorebird species that has experienced historical population declines due to habitat loss and other factors. Surveys carried out by Point Blue Conservation Science, an independent avian research organization, for DAF and provided to Commission staff as part of previous

consistency determinations have documented western snowy plover nesting habitat on the beach approximately 2 miles northwest of the SpaceX launch and landing site within VSFB (USFWS 2023). The rarity and vulnerability of snowy plover is well established, with the species being listed as threatened under the federal Endangered Species Act since 1993 and with global and state rarity rankings of G3T3 and S3 respectively²⁷. They are also listed as California Species of Special Concern. The west coast-wide recovery objective for snowy plover is 3,000 birds, and the current population estimate falls over 20% below that at 2,371 birds. The USFWS notes that threats to snowy plover and their habitat include “habitat loss and degradation attributed to human disturbance, urban development, introduced beachgrass, and expanding predator populations,” indicating that snowy plover nesting habitat is easily degraded by human activities and developments (USFWS 2023). The USFWS additionally identified that active efforts to improve habitat at breeding beaches have improved snowy plover population numbers (USFWS 2023). Therefore, snowy plover habitat has been identified as ESHA by the Commission.

Snowy plovers are present throughout the coastal zone in California, both north and south of VSFB. In the winter, snowy plovers migrate to non-nesting beaches to forage (USFWS 2023). The populations of snowy plover nesting and reproducing on VSFB therefore disperse to other beaches outside the base in the winter and may use beaches in the coastal zone for nesting the following year. Thus, nesting habitat on VSFB contributes to snowy plover population growth within the coastal zone. Impacts to snowy plover nesting habitat on VSFB would affect snowy plovers in the coastal zone due to species movement during the winter season and reduced population viability.

Preventing the degradation of this nesting habitat, including the aural environment, is important for the continued population growth and recovery of snowy plover. VSFB contributes to the largest sub-population of snowy plovers from San Luis Obispo County through Ventura County. The population target established by the USFWS for snowy plover in San Luis Obispo, Santa Barbara, and Ventura Counties is 1,200 breeding adults. In 2022, the USFWS found that the population remains well below this target at 804 breeding adults (USFWS 2023). This comparatively large population is critical to maintain and grow for long-term success of the species along the west coast.

California Least Tern Habitat

Several areas of coastal strand habitat along the north VSFB coastline support nesting colonies of California least tern (*Sternula antillarum browni*), a rare, threatened migratory bird species that has been listed under the federal and California Endangered Species Acts since 1972 with global and state rarity rankings of G4T2T3Q and S2,

²⁷ G3 and S3 ranked species are those considered ‘vulnerable’ and at moderate risk of extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. And taxa which are subspecies receive a taxon rank (**T-rank**) in addition to the G-rank. Whereas the G-rank reflects the condition of the entire species, the T-rank reflects the global status of just the subspecies.

respectively²⁸ (USFWS, 2023). They are also listed as California Fully Protected species. California least tern prefers to nest in small, scattered clusters on natural or artificial open areas near estuaries, bays, or harbors where small fish are abundant. The primary colony at VSFB for California least tern is at Purisima Point, located approximately 8 miles north of the launch facility at SLC-4. California least tern forage in the lagoon at the mouth of the Santa Ynez River and other near-shore locations at VSFB (USFWS, 2023).

Coastal habitats at VSFB support a relatively small percentage of the total number of California's total California least tern breeding population. However, the population at VSFB is significant because it is one of only three breeding colonies between Monterey and Point Conception. Also, the breeding colony at VSFB tends to be reproductively successful (USFWS, 2023). Similar to western snowy plover, since VSFB is a significant location for hosting breeding colonies of California least tern, California least tern nesting habitat is considered ESHA by the Commission. Additionally, since the populations of California least tern disperse to other areas of the coast during the winter, nesting habitat on VSFB contributes to California least tern population recovery within the coastal zone, and impacts to California least tern nesting habitat on VSFB would affect California least tern in the coastal zone due to species movement and reduced population viability. As such, preventing degradation of this nesting habitat is important for the continued population growth and recovery of the California least tern.

California Red-Legged Frog Habitat

Although California red-legged frog (*Rana draytonii*) (CRLF) are not present in Spring Canyon directly adjacent to the SLC-4 SpaceX launch and landing complex, DAF have documented CRLF within Bear Creek and Honda Creek, located 0.75 miles and 2 miles to the south of SLC-4, respectively. The Commission's staff ecologist has identified these locations as ESHA because they provide breeding habitat, forage and refuge for CRLF.

The rarity of California red-legged frogs is widely recognized and has resulted in its designation as a federally threatened species with global and state rarity rankings of G2G3 S2S3 and listing as a California Species of Special Concern²⁹. CRLF are sensitive to disturbance and their habitat can be easily disturbed or degraded from development including direct habitat loss due to stream alteration, loss of aquatic habitat, and indirect effects of expanding urbanization affecting their dispersal and migration into new habitats, as noted in the USFWS Biological Opinion. CRLF is a coastal species found outside of VSFB in the coastal zone in streams along the coast and transverse ranges of California, including coastal Santa Barbara County. The populations on VSFB add to the genetic diversity and population of CRLF outside of the base, particularly because this species of frogs are known to make long-distance

²⁸ A Q-rank indicates questionable taxonomy; that the distinctiveness of this entity as a taxon at the current level is questionable. Resolution of this uncertainty may result in change from a species to a subspecies or hybrid. The "Q" modifier is only used at the global level, not the state level.

²⁹G2 and S2 ranked species are considered 'imperiled' and at high risk of extinction or elimination due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

overland migrations (up to 1.75 miles in wet environments) to suitable breeding habitat elsewhere. The USFWS notes that coastal CRLF populations in Santa Barbara County and to the north show genetic connectivity, indicating that there is migration and gene flow between CRLF populations on VSFB and those in the coastal zone outside of the federal property (USFWS 2023). The loss of CRLF populations on VSFB would reduce genetic diversity and gene flow between frog populations, which could affect the overall population of CRLF in the coastal zone outside of the base. For rare species, maintaining genetic diversity is particularly critical in the face of climate change due to the variety of environmental stressors it can bring and the need for adaptation and new traits that will enable survival.

Pallid Bat and Western Red Bat Habitat

The pallid bat (*Antrozous pallidus*) and western red bat (*Lasiurus frantzii*) are known to be present within VSFB in proximity to the area affected by launch noise and lighting. The most consistent observations have been within the riparian habitat of Honda Creek roughly two miles south of the SpaceX launch complex. These bat species have state rarity rankings of S3 and have been designated by the California Department of Fish and Wildlife (CDFW) as Species of Special Concern³⁰. Bats play a special role in the ecosystem due to their high metabolic needs and extensive feeding on insects.

CDFW identified pallid bats as Species of Special Concern because they have experienced a marked population decline in recent years in California. Pallid bats are not tolerant of suburban or urban development and habitat conversion has led to their decline (CDFW 1998). CDFW identified western red bats as Species of Special Concern because they face increased predation from species associated with human development (jays and opossums), and their primary habitat in riparian corridors is under consistent threat of conversion to other land uses, specifically agriculture (CDFW 1998). CDFW's findings show that the habitat of both bat species is easily disturbed or degraded by development, leading to population declines. Within California, both pallid bats and western red bats are vulnerable and at moderate risk for extinction due to a restricted range, relatively few populations or recent and widespread declines. Populations of these species (and bat populations in general) are also at risk for significant declines in California due to the recent emergence of white-nose syndrome, a disease caused by a fungal infection that frequently results in high mortality rates and the catastrophic loss of entire bat colonies (CDFW 2023). The special role of these bat species in the ecosystem and their vulnerability to population declines supports identification of their riparian corridor roosting habitats as ESHA.

Riparian habitats supporting these bat species occur both on VSFB and outside of VSFB in the coastal zone of northern Santa Barbara County. Adverse impacts to the populations on VSFB would have spillover effects to outside areas, including within the

³⁰ S3 ranked species are those considered 'vulnerable' and at moderate risk of extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

coastal zone, by reducing overall carrying capacity, resiliency, and genetic diversity of pallid bats and western red bats in Santa Barbara County.

Monarch Butterfly Habitat

Monarch butterflies (*Danaus plexippus*) are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. Individual monarchs in temperate climates, such as western North America, undergo long-distance migration, and live for an extended period of time. In the fall, monarchs begin migrating to their respective overwintering sites. This migration can take monarchs over distances of 1,800 miles and last for over two months³¹. Monarch populations have declined over the past twenty years due to several interrelated factors including habitat degradation and loss in breeding and overwintering sites, disease, pesticide exposure, and climate change. Recently, the western migratory population (including California) has experienced dramatic swings, including a low of less than 2,000 individuals in 2020-21, highlighting the vulnerability of the species to perturbations like habitat loss³². Monarch butterflies are currently identified as a candidate species for federal listing, and the USFWS found in 2020 that listing was warranted, but precluded by other higher priority listing actions.

There are multiple eucalyptus groves within VSFB that are known monarch overwintering sites. One of these areas, consisting of two distinct eucalyptus stands that support monarch overwintering aggregations, is located immediately south of SLC-4, within Spring Canyon (**Exhibit 2**). The highest number of monarchs observed in the westward and eastward stands over the past decade was 6,015 and 11,082 in 2011 and 2013 respectively. Those numbers declined to zero in subsequent years but have been slowly increasing in the westward and eastwards stands with 16,616, 10,768, and 2,235 and 30, 186, and 265 in the years spanning 2021 to 2023, respectively.

Similar to western snowy plover and California least tern, since VSFB is a location for hosting overwintering colonies of monarch butterflies, and overwintering habitat is critical for the persistence of the species, monarch butterfly habitat is considered ESHA by the Commission. Additionally, since the populations of monarch butterfly disperse to other areas of the coast, overwintering habitat on VSFB contributes to monarch butterfly populations within the coastal zone and impacts to monarch butterfly habitat on VSFB would affect monarch butterflies in the coastal zone due to species movement and reduced population viability. As such, preventing degradation of overwintering habitat adjacent to the SpaceX launch and landing site is important for the continued population growth and recovery of the monarch butterfly.

Park and Recreation Areas

In addition to ESHA, there are numerous significant park and recreation areas and resources distributed throughout the area that would experience sonic booms from launches or landings throughout Santa Barbara, Ventura, and Los Angeles Counties. These include Channel Islands National Park, the Santa Monica Mountains Recreation

³¹ <https://ecos.fws.gov/ecp/species/9743>

³² <https://wildlife.ca.gov/Conservation/Invertebrates/Monarch-Butterfly>

Area, approximately ten State Beaches and eight State Parks (with a total of nine State Parks-run campgrounds), four State Historic Parks, Jalama Beach County Park and campground, and several other County and City beaches, parks, and camping areas.

General Information on Wildlife Responses to Noise and Sonic Booms

A literature synthesis of effects of aircraft noise and sonic booms on domestic animals and wildlife (Manci et al. 1998) by the U.S. Fish and Wildlife Service National Ecology Research Center (which was also referenced above for its information on pinnipeds and from which background information on sonic booms is provided in [Appendix B](#), below) provides the following general information regarding the effects of elevated and sudden noise on wildlife:

Noise affects wildlife and other animals, including humans, in many ways. Janssen (1980)³³ categorized these effects as primary, secondary, or tertiary. Primary effects are direct physical auditory changes, such as eardrum rupture, temporary and permanent hearing threshold shifts, and the masking of auditory signals. Masking is the inability of an animal to hear important environmental signals. These signals include noises made by potential mates, predators, or prey. Aircraft noise could conceivably cause masking of the signals in some species and populations of wildlife. Secondary effects of aircraft noise and sonic booms on wildlife include such nonauditory effects as stress, behavioral changes, interference with mating, and detrimental changes in the ability to obtain sufficient food, water, and cover. Tertiary effects are the direct result of both primary and secondary effects, and include population declines, destruction of important habitat (Klein 1973)³⁴, and, in extreme cases, potential species extinction (Bender 1977)³⁵.

Animal species differ greatly in their response to noise of various characteristics and duration. Individual animal response to a given noise event or series of events also can vary widely, due to a variety of factors, including time of day and year, physical condition of the animal, physical environment (such as whether the animal is restrained or unrestrained), the experience of the individual animal, and whether or not other physical stressors (e.g., drought) are present.

The effects of noise on the physiology of laboratory animals have been studied more thoroughly than effects on farm animals or wildlife. Although laboratory studies cannot be directly applied to effects of noise on wildlife in their natural habitats, they do describe a range of potential effects that may possibly occur. Hearing sensitivity, susceptibility to noise-induced hearing loss, and physiological

³³ Janssen, R. 1980. Future scientific activities in effects of noise on animals. Pages 632-637 in J.V. Tobias, G. Jansen, and W.D. Ward, eds. Proceedings of the Third International Congress on Noise as a Public Health Problem. Am. Speech-Language-Hearing Assoc., Rockville, MD.

³⁴ Klein, D.R. 1973. The reaction of some northern mammals to aircraft disturbance. Pages 377-383 in 11th Int. Congr. Game Biol., Sept. 3-7, 1973, Stockholm, Sweden. Natl. Swedish Environ. Prot. Board, Stockholm.

³⁵ Bender, A. 1977. Noise impact on wildlife: an environmental impact assessment. Pages 155-165 in Proc. 9th Conf. Space Simulation. NASA (P-20007).

effects of noise vary among animal species. Animals appear to be more sensitive to noise disturbance than humans (Borg,1981)³⁶. Possible harmful effects of sound may be more related to information content of the sound--information pertaining to risky actions or masking significant information--rather than to sound itself.

A sudden or unfamiliar sound is believed to act as an alarm, activating the sympathetic nervous system. The short-term physiological stress reactions, referred to as "fight-or-flight," are similar for many vertebrate species (Holler 1978). Various stimuli can produce similar physiological effects. Different stressors have their own unique effects, however, and reactions to stress can vary between species and also among individuals of the same species. Only laboratory studies have been able to eliminate these variables and show that noise produces certain physiological effects.

The general pattern of response to stress includes activation of the neural and endocrine systems, causing changes such as increased blood pressure, available glucose, and blood levels of corticosteroids. The effect of sympathetic activation on circulation also is believed to have an effect on hearing (Holler 1978). A correlation has been shown to exist between the reaction on the peripheral circulation and the temporary threshold shift caused by noise exposure. Prolonged exposure to severe stress may exhaust an animal's resources and result in death.

DAF provided its own literature review in a memo to Commission staff (included as **Exhibit 17**) on July 24, 2024, in response to a request by Commission staff for information to address concerns about potential impacts to wildlife by noise, including from sonic booms. This memo provides a further summary of findings from scientific studies that have investigated these issues and discusses, among other topics, common animal responses to noise (including startle responses and habituation), the high degree of variability in responses among different species, and the difficulty, in some cases, of separating the effects of noise from other factors. While the memo discusses the potential for habituation to loud noises to occur, stating that the "intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects", Commission staff notes that there is little evidence that wildlife can habituate to loud noise when it occurs irregularly and sporadically. A lack of information and studies on this issue should not be considered evidence of no effects. The limited studies that have been done on sonic booms specifically involved more infrequent sonic booms than are occurring under the current launch cadence.

Additionally, as discussed previously in relation to marine mammals, repeated behavioral disturbances from noise or overpressure events are disruptive to individual animals and to populations, can induce stress responses and physiological changes, increase energy expenditures, and carry a risk of injury, particularly to eggs or young.

³⁶ Borg, E. 1981. Physiological and pathogenic effects of sound. *Acta Otolaryngol. Suppl.* 381:7-68.

The severity of such effects is likely to be influenced by the pattern and frequency of disturbance, as well as the timing in relation to an organism's life cycle (e.g., breeding or nesting periods). Generally, the more frequent and aperiodic the disturbance, the more substantial the risk of adverse effects. Although few studies have been carried out on the long-term effects to seabirds and other sensitive wildlife (e.g., amphibians, bats, insects) of exposure to sonic booms, engine noise or other elevated, short duration sounds, research into other sources of disturbance demonstrates that a threshold exists beyond which the animals and/or colony/aggregation will abandon the area.

More specific discussion of potential impacts from the proposed project to ESHA both on- and off-base is provided below.

Engine Noise and On-Base Sonic Booms

The proposed project has the potential to cause adverse impacts to wildlife use of riparian habitat in Bear Creek and Honda Creek, and Western snowy plover and California least tern nesting habitat in nearby shoreline areas, through exposure to elevated sound levels during static fire tests, launches and landings. Launch and landing noise would be expected to last for several minutes and static fire noise would be expected to last for several seconds. Maps of nearby wildlife occurrences, including California red-legged frogs, pallid bat, western red bat, Western snowy plover, and California least tern along with expected sound levels from launch, landing and engine testing activities are available in **Exhibit 5**. Engine noise and on-base sonic booms are described above in the project description provided in Section IV.A and potential impacts to marine mammals are described in Section IV.C.

SpaceX launch activities would include up to 36 static fire tests, 36 launches and 12 landings annually, leading to a total of 84 proposed events with elevated sound levels. This would result in a total of approximately 90 minutes of elevated sound divided between 84 events spread throughout the year. During these events, the maximum decibel (dB) levels found in the riparian area of Honda Creek, where bats are present, would be expected to reach approximately 120 dB, based on modeling carried out by DAF. The areas of Bear Creek and Honda Creek that contain California red-legged frogs would receive up to 130 dB and 120 dB, respectively. The Western snowy plover nesting habitat would receive sound levels between 100 and 130 dB. The California least tern nesting site at Purisima Point would receive sound levels between 80 dB and 100 dB.

Each landing of the first stage back at VSFB would also generate a sonic boom lasting a fraction of a second and would create an overpressure blast wave between 0.5 to 4 pounds per square foot (psf) across the majority of VSFB. Maps of the sonic boom overpressure are included in **Exhibit 5**. CRLF within Honda Creek would experience a sonic boom overpressure estimated between 2 and 3 psf and CRLF within Bear Creek would experience an overpressure between 3 and 4 psf. For western snowy plovers the level of overpressure is dependent upon which stretch of Surf Beach they are occupying at the time of the landing event, but overpressures would be estimated between 1 and 4 psf. California least tern nesting and foraging sites would experience between an estimated 1 and 1.5 psf. The extent to which these sound levels could significantly

degrade wildlife habitat would be dependent on each species' individual sensitivity and the time between successive noise events. DAF has not identified any scheduling limitations that would ensure a certain duration of quiet between launches, landings or engine tests, but the current time needed by SpaceX to prepare a rocket for launch would mean at least several days would elapse between launches.

The sporadic, short-duration and high intensity noise and overpressure events generated by the launches and landings represent a significant disruption of the aural and barometric environment of these habitat areas. The potential for these habitat disruptions to cause adverse effects on sensitive wildlife species, and the need for continued, effective monitoring, is discussed in detail below.

Western Snowy Plover & Noise (On-Base)

As mentioned above, western snowy plover nesting habitat is located approximately 0.8 miles northwest of SLC-4 at the southern end of Surf Beach. DAF has conducted monitoring of western snowy plover nests during numerous launches at VSFB. In its consistency determination, DAF states:

Direct observations of wintering birds were made during a Titan IV and Falcon 9 launch from SLC-4E (SRS Technologies, Inc. 2006b; Robinette and Ball 2013). The Titan IV launches resulted in sound levels of 130 dBA Lmax. SNPL [snowy plover] did not exhibit any adverse reactions to these launches (SRS Technologies, Inc. 2006b; Robinette and Ball 2013) with the exception of one observation. During the launch of a Titan II from SLC-4W in 1998, monitoring of SNPL found the nest located closest to the launch facility had one of three eggs broken after the launch (Applegate and Schultz 1998). The cause of the damaged egg was not determined.

More recently on 12 June 2019, SNPL response was documented during a SpaceX Falcon 9 launch and first stage recovery at SLC-4. The return flight of the first stage to VSFB produced a 3.36 psf sonic boom and landing engine noise of 138 dB Lmax and 130 dB SEL, as measured on South Surf Beach. SNPL response to the noise impacts was documented via pre- and post-launch monitoring and video recording during the launch event. Incubating SNPL captured on video were observed to startle and either jump or hunker down in response to the sonic boom. One SNPL egg showed signs of potential damage. This egg was part of a three-egg clutch in which the other two eggs successfully hatched. It is not uncommon for one or more eggs from a successful nest to not hatch. Failure of the egg to hatch could not be conclusively tied to the launch event (Robinette and Rice 2019).

The USFWS has also reviewed the potential for launch noise to adversely impact snowy plover, and states:

... past monitoring results suggest that western snowy plovers exhibit some level of tolerance to high thresholds of sound pressure level and that they are nest tenacious during the breeding season (typically March 1 to September 30). However, the proposed action may result in short-term adverse effects including interruption of courtship or breeding activities, flushing from nests, interruptions in

foraging, and behavioral reactions, such as head raising, body shifting, moving short distances, and flapping of wings. Startle responses during nesting may result in nest abandonment or dislodging of eggs from nest scrapes; adults may leave chicks unattended and vulnerable to elements or predation. We do not expect abandoned eggs and chicks to survive if adults do not return to the nest. Non-observable physiological responses of western snowy plover to noise disturbance may include an increased heart rate or altering of metabolism and hormone balance. These responses may cause energy expenditure, reduced feeding, habitat avoidance, reproductive losses, and bodily injury resulting in increased vulnerability to predation (Radle 2007, p. 5)...

... Considering the increase in launch cadence, the proposed project has the potential to contribute to long-term adverse effects that result from routine intermittent acute noise disturbance.

The USFWS Biological Opinion identifies the lack of information available for how plovers are expected to respond to the significant increase in annual launches. The USFWS Biological Opinion notes that:

...Referencing current best available information, the Service cannot adequately determine the anticipated impacts of the proposed project's 84 disturbance events annually on the western snowy plover population at Surf Beach. Similarly, the Service cannot adequately determine how the proposed project's 84 disturbance events would contribute to the existing launch baseline average of 6.2 events or the current permitted annual launch baseline of up to 189 events. The Service considers that although the project has the potential to significantly contribute to the collective effects of the existing launch disturbance baseline and result in long term population level effects, until the novel effects of the project activity are studied, we are unable to anticipate the magnitude of response at this time.

As part of the USFWS review, DAF committed to augmenting the existing western snowy plover monitoring program on VSFB, which records habitat use, nesting efforts, nest fates, fledgling survival, and population size through each breeding season, with geospatial analysis of snowy plover nesting and the noise environment. Sound meters will be deployed immediately inland of South Surf Beach and at a control site to characterize the noise environment during the breeding season within the noise footprint of SpaceX launches. Geospatial analysis will be performed annually as SpaceX's launch frequency increases to assess whether patterns of nesting activity, nest fates, or fledgling success are negatively impacted by noise from SpaceX operations. If the geospatial analysis shows that a statistically significant decline in breeding effort or nest success has occurred over two consecutive years, and this decline cannot confidently be attributed to other natural or human caused factors, DAF will offset this impact by increasing predator removal efforts on VSFB to include the non-breeding season, particularly focusing on raven removal adjacent to VSFB beaches with a goal of achieving no net loss of the species. A more detailed description of this commitment is available in the Biological Opinion in **Exhibit 9**.

Commission staff have reviewed DAF's western snowy plover monitoring program (including the annual reports provided to USFWS, as well as annual reports titled "Monitoring and Management of the Endangered California Least Tern and the Threatened Western Snowy Plover at Vandenberg Space Force Base" prepared for DAF by Point Blue Conservation Science, for the years 2018-2023) and have identified outstanding concerns about the efficacy of the analysis of monitoring available and the conclusions being drawn from it. It is important to note that the requirements of monitoring for western snowy plover were revised and enhanced under the new BO issued in March of 2023. Therefore, the annual report for 2023 only included monitoring under the new requirements for approximately half of the October 2022 – September 2023 annual reporting period. Due to those changes in requirements, as well as the lower number of launches from previous years (and variability in the number of past launches conducted during plover nesting season), the 2023 annual report included a larger number of monitoring events during launches (i.e., 11 in 2023, two in 2022, one in 2019, and none in 2018, 2020, or 2021).

This lack of consistency and overall low number of monitoring events makes it difficult to draw conclusions about historical trends in impacts or how a higher launch cadence could affect western snowy plover over time, but the new BO requirements should provide more consistency in monitoring moving forward. The annual monitoring and management reports prepared for DAF by Point Blue (Point Blue reports) contain more robust and consistent data about western snowy plover breeding and nesting at VSFB beaches; however, the data are not specifically tied to launch events. Based on the monitoring data included in the 2018-2023 Point Blue reports, there was higher level of western snowy plover nest abandonment base-wide and on south VSFB beaches (closer to SLC-4) in 2023 compared to prior years (2018-2022), corresponding to a marked increase in SpaceX launch frequency (from an average of 2.75 launches per year in 2018-2021, to 13 launches to 28 launches in 2023), but a robust statistical analysis including more historical data would be required to draw firm conclusions about these trends. While multivariate statistical analysis of changes in population trends in relation to the frequency of noise events from launches has not yet been conducted, those data sets are a valuable resource to conduct such analyses.

The first of the monitoring reports provided for in the Biological Opinion was prepared for the 2023 calendar year and submitted in February 2024. A total of 24 Falcon 9 missions were performed on VSFB during the reporting period, including six boost-back landings at SLC-4W. Eleven of these 24 launches occurred during the western snowy plover nesting period. The report found no differences in incubation rates between launch events that included a sonic boom and those that didn't, but the report did identify reactions to the associated noise and noted stronger reactions to the sonic boom than the initial launch noise, mainly startle responses and hiding behavior. The report discussed how it is possible that the hiding or "hunker down" behavior could lead to damage to western snowy plover eggs. The majority of monitored eggs showed no signs of damage. However, several eggs were found either damaged or with an embryo that had stopped developing. The report couldn't attribute the damage to these eggs and the embryo from launches, but also could not conclusively discount the possibility that the launches and responses from plovers resulted in damage to the eggs. The

report noted that eggs can be damaged for multiple reasons not necessarily related to launch activity, but emphasized that it will be important to continue to monitor the occurrence of damaged eggs to determine whether the occurrence of damaged eggs increases with increased launch cadence over time. Finally, the monitoring documented higher rates of snowy plover nest abandonment on south VSFB compared to north VSFB. The report was unable to determine if this higher abandonment rate was due to launch activity or other factors.

Although it is difficult to affirmatively discern an effect from one year of monitoring, the monitoring conducted thus far suggests a possible correlation between launching the Falcon 9 rockets and reactions from western snowy plovers, including startle and flushing and abandonment of nests. These first-year results of monitoring under the 2023 USFWS BO highlight the need for additional monitoring and statistical analysis in order to more fully understand how the current Falcon 9 launch cadence could be adversely impacting western snowy plover, and to predict what may happen if the frequency of launches increases further. Importantly, it may be necessary to collect multiple years of monitoring data at a given launch cadence in order to adequately assess the effects of launch noise and sonic booms over time, while accounting for natural variability. This is consistent with the USFWS findings in the Biological Opinion that without long term population level effects analysis on the novel effects of increased launch cadence, it is difficult to accurately anticipate the magnitude of the response from western snowy plover. Additionally, landscape level monitoring and camera redundancy would provide more opportunities to detect any direct causal impacts between noise from specific launches and impacts to specific nests/eggs for which camera data was not available.

Similar to the condition requirements for monitoring marine mammals on-base, as described above in Section IV.C of this report, the Commission is requiring **Condition 1** to ensure the continuation of the ongoing monitoring program for western snowy plover during launches, including monitoring of long-term habitat use and local species populations. **Condition 1** requires that DAF, within 30 days of the Commission's consideration of this CD, DAF prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for VSFB focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

Part (a) of **Condition 1** would require continued monitoring, including adherence to the requirements in the 2023 USFWS BO, as well as identification of data and ongoing monitoring (and, if necessary, establishment) of off-base reference site populations of western snowy plover, and implementation of measures for equipment redundancy and data-handling improvements to help ensure that further loss of monitoring data is avoided. Additionally, part (b) of **Condition 1** requires DAF to conduct multivariate statistical analyses of the changes in population trends using a suite of variables. Relevant data to analyze include, but are not limited to, population sizes and locations,

rates of breeding success (including number of hatched chicks and fledglings), nest/colony abandonment, and injury or mortality to eggs or chicks. Analysis of potential impacts from individual launches would also include use of the results of the landscape-level camera monitoring for western snowy plover required by the 2023 USFWS BO.

Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its monitoring efforts to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to both the Executive Director and relevant resource agency staff to discuss the monitoring results and conclusions. The annual reports would include initial conclusions, including those from the analyses detailed in part (b) of the condition regarding potential effects to western snowy plover as a result of space launch and landing activity at Vandenberg Space Force Base. If significant disruption or degradation of habitat values are identified from those conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of western snowy plover population or reproductive success and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF shall prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts. With these requirements to address any unexpected impacts on western snowy plover habitat, the Commission finds that the proposed project would not significantly degrade snowy plover nesting habitat.

California Least Tern (LETE) & Noise (On-Base)

The known California least tern nesting site at Purisima Point is approximately 8 miles north of the SLC-4 SpaceX launch site and the roosting location at Santa Ynez River is located approximately 3.7 miles north of SLC-4. If launches and static fire tests are performed when California least tern are present at VSFB, the colony at Purisima Point would experience an engine noise of 102 dB to 108 dB while the colony at the Santa Ynez River mouth would receive engine noise of 80 dB to 110 dB. In its consistency determination, DAF states:

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

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

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

In its Biological Opinion, the USFWS found that “past monitoring results suggest that California least tern response to noise is related to timing within the nesting cycle and that launch operations that occur during the breeding season, particularly the early courtship season, may disturb nesting”. However, with DAF’s proposal to monitor and mitigate for any impacts at the local level to achieve no net loss of the species, the USFWS ultimately concluded that:

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

As discussed above, DAF has previously conducted long-term monitoring on VSF to assess California least tern and their response to launch activities, including noise and sonic booms. DAF has stated that its monitoring of California least tern to date has found that launch activities have not decreased California least tern populations and have only produced temporary observable changes in behavior. DAF has committed to California least tern monitoring and mitigation as part of its Biological Opinion with the USFWS.

DAF will continue to monitor the impacts of noise from the SpaceX launches to assess any potential adverse impacts on California least tern as the launch frequency increases and reaches full tempo (36 launches/year). If adverse effects are found, DAF would mitigate those effects by increasing predator management efforts on VSF to comply with the DAF’s sections 7(a)(1) and 7(a)(2) obligations under the Endangered Species Act (ESA). Mitigation activities would align with the California Least Tern Recovery Plan (USFWS 1985b) and 5-year review (USFWS 2020) with the goal of achieving no net loss to the species.

Even with this commitment to monitoring and mitigation if adverse impacts are determined, USFWS expressed concerns about the novelty of the cadence increase and potential impacts to California least tern compared to what has historically occurred at VSFB:

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

Commission staff have reviewed DAF's California least tern monitoring program (including the Point Blue reports discussed above, for the years 2018-2023) and have outstanding concerns about the efficacy of the analysis of monitoring available and the conclusions being drawn from it. As with snowy plover, the requirements of monitoring for least tern were revised and enhanced under the new BO issued in March of 2023, and the 2023 annual report only included monitoring under the new requirements for approximately half of the October 2022 – September 2023 annual reporting period. Due to those changes in requirements, as well as the lower number of launches from previous years (and variability in the number of past launches conducted during least tern nesting season), the 2023 annual report included a larger number of monitoring events during launches (i.e., four in 2023, one per year in 2022, 2019, and 2018, and none in 2020 or 2021).

This lack of consistency and overall low number of monitoring events makes it difficult to draw conclusions about historical trends in impacts or how a higher launch cadence could affect California least tern, but the new BO requirements should provide more consistency in monitoring moving forward. The Point Blue reports contain more robust and consistent data about least tern breeding and nesting at VSFB; however, the data are not specifically tied to launch events. Based on the data included in the 2018-2023 Point Blue reports, there appeared to be some year-to-year variability in breeding success, hatching success, and fledgling success. However, understanding potential causation behind population variation will require more years of monitoring with launches as well as using existing historical on-base (impact sites) and off-base (control sites) population data collected by Point Blue (annually since 1995) now to run multivariate statistical analyses of population trends that incorporate physical (e.g. PDO and El Niño oceanographic data, forage base, peak PSF) and biological data (e.g. population size, mating pairs, hatching success, number of fledglings, chick survival) to identify potential patterns. While such multivariate statistical analyses of historical on-base and off-base population trends have not yet been conducted, they would be a valuable source for interpreting population patterns.

The first of the annual monitoring reports was prepared for the 2023 calendar year and submitted in February 2024. A total of 24 Falcon 9 missions were performed on VSF B during the reporting period, including six boost-back landings at SLC-4W. The report found no differences in incubation rates between launch events with and without a sonic boom but did identify reactions to the associated noise and noted stronger reactions to the sonic boom than the initial launch noise, mainly startle responses and “hunkering down” behavior. The monitoring also documented California least terns flushing off of nests during both initial launch events and sonic booms. The California least terns returned to their nests within minutes after the boost-back had completed.

Although it is difficult to affirmatively discern an effect from one year of monitoring, the monitoring conducted thus far suggests that there could possibly be a correlation between launching the Falcon 9 rockets and reactions from California least terns, including startling and flushing. The results of the first year of monitoring also highlight the need for additional monitoring and statistical analysis in order to more fully understand how launching of Falcon 9 rockets could be adversely impacting California least tern. It will likely be necessary to collect multiple years of monitoring data at a given launch cadence in order to adequately assess the effects of launch noise and sonic booms over time, while accounting for natural variability. This is consistent with the USFWS findings in the Biological Opinion that without long term population level effects analysis on the novel effects of increase in launch cadence it is not possible to anticipate the magnitude of the response from California least tern. Additionally, landscape level monitoring and camera redundancy would provide more opportunities to detect any direct causal impacts between noise from specific launches and impacts to specific nests/eggs for which camera data was not available.

Similar to the condition requirements for monitoring western snowy plover on-base, as described above, the Commission is requiring **Condition 1** to ensure the continuation of the monitoring program for California least tern during launches, including monitoring of long-term habitat use and local species populations. Within 30 days of the Commission’s consideration of this CD, DAF would be required to prepare and provide for the Executive Director’s review and comment an enhanced biological monitoring program for VSF B focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

Part (a) of **Condition 1** would require continued monitoring, including adherence to the requirements in the 2023 USFWS BO, as well as identification of data and ongoing monitoring (and, if necessary, establishment) of off-base reference site populations of California least tern, and implementation of measures for equipment redundancy and data-handling improvements to help ensure that further loss of monitoring data is avoided. Additionally, part (b) of **Condition 1** requires DAF to conduct multivariate statistical analyses of the collected monitoring data, using a suite of variables, to identify significant trends or patterns and evaluate causal relationships with launch events, frequency and timing, along other potential drivers. Relevant population trends to

analyze include, but are not limited to, population sizes and locations, rates of breeding success (including number of hatched chicks and fledglings), nest/colony abandonment, and injury, or mortality to eggs or chicks. Analysis of potential impacts from individual launches would also include use of the results of the landscape-level camera monitoring for California least tern required by the 2023 USFWS BO.

Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its monitoring efforts to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to the Executive Director and relevant resource agency staff to discuss the monitoring results and conclusions. The annual reports would include initial conclusions, including those from the analyses detailed in part (b) of the condition regarding potential effects to California least tern as a result of space launch and landing activity at VSFB.. If significant disruption or degradation of habitat values are identified from those conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of California least tern population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF shall prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts. With these requirements to address any unexpected impacts on California least tern habitat, the Commission finds that the proposed project would not significantly degrade California least tern nesting habitat.

California Red-Legged Frog & Noise (On-Base)

All life stages of California red-legged frogs can detect noise and vibrations (DAF 2023) and are assumed to be able to perceive the engine noise produced by rockets and sonic booms produced by launches and landings. The proposed project thus has the potential to adversely affect California red-legged frog habitat in Bear Creek and Honda Creek. DAF states:

Engine noise would likely trigger a startle response in California red-legged frog, causing them to flee to water or attempt to hide in place. It is likely that any reaction would be dependent on the sensitivity of the individual, the behavior in which it is engaged when it experiences the noise, and the sound level (e.g., higher stimuli would be more likely to trigger a response). Regardless, the reaction is expected to be the same – the frog's behavior would be disrupted, and it may flee to cover in a similar reaction to that of a frog reacting to a predator. As a result, there could be a temporary disruption of California red-legged frog behaviors including foraging, calling, and mating (during the breeding season). However, frogs tend to return to normal behavior quickly after being disturbed.

There are no known studies on the impacts of launch sound on the hearing capabilities of California red-legged frogs, however Simmons et al. (2014)³⁷ found hearing damage to American bullfrogs, which are in the same family as California red-legged frogs, when they were exposed to sounds greater than 150 dB. After hearing damage, the bullfrogs showed full functional recovery of their hearing within 3 to 4 days. California red-legged frogs likely have similar hearing structures and a similar resilience to sounds below 150 dB as well as an ability to recover from hearing damage.

In its review of the potential project impacts to California red-legged frogs, the USFWS states that, “However, the specific acoustic thresholds for California red-legged frog are unknown and the Service does not anticipate physiological effects to California red-legged frog’s inner ears at this time due to the short duration and lower noise levels of the project’s anticipated noise disturbance events.” However, the USFWS did find that operational noise may impact frog behavior, including calling frequency, and lead to increased risk of predation due to a “freeze” response to excessive sound. Despite anticipating some local negative effects, the USFWS found overall that:

Using the available information and considering minimization measures, including potential mitigation ensuring no net loss, we expect adverse effects to the recovery of California red-legged frogs on VSFb would be low.

It is important to note that in its review of potential project impacts to California red-legged frogs, the USFWS’ March 21, 2023, Biological Opinion regularly identifies the significant change in overall launch numbers as a result of the proposed SpaceX project from 12 to 36 launches annually and how this increase represents a novel disturbance. Especially when considered in conjunction with the other active and proposed launch programs at VSFb, the potential for increased disturbance from launch-related noise is significant. The USFWS Biological Opinion notes that:

“...until the novel effects of the project activity are studied, we are unable to adequately anticipate the magnitude of any specific response at this time.

California red-legged frogs would be startled between 6 to 9 times a month as a result of the proposed project alone when considering that each launch would include a static test fire and could include a terrestrial landing. When reviewing the proposed project in addition to other active/permitted launch programs (collectively totaling 129 to 217 launch related disturbance events between the Santa Ynez River and Honda Creek; MSRS 2022b, p. 76), the Service understands that launch activities would startle California red-legged frogs in these areas frequently each month, although the Space Force has clarified that multiple launch related disturbance events would not occur on the same day (Kaisersatt, pers. comm. 2023c). The Service anticipates the potential for long-term effects from chronic stress caused by routine intermittent acute noise from the proposed project’s launch disturbance. These may include long-term population level effects including

³⁷ Simmons, D. D., Lohr, R., Wotring, H., Burton, M. D., Hooper, R. A., & Baird, R. A. (2014). Recovery of otoacoustic emissions after high-level noise exposure in the American bullfrog. *The Journal of experimental biology*, 217(Pt 9), 1626–1636. <https://doi.org/10.1242/jeb.090092>

reduced reproductive success, survival, fitness, and spatial displacement. Although we do not have an estimated survivorship of displaced California red-legged frogs, this could result in injury or death to individuals as a result of increased intraspecific competition, lack of familiarity with new locations of potential breeding, feeding, and sheltering habitats, and increased risk of predation. However, it is unknown how California red-legged frogs would react to repetitive launch events of variable disturbance levels with increasing frequency. Improved monitoring information is needed to help identify thresholds that quantify what level of noise or frequency of disturbance would elicit stress hormone responses that may lead to impacts to breeding and reproduction or other negative population level effects.”

As discussed above, DAF has conducted long-term monitoring on VSFB to assess the frogs and their response to launch activities, including noise and sonic booms. DAF has consistently stated that past launch activities have not decreased CRLF populations or led to the abandonment of habitat areas and have only produced temporary observable changes in behavior. However, the DAF’s monitoring and determinations to date have mainly included surveying during the much less intense launch frequencies that have occurred over the last several years and those previous determinations may not comport with the increased launch frequency being proposed and potential adverse impacts that could occur. For example, if it takes several days for individual frogs or populations to recover from a launch disturbance and another disturbance occurs before that recovery, chronic stress or habitat abandonment may occur. To address the need for better information about it an increased frequency in elevated sound levels from launches will be incompatible with the continued use of frog habitat near the proposed project site, DAF has committed to monitoring and mitigation as part of its Biological Opinion with the USFWS.

In the Biological Opinion, and as part of DAF’s recent Consistency Determination No. CD-0010-22 for the Phantom Space Corporation’s launch complex and operation at VSFB, DAF committed to placing passive bioacoustic recorders in Honda Creek and conducting California red-legged frog surveys there as well. This monitoring program will be carried out at part of the SpaceX launch program as well and is designed to track habitat occupancy, breeding behaviors (calling), and breeding success (egg mass and tadpole density). If habitat occupancy, calling frequency, or tadpole densities decline from baseline by 15 percent or more over two years, and the decline cannot be confidently attributed to other natural or human caused factors such as drought or wildfire, DAF will mitigate for impacts to California red-legged frog breeding habitat. To offset any impacts found, DAF will create new California red-legged frog breeding habitat at a 2:1 ratio (breeding habitat enhanced: breeding habitat affected) at the San Antonio Creek Oxbow Restoration Area, an established wetland site on VSFB that is located outside of areas currently affected by launch noise over 110 dB and artificial lighting on VSFB. A detailed description of this commitment is available in the Biological Opinion in **Exhibit 9**.

According to the “Activities Pursuant to Biological Opinion 2017-F-0480: 2023 Activities Report” (which covered a reporting period from October 2022 through September 2023) no launches occurred during the CRLF breeding season (late November to late April)

during the reporting period under the new BO requirements. Under the prior BO requirements, the only launch when bioacoustic monitoring was conducted during the CRLF breeding season for the reporting period was during the SWOT mission launch on December 16, 2022. The monitoring resulted in a finding of more breeding calls per hour on average at the Fitness Center Drainage after the launch (31.4) compared to before the launch (7.8) however the report concluded that noise from the launch did not negatively affect CRLF breeding behavior. No rationale for this conclusion was provided in the 2023 Activities Report.

In response to concerns raised by Commission staff regarding this instance and how effective the monitoring is if doesn't include appropriate controls/reference populations outside the influence of launches and sonic booms, DAF responded with the following statements:

Prior to the 2023-2024 winter, bioacoustic monitoring for red-legged frogs was conducted during two launches. Concerns initially centered on the potential for sonic booms to startle frogs and deter them from breeding behavior. However, the monitoring data summarized below suggest otherwise.

During the NROL-87 mission on February 2, 2022, and the SWOT mission on December 16, 2022, monitoring was conducted in areas expected to be impacted by sonic booms, as per the 2017 Biological Opinion (BO) requirements. Notably, monitoring during the NROL-87 at locations like the drainage near the VSFBR Recreation Center and lower Honda Creek did not show a reduction in the California red-legged frog (CRLF) calling frequency. In fact, call rates post-sonic boom were similar to or greater than rates before the launch.

For instance, at the Recreation Center Drainage, CRLF calls persisted through the hour of the sonic boom, with calls detected both before and after the boom. At lower Honda Creek, while no calls were noted just before the boom, several were detected soon after, indicating no disruption in calling activity.

Similarly, during the SWOT mission, although no calls were detected at Honda Creek around the time of the launch, increased calling was observed at the Recreation Center Drainage post-sonic boom. This increase, however, seemed coincidental and aligned more with natural peaks at sunrise rather than being a response to the sonic disturbances.

The USFWS has reviewed and approved the current monitoring protocols, which include extensive bioacoustic monitoring throughout the breeding season at various locations on VSFBR. Discussions with the USFWS confirmed that no suitable reference sites exist outside VSFBR that could replicate local environmental conditions. Monitoring efforts also include aquatic surveys for tadpoles and habitat assessments to gauge breeding success and population trends. This comprehensive approach is aimed at understanding whether breeding occurs at these sites and whether CRLF populations are stable, increasing, or declining.

However, Commission staff would note that greater call rates following a sonic boom compared to rates before a launch could indicate an impact to the species, such as an increase in energy expenditure, eardrum damage, or distress. Given the lack of monitoring data collected under the new 2023 USFWS BO monitoring requirements, it appears that there has not been enough CRLF bioacoustic monitoring to determine that this species is not adversely impacted by launches or sonic booms, especially since modeling of sonic booms/boost backs includes sound levels reaching 3 and 4 psf in areas of known CRLF habitat. Moreover, as noted previously in discussing the habitat of other sensitive species, multiple years of monitoring data at a given launch cadence may be necessary to adequately assess the effects of launch noise and sonic booms on CRLF over time, while accounting for natural variability. Additionally, it is Commission staff's understanding that the discussion between DAF and USFWS regarding potential reference sites existing outside VSFB that could replicate local environmental conditions is still ongoing, and Commission staff would support establishment of one if necessary.

Similar to requirements for monitoring western snowy plover and California least tern on-base, as described above DAF would also be required to continue its ongoing monitoring program for California red-legged frog during launches, including monitoring of long-term habitat use and local species populations, as required in **Condition 1**. Within 30 days of the Commission's consideration of this CD, DAF would be required to prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for VSFB focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

Part (a) of **Condition 1** would require continued monitoring, including adherence to the requirements in the 2023 USFWS BO, identification of data and ongoing monitoring (and, if necessary, establishment) of off-base reference site populations of California red-legged frog, and implementation of measures for equipment redundancy and data-handling improvements to help ensure that further loss of monitoring data is avoided. Additionally, DAF would be required to conduct multivariate statistical analyses of the changes in population trends using a suite of variables, as required in part (b) of **Condition 1**. Relevant population trends to analyze would include, but not be limited to, population sizes and locations.

Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its monitoring efforts to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to relevant resource agency staff on how the SpaceX project is or is not adversely affecting its surrounding environment. The annual reports would include initial conclusions, including those from the analyses detailed in part (b) of the condition regarding potential effects to California red-legged frog as a result of space launch and landing activity at Vandenberg Space Force Base. If significant disruption or degradation of habitat values are identified from those conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in

monitored indicators of California red-legged frog population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF shall prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts.

With the information provided by DAF on the potential effects of engine noise on California red-legged frog habitat at Bear Creek and Honda Creek, the collecting of data to better understand the adverse effects from launch activities, the monitoring that would continue to be carried out as part of the proposed project, and DAF's requirement to work with the Executive Director to address any unexpected impacts on California red-legged frog habitat, the Commission finds that the proposed project would not significantly degrade California red-legged frog habitat in Honda Creek.

Bats & Noise (On-Base)

The bat species found in the riparian habitats of Honda Canyon are very sensitive to sound, as they use echolocation to navigate around obstacles and hunt in the dark. A 2016 report from Caltrans notes:

In bats, damage to high frequency hearing cells would likely result in impaired echolocation. Damage to the lower frequency hearing cells would likely result in impaired capacity for passive listening. Either effect could potentially be life threatening. Failure to accurately assess the locations of trees, branches, and other obstacles in their flight path could result in fatal collisions or debilitating injury. Failure to accurately detect and determine the precise location and movement patterns of prey (both aerial and ground) would likely result in significantly diminished capture success. Similarly, failure to detect the approach of a predator could be fatal. Because bats simply do not have the luxury of extended recovery time, even temporary shifts in hearing abilities have the potential to result in negative effects on affected individuals.

DAF's integrated resources management plan states that studies on the hearing sensitivity of bat species show that they have excellent hearing in the higher frequency ranges (above 20 kHz) but are insensitive to lower frequencies where launch noise has most of its energy (e.g., highest decibel measurements). This may reduce potential impacts to bats and to continued use of their habitat, but as noted in the Caltrans report cited above, damage to lower frequency hearing cells in bats would still affect their passive listening abilities.

Consultations between Commission staff and staff of the California Department of Fish and Wildlife (CDFW) during the review of other space vehicle launching projects have indicated that birds and bats can experience permanent hearing loss at continuous sound exposure above 110 dB. CDFW staff recommend that continuous sounds be kept below the temporary threshold shift or temporary hearing loss threshold of 93 dB and that impulse noise should not exceed 110 dB at any point in operations measured at bat roosting locations. Bat habitat in Honda Canyon is expected to receive engine noise exceeding these thresholds, as described above. However, there is very little research

on rocket engine noise and its impact on bats. Existing studies on the impacts of other types of noise on bats may not be very representative of bat response to rocket engine noise. This is because engine noise exposure is very intermittent, with long periods of quiet between launches or static fire tests, and very short periods of elevated sounds (e.g. one minute or less).

With SpaceX's proposed launch schedule, bat habitat in Honda Creek would receive engine noise from launches and static fire tests for a total of up to 90 minutes per year. 90 minutes of engine noise across the 10,000 minutes that pass in a week means that engine noise would not be generated for a majority of the time. Finally, DAF actively monitors bat diversity and distribution on VSF, and has found that bat species use wetland, riparian, and forest habitats, despite launch activities on-base (Heady and Frick 2013). DAF's Integrated Natural Resources Management Plan states that:

Studies have shown that the effect of intermittent noise from aircraft overflights on small terrestrial mammal demography is likely to be small and difficult to detect, if it occurs at all (McClenaghan and Bowles 1995). Studies on the hearing sensitivity of a variety of bats (Dalland 1965; MacDonald 1984; Popper and Fay 1995) have shown that they have excellent hearing in the higher frequency ranges (above 20 kilohertz [kHz]) but are very insensitive to lower frequencies where launch noise has most of its energy. Therefore, impacts on these mammals are expected to be minimal to nonexistent.

Due to the intermittent nature of engine noise, the very short duration of engine noise relative to periods of quiet, and DAF's existing monitoring demonstrating that bats have used habitat on VSF despite engine noise and launches, DAF has concluded that significant degradation of bat habitat in Honda Canyon from launch-related noise is unlikely, despite exceeding CDFW's sound exposure level recommendations for other types of projects.

Although prior monitoring has not demonstrated adverse impacts to or degradation of bat habitat on VSF, an average of only 9.7 rocket and missile launches per year occurred from 2015-2021, during the course of that monitoring. In contrast, SpaceX would carry out a greater frequency of launch activities, to include a maximum of 36 launches, 12 landings, and 36 static fire tests per year, resulting in a commensurate increase in elevated noise episodes and the potential for disruptions to bat habitat.

Similar to requirements for other species monitoring on-base described above, DAF would also be required to monitor the on-base pallid bat and western red bat populations in a manner sufficient to assess potential changes in habitat use patterns and population levels, as required in **Condition 1**. Within 30 days of the Commission's consideration of this CD, DAF would be required to prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for VSF focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the

enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

Part (a) of **Condition 1** would require DAF to this monitoring. Additionally, DAF would be required to conduct multivariate statistical analyses of the changes in population trends using a suite of variables, as required in part (b) of **Condition 1**. Relevant population trends to analyze include, but are not limited to, population sizes and locations. Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its monitoring efforts to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to the Executive Director and relevant resource agency staff to discuss the monitoring results and conclusions. The annual reports would be required to include initial conclusions, including those from the analyses detailed in part (b) of the condition regarding potential effects to bat species as a result of space launch and landing activity at Vandenberg Space Force Base. If significant disruption or degradation of habitat values are identified from those conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of bat species population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF shall prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts.

With the information provided by DAF on the potential effects of engine noise on bat habitat in Honda Canyon, the absence of data demonstrating adverse impacts over the past roughly 20 years of monitoring bat populations at VSFB, the monitoring that would be carried out as part of the proposed project, and DAF's requirement to work with the Executive Director to address any unexpected impacts on bat habitat, the Commission finds that the proposed project would not significantly degrade bat habitat in Honda Canyon.

Monarch Butterfly & Noise and Other Launch Activities (On-Base)

As described above, there are two monarch aggregations sites located in the eucalyptus tree stands in Spring Canyon immediately adjacent to SLC-4, which could be impacted by noise and other launch activities. A deluge of water is flooded onto the launch pad following ignition of SpaceX Falcon 9 rockets to absorb or deflect the high levels of acoustic energy that are released as the rocket lifts off and to avoid damage to the vehicle and payload (**Exhibit 6**). The exhaust cloud is comprised of combusted fuel and water that largely consists of steam. The steam cloud generally billows out directly south of the launch pad but may move in different directions under various atmospheric conditions. For example, offshore winds could push the steam cloud toward the monarch aggregations resulting in adverse impacts such as physical damage to either stand trees or the monarchs themselves as well as initiation of flight responses causing the butterflies to use up necessary energy stores.

Another source of disturbance is the sonic booms or boost backs when the rocket's first stage returns to SLC-4. Noise modeling provided to Commission staff by DAF and

included as **Exhibit 5** indicates that the two monarch aggregations would be within the level 5 psf zone which is the highest noise level zone. Monarch butterflies are known to overwinter in two eucalyptus stands in the eucalyptus grove ESHA located approximately 300 feet south of SLC-4W (**Exhibit 2**). This area could experience engine noises in excess of 130 dB during launch and landing, and also experience sonic booms with a peak overpressure of at least 4 psf. In addition, the proximity of this grove to the launch and landing complex and the susceptibility of eucalyptus to fire raises concerns about its long-term viability and exposure to fire risk as the number of launch and landing events and proportional risk of accidents increases. How the monarchs would react to this level of noise is not fully known and therefore should be monitored.

DAF has noted that in some instances, monarch clusters at Spring Canyon have been photographed remotely during multiple daytime and nighttime launches from SLC-4, as well as during a daytime boostback to SLC-4. Based on DAF's review of photos of monarch clusters taken minutes before and after launches and landings, DAF has stated that monarchs had no reaction to launches, landings, or sonic booms, but they note that this research is ongoing. Additionally, in response to questions from Commission staff about what monitoring of monarch butterfly on VSFB has occurred, the methods used and any conclusions from monitoring, DAF provided the following response:

SLD 30 has conducted annual overwintering counts of monarch butterflies at VSFB since 1997. These counts follow the established protocol of the Western Monarch Thanksgiving Count. In January 2018 we added a second annual count following the standardized protocol of the Western Monarch New Year's Count, which we have conducted annually ever since. Annual population counts at VSFB correlate to broader population trends across the west; i.e. when the western monarch population is high, so are the counts at VSFB, and vice versa. Low numbers at VSFB and Spring Canyon from 2018-2020 reflect the region-wide western monarch population crash during those years. Population counts also reflect changing habitat suitability at individual overwintering sites, especially impacts of severe drought on eucalyptus trees (e.g. overwintering sites comprised of drought-stressed eucalyptus trees which have lost canopy cover now have smaller overwintering populations than pre-drought). Population fluctuations over time follow region-wide variation and/or have been attributed to changes in habitat quality. We have found no evidence that any population changes are related to launch cadence. Our team will continue to monitor and work with species experts on this topic.

Since providing this information regarding annual overwintering counts of monarch butterflies at VSFB, DAF has also shared historical data, but has not provided a detailed analysis of what this data shows for the monarch aggregation sites within the noise footprint of launches and landings at SLC-4. Any monarch monitoring and statistical analyses should include two or more monarch aggregation reference sites outside the influence of the launches and sonic booms that would be surveyed at similar times to the impact site for comparison.

Similar to requirements for other species monitoring on-base described above, DAF would be required to monitoring of the on-base monarch butterfly populations in a manner sufficient to assess potential changes in habitat use patterns and population levels, as required in **Condition 1**. Within 30 days of the Commission's consideration of this CD, DAF would be required to prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for VSFB focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

Part (a) of **Condition 1** would Require DAF to conduct this monitoring. Additionally, DAF would be required to conduct multivariate statistical analyses of the changes in population trends using a suite of variables, as required in part (b) of **Condition 1**. Relevant population trends to analyze include, but are not limited to, population sizes and locations. Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its monitoring efforts to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to relevant resource agency staff to discuss the monitoring results and conclusions. The annual reports would include initial conclusions, including those from the analyses detailed in part (b) of the condition, regarding potential effects to any monarch butterfly as a result of space launch and landing activity at VSFB. If significant disruption or degradation of habitat values are identified from those conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of monarch butterfly population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF shall prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts.

Cumulative ESHA Considerations for Engine Noise and On-Base Sonic Booms

DAF's position is that its long-standing monitoring of sensitive species and their responses to space launch vehicle engine noise has documented only temporary observable changes in wildlife behavior as a result of launch activities and has not shown changes in habitat occupancy or population numbers. However, these monitoring results – which have informed DAF's effects determinations to date – reflect only the lower launch frequencies that have occurred over the last several years and may not be predictive of the potential for adverse effects under the increased launch frequencies now being proposed. The proposed monitoring provided as part of the SpaceX project, and other projects like Phantom, would include monitoring of California red-legged frog habitat, snowy plover nesting sites, California least tern nesting sites, bat habitat, and monarch aggregation sites, for adverse impacts from launch activities. Although the focus of this monitoring would be on the SpaceX project, the monitoring

design would also capture adverse impacts to these species and their habitats from other launch activities at VSFB.

A significant concern with the proposed project and the associated monitoring for these sensitive species is the significant and rapid increase in cadence to 36 launches per year, compared to the number of historic launches at VSFB. There simply has not been sufficient monitoring at the current cadence or a lesser one above the historic average to adequately assess how these species may, or may not, be reacting to launches, and the extent to which their habitats are being disrupted. This issue is reflected in the findings of the 2023 monitoring report for western snowy plover and California least tern. 2023 monitoring suggests that there could possibly be a correlation between launching the Falcon 9 rockets and reactions from these two species, including startling, flushing, damage to eggs, and abandonment of nests. Under a higher launch cadence, more frequent behavioral responses of this sort could conceivably lead to lower nesting success and, over time, population level impacts. These effects on species would be indicative of increasingly severe disruption of their habitats. Sustained monitoring at the current launch cadences is needed to determine if impacts are occurring. This is consistent with the USFWS findings in the Biological Opinion that without long term population level effects analysis on the novel effects of increased launch cadence, it is difficult to accurately anticipate the magnitude of the response from these species, and thus the level of disruption to ESHA.

The monitoring also lacks any kind of rigorous statistical analysis of the changes in populations trends using the historic data that DAF has been collecting for decades. Annual monitoring reports should incorporate comprehensive statistical analysis by looking at physical (oceanographic conditions, climate, storms, beach width, etc.), biological (population size, population location, behavior, etc.), temporal (frequency and time between launch events for species to recover, seasonal timing of launches and sensitive times of the year such as nesting), and anthropogenic factors (launches), to more accurately evaluate the likely causes of population trends. DAF has addressed the lack of statistical analysis of historical data, saying:

Historic monitoring of sensitive species was launch specific. Population level monitoring is now being conducted to determine any additional effects to population and distribution trends of sensitive species as a result of the increase in launch cadence. Species-specific monitoring measures are included in the Consistency Determination submitted to the Commission on March 7, 2024. The established methods and scale of this monitoring are robust enough to detect changes in populations and breeding behaviors, and these methods will remain consistent regardless of the number of launches.

Regarding this, DAF also noted:

The geospatial analysis for plover and tern populations is being developed and will employ multivariate statistical analysis, leveraging an adequate and robust historical dataset. Conversely, there is insufficient historical data to conduct a similar statistical analysis for red-legged frogs or other species. Nonetheless,

SLD 30 has collaborated with the USFWS to establish baseline population estimates for the action area, along with thresholds for changes in those populations that would trigger mitigation measures.

However, this dominant focus on wildlife populations does not necessarily align with the requirements in the Coastal Act for sensitive habitats to be protected from disturbance and degradation. In other words, a population may continue to persist while also losing or abandoning important habitat areas as a result of degradation or consistent disturbance.

Another issue that has come to light following the review of the additional annual wildlife monitoring reports provided by DAF over the past month is that there are weaknesses in the design of the various monitoring programs and their implementation. For example, the monitoring programs for western snowy plover and California least tern do not include any control observations. As such, it is not possible to understand how an observed behavior recorded during a launch may differ from more normal behavior outside of launches. Also, the western snowy plover report compares the number of nests and their fates for beaches in south VSFB versus beaches in north VSFB. The report states that this comparison is provided because the beaches in north VSFB are a non-impact area. However, a significant portion of the north VSFB beach area, as identified in Figure 1.1 of the monitoring report, is within the same level 2 psf sonic boom footprint as the south VSFB beaches. Therefore, it is unclear why the report considers north VSFB as a non-impact area and how it can function as a comparison to south VSFB beaches during launches.

In addition, numerous monitoring reports acknowledge equipment issues that significantly limited the data that was collected or resulted in the loss of extensive datasets. For example, batteries on monitoring devices failed at critical times, hard drives were compromised and cameras were dislodged or unable to work effectively under the windy and foggy conditions common to Vandenberg and surrounding areas. These issues would need to be resolved for VSFB's wildlife monitoring programs to function effectively and be capable of capturing potential impacts from the project to wildlife and habitat areas.

If adverse impacts are observed, the method of mitigation proposed to be implemented by DAF in response also raises questions. Species specific mitigation is proposed for those species that may be adversely affected by the increased Falcon 9 launch cadence. For western snowy plover and California least tern, mitigation proposed by DAF would involve increasing predator control efforts in the non-breeding season. Currently, the DAF funds three full-time staff to perform predator control efforts on VSFB during the breeding season. The DAF would add one full-time staff to continue these activities through the non-breeding season. These activities would include trapping, shooting, and tracking known predators of snowy plover with particular focus on raven and crow removal at and adjacent to VSFB beaches. The DAF would report predator removal efforts and success within an annual report.

Although it is foreseeable that implementing predator controls may benefit western snowy plover and California least tern to some degree, it isn't clear from the mitigation plan how predator controls relate directly to the types of responses being exhibited by western snowy plover and California least tern during an increased number of launches. For example, it is possible that if the birds are consistently flushing in response to launches they could be depleting their energy reserves. Birds that engage in repeated short flights were found to expend significantly more energy than under "non-flying" controls which equated to a flight expenditure multiple times their basal metabolic rate³⁸. The project doesn't clearly explain or demonstrate how predator controls would mitigate for depleted energy reserves.

As described in the 2023 annual monitoring report, in addition to responses from western snowy plover and California least tern, the monitoring recorded responses from predators. Specifically, predators were observed moving away from launch noise. The report concluded it is possible that consistent launches may be impacting predators in the vicinity. However, DAF has stated:

Predators are not being driven out of the project area by launches. For example, the raven population on VSFB continues to increase, which accounts for the largest predation rate on the snowy plover. If these mitigation measures are not successful in achieving no net loss to species abundance and distribution, consultation with the Commission would be re-initiated.

If the launches are in fact causing predators to move out of the area, then it would mean there are fewer predators in the area of western snowy plover and California least tern nesting areas. The mitigation program from DAF for western snowy plover and California least tern specifically proposes predator control efforts during the breeding season. If, in further monitoring, predators are found to be reacting to the launches and moving out of the area, then the proposed mitigation may be ineffective or provide limited value, alternative mitigation to quantifiably offset adverse impacts to western snowy plover and California least tern may be necessary.

To help resolve these various issues, DAF would be required to continue its ongoing on-base monitoring programs for western snowy plover, California least tern, California red-legged frog, and to monitoring bat and monarch butterfly populations, including monitoring of long-term habitat use and local species populations, as required in in **Condition 1**. Within 30 days of the Commission's consideration of this CD, DAF would be required to prepare and provide for the Executive Director's review and comment an enhanced biological monitoring program for VSFB focused on evaluating the biological effects of engine noise and sonic booms from launches and boost-back landings. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the enhanced biological monitoring program and/or written responses as to why such modifications are infeasible.

³⁸ <https://pubmed.ncbi.nlm.nih.gov/10769218/>

Part (a) of **Condition 1** require DAF to conduct monitoring that would also incorporate and identification of data and ongoing monitoring (and, if necessary, establishment) of off-base reference site populations of western snowy plover, California least tern, and California red-legged frog. Additionally, to address the concerns detailed above, DAF would be required to conduct multivariate statistical analyses of the changes in population trends and other indicators of species status, as required in part (b) of **Condition 1**. These analyses would use: (a) relevant historical population data; (b) frequency of launches and on-base boost-back landings over different time scales; (c) seasonality of launches and sensitive times of year for respective species; (d) geospatial variability; (e) off-base reference site data; (f) climatic and oceanographic patterns (e.g. El Niño, Pacific Decadal Oscillation, storms, ocean temperature); (g) acoustic monitoring data; (h) and patterns of other variables including (as relevant to the respective species), but not limited to, fledging rates, breeding rates, beach width, behavior during launches, and forage base or food web trends. Relevant population and status indicators to analyze include, but are not limited to, population sizes and locations, and for western snowy plovers and least terns, rates of breeding success (including number of hatched chicks and fledglings), nest/colony abandonment, injury, or mortality to eggs or chicks. Analysis of potential impacts from individual launches would also include use of the results of the landscape-level camera monitoring for western snowy plover and California least tern required by the 2023 USFWS BO.

Part (c) of **Condition 1** would require DAF to submit annual reports on the findings of its monitoring efforts to the Executive Director by July 1st of each year, as well as a comprehensive 3-year report and presentation to the Executive Director and relevant resource agency staff to discuss the monitoring results and conclusions. The annual reports would include initial conclusions, including those from the analyses detailed in part (b) of the condition regarding potential effects to any monitored species regarding potential effects to any monitored species as a result of space launch and landing activity at Vandenberg Space Force Base. If significant disruption or degradation of habitat values are identified from these conclusions in terms of either (i) a statistically significant change, or (ii) a change greater than the baseline annual variation over the course of two consecutive years, in monitored indicators of species population or reproductive success, and cannot confidently be attributed to other natural- or human-caused catastrophic factors not related to the launch and landing activities, DAF would be required to prepare and provide for the Commission's federal consistency review a proposal for avoidance, minimization and mitigation measures to address the impacts.

Additionally, the USFWS considered the impacts of multiple launch programs when working with DAF to design monitoring for federally listed species and developing its Biological Opinion and concluded that the proposed project, both individually and cumulatively in combination with other existing activities, is not expected to interfere with the recovery goals for California red-legged frog, western snowy plover, or California least tern. With the requirements in **Conditions 1 (On-Base Biological Monitoring Program)** to address any unexpected impacts to sensitive species and their habitats from engine noise and sonic booms (from landings) on-base, the

Commission finds that the proposed project would protect on-base EHSA against any significant disruption of habitat values.

Off-Base Sonic Booms

Off-base sonic booms, and the sudden noises and overpressures associated with them, are described in detail above in the project description provided in Section IV.A, and in Section IV.C for potential impacts to marine mammals. DAF's modeling suggests Rocket launches could create sonic booms of up to four psf across Channel Islands National Park and of up to approximately 2 psf along the off-base, mainland coastal areas of Santa Barbara, Ventura, and Los Angeles Counties (**Exhibit 3a and 3b**).

There is a significant distribution of ESHA and park and recreational land across the Channel Islands and along the mainland coast that is exposed to sonic booms from launches. These areas may be adversely affected by sudden noises and overpressures associated with these sonic booms. **Exhibit 13** shows the mapped³⁹ ESHA in the coastal areas of Ventura County and the Santa Monica Mountains areas of Ventura and Los Angeles Counties. However, these figures show only some of the off-base ESHA that has the potential to be adversely affected by sonic booms.

As with on-base launch noise events and sonic booms, the sporadic, short-duration sonic booms occurring along certain launch trajectories represent a disruption to the aural and barometric (air pressure) conditions within a wide range of rare and/or sensitive habitat areas in the region, and have the potential to adversely affect both habitat values and the species that depend on them. The extent to which sonic booms could significantly degrade wildlife habitat would be dependent on each species' individual sensitivity and the frequency and magnitude of the sonic booms.

As discussed above in the general information regarding noise and wildlife from the literary synthesis from Mancini et al. (1998), sonic booms can lead to impacts to wildlife that inhabit ESHA, including direct physical auditory changes and other stress, behavioral, and reproductive changes, that may cumulatively result in adverse impacts to species at a population or habitat scale. However, as noted above, at present there is little or no data that would allow the Commission to draw firm conclusions about whether sonic booms under the current SpaceX launch cadence will adversely affect sensitive species and ESHA in the geographically and ecologically diverse areas now exposed to this perturbation.

Given the presence of sensitive species and ESHA and the uncertainties in the extent and severity of regional effects of off-base sonic booms from launches (described above in Section IV.A), the proposed project raises concerns that sound and pressure waves generated by sonic booms (especially from strong ones) could result in the degradation and significant disruption of ESHA over a broad area. To address this, and to ensure

³⁹ ESHA maps may not depict the location of all ESHA, and the precise boundaries of ESHA will be determined on a site-specific basis using site-specific biological surveys and site-specific maps. A site-specific map of ESHA is required for all development that could result in adverse impacts to ESHA or buffer zones

consistency with Section 30240 of the CCMP, **Condition 2** requires DAF to submit and implement a Sonic Boom Minimization Plan for limiting the spatial extent and severity (in terms of overpressure levels) of sonic booms caused by launches. Within 30 days of the Commission's consideration of this CD, DAF would be required to submit the plan for Executive Director review and comment. The plan would include measures for evaluating modeling for specific atmospheric conditions to anticipate sonic boom effects on the Northern Channel Islands and off-base areas of the mainland coast of Santa Barbara, Ventura, and Los Angeles Counties, and measures for making decisions on launch timing and trajectory based on an analysis to minimize the spatial extent and severity of sonic booms experienced in those off-base areas. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the Sonic Boom Minimization Plan and/or written responses as to why such modifications are infeasible.

More detail regarding how the Base Commander would evaluate predicted model outputs of sonic boom by spatial extent and magnitude and evaluate each launch's importance for military objectives prior to authorizing it, is discussed above in Section IV.C.

Further, if implementation of the Sonic Boom Minimization Plan required under **Condition 2** would not result in avoidance of sonic boom effects on the Northern Channel Islands and off-base areas of the coastal zone in mainland Santa Barbara, Ventura, and Los Angeles Counties, **Condition 3** would require DAF to prepare an Acoustic and Biological Monitoring Program for affected coastal areas outside of Vandenberg Space Force Base, and submit this plan for Executive Director review and comment. The Acoustic and Biological Monitoring Plan shall that include: (a) monitoring that quantifies species response to sonic booms, including in Environmentally Sensitive Habitat Areas (ESHA), including dune ESHA and significant bird breeding, nesting, foraging, or roosting sites, which could be affected by sonic booms; and (b) acoustic monitoring at those sites during launches to measure received sonic boom overpressure levels. DAF would be required to consider comments provided by the Executive Director and address them through modifications to the Acoustic and Biological Monitoring Program (prepared pursuant to the requirements in **Condition 1**) and/or written responses as to why such modifications are infeasible. DAF would be required to implement this off-base monitoring as part of the Acoustic and Biological Monitoring Program.

This requirement to implement an expanded monitoring program would provide additional assurance that impacts to ESHA are recorded and evaluated if DAF is not able to effectively ensure that avoidance and minimization of sonic booms occurs through implementation of plan called for in **Condition 2**. This evaluation would allow the Commission to further gauge the accuracy of DAF's assumption of no effects to ESHA and parks and recreation areas as a result of sonic booms and to provide information that could be used to re-open the Commission's review if this assumption is shown to be inaccurate. The Commission finds, with the inclusion of **Conditions 2 (Off-Base Sonic Boom Minimization Measures)** and **3 (Off-Base Acoustic and**

Biological Monitoring), that the proposed project would protect off-base ESHA against any significant disruption of habitat values consistent with Section 30240 of the CCMP.

Artificial Night Lighting

As was the case with the coastal habitats used by marine mammals, artificial night lighting associated with the proposed project has the potential to adversely affect ESHA. At present, there is little available information about the intensity of artificial night lighting at the SpaceX launch facility or for the degree to which it would affect nearby ESHA or sensitive species. Light is used by plants and animals to infer a wide range of information from their environment. One of the most important roles of light for both plants and animals is regulation of their biological clocks or circadian rhythms on a daily, weekly, seasonal, and annual basis, and thus light is a key influence on fundamental behaviors such as sleeping, foraging, hunting, eating, moving, and resting. As such, the light environment is an important habitat component. Introducing artificial night light to an area will change the ambient setting and may adversely impact animals.

A primary concern with both the regular illumination at the launch facility and the more episodic illumination from the rockets during night launches and landings is their location near the coast and the potential for night-migrating birds to become confused and attracted to the lights during inclement/foggy weather. Most migratory movement occurs early in the evening so any impacts to migrating birds due to artificial night lighting are likely to occur during the first two to three hours after sunset. Birds that migrate at night rely on the moon and stars for navigation. During clear weather the birds appear to be able to distinguish artificial night lighting from light emanating from planets and stars. However, during inclement weather, birds can become confused and drawn to artificial night lights. This phenomenon has been observed on numerous occasions at lighted buildings, oil platforms, and athletic fields. Once drawn into an artificial light source, a number of negative outcomes, including mortality, can occur; birds may crash into objects, circle the light source and become exhausted, or become confused and drawn off course.

In addition to the potential disruption of migratory patterns, the University of California, Los Angeles (UCLA) published a study in 2021 examining how exposure to artificial light at night (ALAN) could affect the distributions of avian species, in particular western snowy plovers⁴⁰. The study included western snowy plover roosting sites from the northern Ventura County line down to the southern Orange County line. The study used species distribution models with exposure to ALAN based on a ground-verified model of night sky illuminance. The study determined that significant declines were found in the likelihood of western snowy plover roosting locations where ALAN exposure exceeded illuminance levels equivalent to approximately one half a full moon. The study concluded that these disruptions in behaviors were likely the result of increased risk of predation and that control of nighttime illumination be used to mitigate disturbances to western snowy plover.

⁴⁰ <https://meridian.allenpress.com/jcr/article-abstract/38/2/302/474456/Determining-the-Effects-of-Artificial-Light-at>

Bats are nocturnal animals adapted to life in the dark and therefore artificial night lighting of bat roosts and foraging pathways can be extremely disturbing. Artificial night lighting can cause many problems for bats including delaying or preventing emergence from roosts, abandonment of roosts, and avoidance of important foraging areas. Insect eating bats, such as pallid and western red bats, and other carnivorous bats, are highly adapted to finding prey in the dark, while avoiding predators. These species are particularly vulnerable to the effects of light pollution.

Artificial night lighting also has the potential to negatively impact California red-legged frogs and their use of habitat areas. Although no CRLFs were located near the proposed project site, light from launch vehicles would extend beyond the project site and into other areas of VSFB. In studies on wood frogs, experimental exposure to artificial light at night was found to make them more vulnerable to other stressors such as parasites and pollution (DAF 2023). Another study focused on common toads found that artificial night lighting reduced activity in male toads by half during the breeding season and changed their energy metabolism, which has the potential to adversely affect reproduction and overall fitness (DAF 2023). The effects of artificial night lighting on frogs are inconsistent and vary by species and life stage; however available research indicates a potential risk to CRLF breeding habitat from the proposed project.

The increased frequency of launches represents a novel disturbance to the habitats and species of VSFB and there currently is not sufficient data to understand how species within the area could be reacting to artificial night lighting. USFWS recently started investigating the increase in artificial night lighting from launch activities at VSFB, including the SpaceX launches proposed in the CD, and has been coordinating with DAF. DAF is working with USFWS on measures to minimize the potential adverse impacts from night lighting including development of a light management plan.

DAF has recently clarified that the type of night lighting required at SLC-4E is operational and safety lighting to support launch operations, and that at SLC-4W there is safety lighting around the support building. The lighting is used when necessitated by operational safety, with a duration that varies with the type of operation. DAF states that a total elimination of exterior lighting at SLC-4 is not possible due to safety, security, and mission critical operational requirements. They have communicated that the intensity of night lighting and best management practices to reduce lighting would be addressed in a Lighting Management Plan being prepared for SLC-4.

While DAF has acknowledged that nighttime lighting can lead to skyglow (a phenomenon well-documented in urban environments), DAF has communicated its position to Commission staff that light emissions during a rocket launch are temporary, that the beaches and general landscape at VSFB are generally dark compared to other beaches and landscapes in central and southern California, and (citing the UCLA study referenced above) that no adverse effects to species in the coastal zone are expected due to nighttime lighting. Nonetheless, given the paucity of data on the effects of nighttime lighting associated with rocket launches at VSFB on sensitive species and ESHA, the Commission is including **Condition 4**, which requires DAF to submit a Lighting Management Plan within 30 days of the Commission's consideration of the

consistency determination. The plan shall include best management practices including, light shielding, luminare color and temperature considerations, avoidance of lights facing the beach where practicable, metrics for when lights are needed for operations, and monitoring of lighting on Surf Beach which shall include use of sky-quality camera(s) to assess any observable changes in lighting there (where there is an annual western snowy plover population) during night launches. Additionally, DAF has committed to keep Commission staff informed on the progress of its ongoing investigation with the USFWS, and to work with Commission staff to address any unexpected impacts to sensitive species from artificial night lighting.

Conclusion

As described above, although the Commission finds that the proposed project has the potential to adversely impact ESHA both on-base and off-base, with implementation of **Conditions 1 (On-Base Biological Monitoring Program), 2 (Off-Base Sonic Boom Minimization Measures), 3 (Off-Base Acoustic and Biological Monitoring), and 4 (Lighting Management Plan)**, the project would be carried out in a manner in which would protected ESHA against any significant disruption of habitat values. The Commission therefore finds the proposed project, as conditioned, consistent with the ESHA policies of the CCMP (Sections 30240 of the Coastal Act).

E. PUBLIC ACCESS AND RECREATION

Coastal Act Section 30210 of the Coastal Act states:

In carrying out the requirement of Section 4 of Article X of the California Constitution, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.

Section 30213 of the Coastal Act states (in relevant part):

Lower cost visitor and recreational facilities shall be protected, encouraged, and, where feasible, provided. Developments providing public recreational opportunities are preferred...

Section 30220 of the Coastal Act states (in relevant part):

Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.

Section 30221 of the Coastal Act states:

Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial recreational activities that could be accommodated on the property is already adequately provided for in the area.

Section 30223 of the Coastal Act states:

Upland areas necessary to support coastal recreational uses shall be reserved for such uses, where feasible.

The proposed project involves a six-fold increase (from six per year to 36 per year) in launches of the SpaceX Falcon 9 rocket from the existing space launch complex SLC-4E on the southern portion of Vandenberg DAF Base (VSFB), as well as up to 12 first stage landings at the existing SLC-4W launch complex. Depending on the trajectory of these rockets, prevailing atmospheric conditions, potential debris corridors from rocket explosion or catastrophic failure, and modeled public safety risks, closure and evacuation of public areas under the rocket trajectories has been historically necessary to protect the public from these potential rocket hazards. These closures and evacuations have had adverse impacts on public coastal access and recreation at Jalama Beach and the Jalama Beach County Park campground (referred, collectively, as "Jalama"), inconsistent with Chapter 3 policies of the Coastal Act.

Jalama Beach is an important public recreational resource because of its upland and water oriented recreational values and scenic resources. It is popular for surfing and wind surfing and used by people from all over the state. The Commission's California Coastal Resource Guide also describes this area as a popular fishing spot: "An offshore reef protects the nearshore waters from turbulent wave action, creating a popular sport fishing... spot." In addition, Jalama Beach County Park provides some of the only overnight beach camping sites within northern Santa Barbara County and is heavily used throughout the year. The sandy beach and estuary along Jalama Creek provide ample opportunity for the public to bird watch, walk, and passively enjoy coastal resources. The scenic resources of Jalama Beach provide a unique place to enjoy coastal recreational resources as well due to its remote location and the absence of visible development such as homes, buildings and lights in surrounding areas.

In the past, the Commission has had significant concerns about public beach closures in this area. The Commission has generally agreed that beach closures are necessary part of the space launching activities at VSFB and the Commission has generally supported these space launching activities. However, in evaluating these activities, the Commission required some mitigation for the beach closures. This mitigation included a limitation on the number of launches annually and other measures designed to reduce the significance of the impact.

The Commission has historically considered and analyzed the number of temporary closures to beaches in northern Santa Barbara County associated with launch activities and determined that with implementation of measures to minimize and offset adverse effects to the public, a total of 14 closures per year is consistent with the public access and recreation policies of the CCMP.

In its most recent negative determination (No. ND-0009-23), DAF analyzed the potential effects of the proposed increase in SpaceX launch and landing activity on coastal access and recreation uses and resources:

Since 1979, an evacuation and closure agreement has been in place between the Department of the Air Force (DAF) and Santa Barbara County (County). For the safety of park visitors, the County Parks Department and the County Sheriff currently close the parks upon request from the DAF. This agreement includes closing Jalama Beach County Park, Ocean Beach County Park, Surf Beach, and Point Sal Road, in the event of launch activities that have been determined by SLD 30 Range Safety to have certain human health and safety risks. These closures are communicated at least 72 hours prior to closure and can be closed for a maximum of 48 hours per the agreement. Point Sal Road is not anticipated to be closed due to SpaceX launches.

Under the Proposed Action, public access to the coastline via Jalama Beach County Park, Ocean Beach County Park, and Surf Beach may be temporarily restricted during launch and landing operations. The length and frequency of temporary closures are mission dependent and determined by SLD 30 Range Safety; however, typical closures for launches from SLC-4E last between 4 to 8 hours. Launches from SLC-4E due to the Proposed Action would not cause an exceedance of 12 closures of Jalama Beach County Park per year. In the past, SLD 30 has restricted access to Ocean Beach County Park and Surf Beach for all launches from SLC-4E. Based on updated modeling and safety considerations, SLD 30 Range Safety and the Security Forces Squadron have determined closures are only required if the first stage of the Falcon 9 launch vehicle will boost back to land at SLC-4W. Thus, closures due to the Proposed Action would be infrequent (up to 12 times per year) and would not substantially diminish the protected activities, features, or attributes of Jalama Beach, Surf Beach, or Ocean Beach County Parks.

If it is later determined there are public safety issues or other human health and safety concerns, additional closures may be authorized. The DAF would notify the California Coastal Commission and determine the best path forward to offset impacts if more than 12 closures will occur in a calendar year during open public access hours .

Access to the coastline from Surf Beach is available year-round. During the western snowy plover season, beach access is available from 0800-1800 and restricted during evening hours from 1800-0800. Access to the coastline from Ocean Beach County Park is available via a trail established by SLD 30 connecting this area to the coastal access available at nearby Surf Beach.

Ocean Beach County Park is open from 8:00 AM to dusk year-round. A portion of launches would occur at night when these locations are closed. Accordingly, the Proposed Action would only restrict public access to the coastline during daytime launches with boost back to SLC-4W.

Activity Conducted and Having Effects Substantially Different than Described

In its December 15, 2023, findings, the Commission discussed how the SpaceX space launch activity was affecting public coastal access and recreation different than as described in the ND. The Commission found that:

Based on this description and analysis, effects to coastal access and recreation from SpaceX's increase in launch and landing activities (from 6 to 36 launches and 6 to 12 landings) were expected to be limited to no more than 12 temporary closures of Jalama per year during launches. Closures were expected to last four to eight hours.

Shortly after the Executive Director's concurrence with DAF's negative determination (No. ND-0009-23), however, Commission staff were informed through discussions with Santa Barbara County Parks and Recreation Department staff responsible for the management of Jalama Beach County Park that the number of closures at Jalama due to SpaceX launches within the first seven months of the year had already exceeded the maximum annual number committed to by DAF. While there may be some discrepancy based on data collection methods, it is Commission staff's understanding that Jalama had been closed and evacuated 15 times by July 7, 2023, three more than the "no more than 12" stated by DAF in its negative determination.

In addition, over a dozen more launches and potential closures of Jalama were scheduled to occur before the end of that year.⁴¹ Additionally, as noted above, launch frequency and beach closure information from 2022 indicates that the number of SpaceX launches and related beach closures also exceeded the numbers evaluated in the prior ND concurrence (ND-0027-15).

The Commission went on to find that:

These exceedances appear to be due, in part, to SpaceX directly communicating with Santa Barbara County regarding scheduled launches and closures in a manner that DAF was unaware of and that did not take into consideration DAF's commitment and, in part, due to the fact that the process for evacuations and closures of Jalama in anticipation of a scheduled launch was not as simple and linear as one closure per launch. Rather, a single scheduled launch could require multiple evacuations and closures of Jalama. Several variables, such as weather, could result in a launch being scheduled, cancelled, and rescheduled any number of times before successful completion. As such, Jalama could be closed multiples times because of a single launch.

⁴¹ Following Commission staff's identification of this issue with DAF, a refined protocol was established that only required the closure and evacuation of Jalama during launches if generally 400 or more members of the public were present at the beach and campground. In addition, SpaceX shifted launch trajectories and/or launch timing to overnight hours when numbers are lowest at Jalama

Through discussions with Santa Barbara County Parks and Recreation Department staff, Commission staff also came to understand that adverse impacts to public access and recreation at Jalama as a result of launches were not limited to only closures and evacuations of the beach and park – as described and analyzed in DAF’s negative determination - but rather that they occurred in four primary ways.

The first is through an advanced email notification to camping reservation holders that they may be required to temporarily evacuate Jalama during their stay due to safety concerns over potential hazards from a scheduled launch. Jalama includes a total of 110 individual camp sites ranging from basic campsites for tent campers, group sites for large parties of tent campers, sites with water and electricity hookups for recreational vehicles (RVs), and cabins equipped with additional amenities. Based on information provided to Commission staff by Santa Barbara County, these evacuation notifications often result in cancellations by approximately 25% of reservation holders, due to concerns about needing to pack up and evacuate approximately 30-40 minutes away to Highway 1 several hours in advance of a scheduled launch – some of which occur late at night or during early morning hours. At maximum capacity, Jalama can accommodate approximately 900 campers per night so any particular launch could result in significant disruption and loss of coastal recreation and low-cost overnight accommodation resources. Each evacuation notification and resulting reservation cancellation can also result in lost revenue for Santa Barbara County, which owns and operates the campground

The second way that public access and recreation was adversely affected was through similar notices that are provided through the County’s reservations website to those attempting to book a campsite during the time of a scheduled launch. These notifications also resulted in cancellations and limit bookings, both of which reduce public coastal access and recreation.

In addition to overnight camping, Jalama offers day use parking and facilities for members of the public. Popular activities for day use visitors include exploring Jalama’s beaches, picnicking, fishing, and surfing. The third way that public access was adversely impacted is through closure of the road to Jalama to prevent day-use patrons from entering the park during evacuations or to limit the number of people at Jalama in order to remain below the 400-person level that would trigger an evacuation and closure event. Jalama includes dozens of parking spaces for day-use patrons and, as one of the few publicly available beaches in northern Santa Barbara County, is a popular and well used area. Thus, in addition to the displacement of campers, a particular launch and closure of Jalama Road also has the potential to eliminate public access and recreation opportunities for day-use patrons.

The fourth and most severe type of adverse impact to public access and recreation was through evacuation sweeps of the park to remove all campers and day-use patrons currently within Jalama prior to a scheduled launch. Any campers and day-use patrons were asked to leave Jalama and not return until the launch has

completed. Jalama is located in a remote part of the County, with the nearest town being Lompoc located 20 miles to the north. Jalama is accessed by a narrow, two-lane road. Vacating the park and traveling to Lompoc to wait for launch completion takes significant time, approximately 45 minutes each way. Considering the time needed to drive out of Jalama to Lompoc, the time for a launch to initiate and complete, and the time needed to drive back to Jalama from Lompoc, campers and day-use patrons who had been evacuated from Jalama could be displaced for much of the day, between four and eight hours.

As noted by DAF in its 2023 negative determination (ND-0009-23), in 2022, a total of 13 SpaceX launches occurred. Although there may be discrepancies based on data collection methods, it is Commission staff's understanding based on information provided by County staff, that these triggered 18 evacuation notification emails to reservation holders as well as eight evacuation and closure events at Jalama.

The Commission's findings on how the activity was being conducted and was having effects substantially different than described concluded by stating:

Because DAF's negative determination stated that no more than 12 closures would occur⁴² and did not describe or evaluate the full range of adverse impacts to coastal access and recreation resulting from SpaceX's expanded launch program, a program that, at the time of the negative determination's submittal, had already expanded well beyond the level previously considered and concurred with by the Executive Director, the Commission found in December of 2023 that the SpaceX program was being conducted and was having coastal effects substantially different than originally described by DAF in its negative determination. This finding led to the consistency determination currently being considered.

In 2023, it is Commission staff's understanding that a total of 28 SpaceX launches occurred. Between January and July 2023, these launches required 16 evacuations and closures of Jalama Beach and Jalama Road, 21 evacuation notification emails to reservation holders and an unknown number of reservations that were not made due to concerns about potential evacuations. Between August 2023 and March 2024, 30 launches were carried out but no evacuations of Jalama Beach or closures of Jalama Road were required or carried out. This is because the launches were scheduled during nighttime hours when the occupancy of Jalama has been below the evacuation threshold. Further, no evacuation emails have been sent and only seven contingency emails⁴³ have been sent. Santa Barbara County has indicated that less than one percent of reservations have been cancelled or changed due to the contingency emails during this time. Thus far this year, through the most recent flight on July 11, 2024, a total of 23 SpaceX launches have occurred, with at least 10 more launches tentatively

⁴² The commitment that no more than 12 closures would occur was also included in the subject CD.

⁴³ These emails consist of notifications sent by Santa Barbara County staff to Jalama campground reservation holders once the County receives contingency evacuation notices from DAF about an upcoming scheduled SpaceX launch and potential evacuation. Emails are sent several days in advance of the anticipated launch date.

scheduled through the end of 2024.⁴⁴ Depending on launch timing, these planned launches could result in additional camper notifications, closures of Jalama Road, and evacuation sweeps. Any increase in SpaceX launches beyond the 36 per year currently proposed by DAF and evaluated in this report would trigger additional federal consistency review by the Commission. In fact, DAF has already submitted a new consistency determination to allow SpaceX to further increase its launches in 2024 from 36 to 50.

Effects on Coastal Resources and Consistency with the CCMP

Due to the limited availability of coastal access and recreation opportunities in northern Santa Barbara County – which only includes three publicly accessible beaches in the approximately 63 miles between Gaviota State Beach and Pt. Sal – and their high levels of use and regional importance, the Commission has long been concerned about any potential adverse effects to public access at these beaches.

In prior reviews of coastal and recreational access impacts from space launch activities at VSFB, adverse impacts to public coastal access and recreation have been described in terms of “beach closures.” As noted above, in its concurrence with the DAF’s Consistency Determination No. CD-049-98, the Commission found that with the addition of minimization measures (such as avoiding high use holidays and summer months), an average of eight and maximum of 14 launches per year and associated temporary beach closures would be consistent with the coastal access and recreation policies of the CCMP.

Although this numeric limit was established in 1998 and prior to the authorization of a wide range of new space launch programs with significantly higher stated levels of launch activity, the DAF adhered to it consistently through 2021. However, the number of launches from VSFB has steadily increased over the past two years and exceeded the limit of 14 closures per year maximum considered by the Commission in CD-049-98. In addition, as described above, Commission staff have learned that adverse impacts to public coastal access and recreation in northern Santa Barbara County associated with the SpaceX expanded rocket launch and landing activities, particularly at Jalama, take a variety of forms and cannot simply be categorized as “beach closures.”

Accordingly, the scope and magnitude of adverse impacts to the coastal access and recreation resources of northern Santa Barbara County that have occurred as part of SpaceX’s expanded launch and landing program significantly exceed those previously considered and concurred with by the Commission and Executive Director in their review of prior space programs at VSFB. These adverse impacts are not consistent with the relevant coastal access and recreation protection and maximization policies of the California Coastal Management Program, including Sections 30210, 30213, 30220, 30221 and 30223.

On December 15, 2023, the Commission approved a resolution making these findings, and “re-opened” the Executive Director’s prior concurrence by concluding that the

⁴⁴ <https://www.spacelaunchschedule.com/category/vandenberg-sfb/>. Accessed July 15, 2024.

original negative declaration made by DAF for the subject SpaceX launch activity was no longer applicable to the project as described and conducted. Approval of that resolution made the Executive Director's prior concurrence with the ND no longer applicable and authorized the Executive Director to prepare and send a letter to DAF requesting remedial actions to resolve this situation and help ensure that launch activities by SpaceX are carried out consistent with the enforceable policies of the CCMP. The Executive Director's letter was officially transmitted to the DAF on February 22, 2024, and DAF confirmed receipt of the letter that same day.

Consistency Determination and Remedial Actions

On March 7, 2024, DAF submitted the subject CD in response to the Executive Director's letter. The project, as described in the CD, would be identical to the project concurred with by the Executive Director in ND-0009-23.

In addition, the CD submitted by DAF also addresses coastal access and recreation effects with respect to how SpaceX launch activities are conducted.

Ocean Beach County Park and Surf Beach

Access to Surf Beach is available throughout the year except during western snowy plover nesting season when beach access is available from 8:00 a.m. to 6:00 p.m. and restricted from 6:00 p.m. until 8:00 a.m. These restrictions to access at Surf Beach were previously concurred with by the Commission in CD-0004-18 as part of a Beach Management Plan to help protect and enhance coastal access and recreation while simultaneously promoting the survival and recovery of the western snowy plover. Access at Ocean Beach County Park is available from 8:00 a.m. to dusk year-round and at Ocean Beach County Park there is a trail created by DAF that leads directly to the coast at Surf Beach.

Historically, DAF has additionally restricted access to Ocean Beach County Park and Surf Beach during all launches from SLC-4E based on modeling and safety considerations as determined by the Range Safety and the Security Forces Squadron. In response to the Executive Director's letter, DAF engaged in discussions with the Range Safety and the Security Forces Squadron to discuss the modeling and whether adjustments were feasible in order to minimize restriction in access and recreation at these locations. After updating the modeling and revisiting the safety considerations DAF, in coordination with the Range Safety and the Security Forces Squadron, determined that evacuations of Ocean Beach County park and Surf Beach would only be required in the event that the first stage of the Falcon 9 launch vehicle would be boosting back to land at SLC-4W. Launches with the first stage boosting back to land at SLC-4W would be expected to occur 12 times per year.

Since nighttime access at Surf Beach is already restricted during western snowy plover nesting season and nighttime access at Ocean Beach County Park is restricted year-round, any SpaceX launches scheduled during the night that would boost back to land at SLC-4W would not adversely impact access and recreation at these locations. This means that only daytime launches with boost back to land at SLC-4W would affect

access and recreation at Ocean Beach County Park. At Surf Beach, boost back would only affect access and recreation during daytime launches or during nighttime launches scheduled outside of the snowy plover nesting season. DAF anticipates that in response to SpaceX launches, these two locations would only be evacuated up to 14 times per year for approximately four to eight hours each time during select launch attempts.

Jalama

At Jalama, the determination whether to evacuate the campground and adjacent beaches is dependent on a risk analysis completed by DAF for each individual launch. The DAF describes the process for calculating this risk analysis in the CD submittal as follows:

The launch risk factors are estimated based on the probability of vehicle failure, population size in the high-risk area, day of launch weather, trajectory, and other factors. SLD 30 Range Safety considers the number of people within the Impact Limit Line and thirty days prior to launch, conducts prelaunch debris risk assessments that determine high risk areas that contribute to the allowable risk criteria. If the risk of a Conditional Expected Casualty (CEc; a factor that estimates the risk of a multiple casualty event and assumes 100% vehicle failure) is greater than 0.01, Individual Risk is greater than 1/1,000,000, or the Expected Casualty risk is greater than 1/10,000, SLD 30 issues an evacuation requirement letter 25 days prior to launch. Generally, for launches from south VSB, the population size in the Impact Limit Line determines the need for evacuation of Jalama Beach County Park and a CEc greater than 0.01 is typically triggered when the population exceeds 500. Therefore, the number of users, including day users, campers, and staff, at Jalama Beach County Park may or may not exceed a level that triggers evacuation.

The project concurred with under ND-0009-23 included a process whereby if evacuation would be required for a particular launch, DAF would notify the County and the County subsequently would notify reservation holders via email as described earlier. A copy of the County's email notification system is included as **Exhibit 14**. As described by DAF in the CD submittal, pursuant to discussions with the County, the email notification typically resulted in three to four reservations being cancelled for each launch. This number of reservation cancellations could include up to a maximum of 32 individuals no longer camping at Jalama.

In response to discussions with Commission staff, DAF reviewed the risk analysis to consider alternatives that could minimize adverse impacts to access and recreation. One option included changing the trajectory of the launch to a "dog leg" trajectory so that the Impact Limit Line would shift away from Jalama such that the risk to persons from vehicle failure would be effectively zero. This would eliminate the need to evacuate Jalama completely. However, the maneuvering required for this trajectory would result in a significant performance reduction for the launch vehicles which would then reduce the total payload mass that could be placed into orbit. This would then require more launches to place the same amount of mass in orbit compared to the current trajectory. Also, if the mass of the payload is sufficiently great then this maneuver would preclude certain missions from launching.

Since one component of the risk factor analysis is the number of people within the Impact Limit Line, DAF proposed changing the launch schedule to avoid launching during the day and instead launching during the night. During the day, members of the public at Jalama include campers with reservations as well as day use visitors who are exploring Jalama's beaches, picnicking, fishing, and surfing. At night, visitors at Jalama are limited to campers with reservations. Thus, by shifting the launch schedule to avoid daytime hours and take place primarily at night the number of people within the park would be less and therefore fall below the risk factor. DAF has committed to primarily launch during the night to avoid any evacuations of Jalama to the extent practicable. If scheduling is unable to completely avoid evacuations, DAF has committed to ensure that the total number of evacuations of Jalama within a given year would not exceed 12, consistent with previous Commission approvals for launch programs at VSBF. However, as discussed in Section IV.E (above), a shift toward nighttime launches could result in new effects on sensitive species and habitats.

Finally, in order to help offset the adverse impacts to access and recreation at Jalama that have been occurring as a result of the SpaceX launches and public coastal access and recreation restrictions that exceeded the scope of ND-0009-23, DAF has committed to implement four additional measures:

- DAF in coordination with SpaceX would provide high-speed internet terminals at Jalama Beach County Park in order to improve internet coverage there;
- DAF in coordination with SpaceX would fund a variable messaging sign for use by Santa Barbara County Parks and Recreation to replace the existing sign at the intersection of Highway One and Jalama Road;
- In the event that an evacuation of Jalama is necessary, DAF in coordination with SpaceX would operate a shuttle program to evacuate campers from the park to a safe location so that their camps can remain intact. After the launch is complete the shuttles would bring campers back into the park;
- DAF, in coordination with SpaceX and the Lompoc Unified School District (LUSD) and SpaceX, will fund transportation for all 3rd graders in LUSD to visit Surf Beach/Ocean Park on an annual basis.

Currently, cell phone service in the area of Jalama is limited. More reliable internet would increase the efficiency of County Parks and Recreation operations at Jalama and allow the County to more efficiently manage its reservation system. Greater efficiency would help avoid congestions for members of the public looking to reserve a camping site at Jalama, thus helping to increase its usage. Also, this greater efficiency would allow County staff to more quickly process transactions for visitors passing through the entrance kiosk, therefore helping to reduce congestion at the entrance and getting more people into Jalama more quickly. Finally, more reliable internet would allow County emergency responders to communicate more effectively. Depending on the amount of bandwidth required by the County any remaining data could also provide the public with some reliable connectivity.

Jalama offers 110 campsites, including 12 walk-in, first-come first-served sites. The drive from Highway One to Jalama can take upwards of 45 minutes and cellphone

connectivity in this area can be intermittent. For any members of the public in the area who may be considering a stay at Jalama but do not know the current availability of the campsites, the only option currently available is to drive into the site and inquire. The proposed variable messaging sign at the intersection of Highway One would allow County staff to post vacancy status and campsite availability information to members of the public so they can check the status of available campsites at Jalama before committing to driving 45 minutes to the park from Highway 1. Additionally, making this information more readily available would encourage greater use of Jalama by the public and thus encourage access and recreation.

Regarding the evacuation shuttles, under the current system once an evacuation order is issued campers within Jalama are instructed to prepare to leave the campground and asked to secure their valuables. Depending on the type of camping equipment being used an evacuation order could require campers to break down equipment to ensure it is secure. For larger recreational vehicles (RV) an evacuation order could mean securing the vehicle and driving the entire vehicle out of the campsite along Jalama Road. This system for evacuation could create frustrations for campers, particularly if the evacuation order is issued during the night or at some other inopportune time. Additionally, once an evacuation order is issued campers are instructed to leave the campground and not return until the launch is complete. However, it may be difficult for campers to monitor the status of the launch and therefore know when it is safe to return to the park which could result in campers waiting an unnecessarily long time. The proposed shuttle service would help to alleviate these issues since it would avoid the need to break down camping equipment and would also allow campers to return to the park as soon as possible.

Finally, although there are some programs within the LUSD focused on marine resource education for children in grades four through seven, including the aquarium at Cabrillo High School, there is currently no program for children younger than fourth grade. In response, DAF has proposed a new program for third graders described in the CD as follows:

SLD 30, in coordination with LUSD and SpaceX, will fund transportation for all 3rd graders in LUSD to visit Surf Beach/Ocean Park on an annual basis. SLD 30 will coordinate with LUSD and set up a field trip date for all 9 schools each school year. SLD 30 will coordinate with the individual teachers and provide structured activities during the beach visit that are generally focused on environmental stewardship and understanding our coastal resources, particularly the Western Snowy Plover. This program will ensure that an average of 700+ third graders, 25+ teachers, and 100+ chaperones (typically student family members) would visit Surf Beach/Ocean Park annually. This will likely have secondary effect of families visiting the beach more often after the facilitated introduction provided through this program.

Condition 5 would memorialize this commitment and require DAF to submit a Public Access and Recreation Enhancement Plan within 30 days of the Commission's consideration of the consistency determination. The plan would include specific details on implementation of the commitments DAF has made for the evacuation shuttle,

satellite internet and Highway 1 digital signage projects for Jalama Beach County Park and the Lompoc Unified School District third grade beach field trip program. These details would include when the programs would officially commence, how long the programs and services would be provided, which schools would participate, how many students would participate and what activities would be provided. The Plan will also include details of measures that SpaceX and DAF will take to ensure that the proposed launch activities will not exceed the no more than 12 annual closures of Jalama Beach DAF has committed to, and a minimum notice period, coordinated with the Santa Barbara County Parks and Recreation Department, for any planned evacuations for Jalama Beach.

Coastal Act Section 30213 requires that lower cost visitor and recreational facilities be protected. As described previously, SpaceX launching activities were adversely affecting access and recreation at Jalama due to excessive evacuations and closures. The modified launch program proposed by DAF would result in most launches occurring at night, lowering the safety risk factors and thereby reducing the number of necessary evacuations to levels that the Commission has historically concurred with. Additionally, Coastal Act Sections 30210, 30220, 30221 and 30223 require maximum access and recreational opportunities within coastal areas. The offsets proposed by DAF as part of the subject CD will increase access and recreation at Jalama while the LUSD program will promote coastal access and recreation within the greater area of Northern Santa Barbara County.

Conclusion

Therefore, the Commission finds that, with the DAF's commitments and mitigation measures, including implementation of **Special Condition 5**, the proposed activities would be conducted in a manner that would protect, encourage, and provide coastal access and recreation consistent with Sections 30210, 30213, 30220, 30221, and 30223 of the Coastal Act.

F. COMMERCIAL AND RECREATIONAL FISHING

Section 30234.5 of the Coastal Act states:

The economic, commercial, and recreational importance of fishing activities shall be recognized and protected.

The proposed project has the potential to affect commercial and recreational fishing activities off the coast of VSFB. Coastal Act Section 30234.5 requires that the commercial and recreational importance of fishing be recognized and protected.

A map depicting the range of SpaceX's launch angles with respect to areas of commercial fishing is provided in **(Exhibit 15)**. DAF describes SpaceX's launch azimuth and relation to fishing areas in the CD as follows:

Southern California's west coast is a leading recreational and commercial fishing area. SpaceX launches missions from VSFB with a launch azimuth between 140

and 325 degrees, supporting a wide range of U.S. Government missions. The maritime hazard area for any given mission would include up to approximately 54 California Commercial Fisheries Blocks as defined by the California Department of Fish and Wildlife. Southerly trajectories would cover more blocks than westerly trajectories, as the vehicle's trajectory is over state waters for longer. The maritime hazard area follows the path of the trajectory and is approximately 21 miles wide at its widest. These launch azimuths also include multiple State Marine Reserves, which prohibit or significantly limit fishing. These are generally clustered around VSFB and the Northern Channel Islands.

In the event that SpaceX launch and reentry operations pose an extreme risk to public safety over navigable waters, the United States Coast Guard (USCG) would have the authority to determine whether risk mitigating strategies would need to be implemented, including restricting vessel traffic. USCG would be responsible for issuing a Notice to Mariners (NOTMAR) that would provide vessel operators with a location of potential hazards as well as dates and times of the hazardous conditions. Launches would be scheduled in advance to minimize the interruption of airspace and waterways. Once a NOTMAR is issued, there is no requirement for vessels to alter their routes or change their navigation speeds and if vessels are within the potentially hazardous area despite the NOTMAR, a scheduled launch would be delayed or altered to avoid potential hazards to vessels. DAF noted that:

SpaceX has not needed to scrub or move a launch due to the launch ascent hazard area since the COSMO Skymed mission in 2022, which was scrubbed due to a cruise ship violating the required keep-out zone that was required at the time. Since that incident, the DAF, NASA, FAA, and SpaceX have collaborated to further reduce impacts on large vessels during future launches. This cooperation has been a vital part of ensuring no further incidents to date.

DAF has also noted the following regarding their coordination efforts:

SpaceX is in constant coordination with the USCG and SLD30 Range Safety to provide the most up-to-date requirements to protect the maritime community [...] The USCG continues to implement new tools to enhance communication of hazards to users of the marine transportation system, such as electronic broadcast NOTMARs (e-BNM) and the public-facing Space Operations Launch and Recovery (SOLAR) application.

As described previously, between 2017 - 2021, VSFB supported an average of 4.4 rocket launches per year, with a maximum of 7 launches in both 2017 and 2018. Launch activities increased to 21 launches in 2022 and 36 launches in 2023. As of the date of this staff report, thus far there have been a total of 23 SpaceX rocket launches in 2024. The subject CD requests a launch cadence of up to 36 SpaceX launches per year. Although DAF has stated that launches would be scheduled to avoid interruption of waterways and that once a NOTMAR is issued vessel operators would not be required to alter routes or change navigation speeds, there is still some uncertainty

regarding how the rapid increase in launch cadence could adversely impact the fishing industry.

One outstanding concern is that while a single launch can be scheduled and scrubbed multiple times before successfully launching, DAF has stated that if a launch is rescheduled, a new NOTMAR would be distributed per federal requirements. Multiple NOTMARs issued for a single launch could create confusion within the fishing industry and preclude fishermen from fishing. Another concern is that while fishermen using the areas within the fishing blocks that may be impacted by launches typically fish during certain times of the day or periods of the year, DAF has not committed at this time to ensuring that SpaceX will time its launches to avoid impacting these peak fishing times or periods. While DAF has stated that no adverse effects are anticipated, they have also stated that “in the event concerns or complaints related to activities in State waters with an impact on fishing are substantiated, SLD 30 and SpaceX would negotiate with the stakeholders in the development of [a] Commercial and Recreational Fishing Coordination Plan”.

In addition to issuing NOTMARs, and to address the outstanding concerns detailed above, DAF and SpaceX would be required to establishing a communication protocol and regular dialogue with the commercial and recreational fishing industry in this area of the coast including: the Port San Luis Commercial Fishermen’s Association, other fishing associations, fish buyers and processors, harbor masters, and sport fishing companies. Prior to each scheduled launch, the chairperson of these entities would be sent an email which would include the date and time of the hazardous conditions as established in the NOTMAR, and how long the conditions would be in effect. This advance notice is intended to allow fishermen to better understand the conditions and adjust their operations to help ensure fishermen meet their landing goals while also abiding by the NOTMAR. If these measures do not fully satisfy fishermen, DAF would be required to engage in additional coordination prior to and on the day of scheduled launches. This additional coordination would include updated safety calculations and real-time radio communications. To ensure consistency with Section 30234.5 of the CCMP, the Commission is requiring **Condition 7** for DAF to develop a Commercial and Recreational Fishing Coordination Plan and to provide the details of the communication protocol and additional measures to the Executive Director for review and approval within six months.

Concerns about the launching of space vehicles from VSFB, NOTMARs, and the need to recognize and protect the importance of fishing were previously expressed by local fishermen and processors at the Commission’s December 2023 meeting for CD-0010-22 and also in comments submitted for the April 2024 meeting for this project. Those comments raised concerns that the project would require closure of fishing grounds without compensation to mitigate to impacts to fishing. The comments also stressed the need for increased communication between launch providers and the commercial fishing industry.

These same concerns apply to the proposed project. By including a requirement to implement a notification protocol and maintain regular dialogue with the fishing industry

the project would recognize the importance of fishing. Also, the project would protect the fishing industry by avoiding complete closures of fishing areas during launch events. Instead, DAF would use the notification and dialogue processed described above to ensure that fishermen are aware of the launch activities and NOTMARs. Finally, if a vessel is in a hazardous area despite a NOTMAR, a scheduled launch would be delayed or altered to avoid hazards to fishermen.

As such, the Commission finds the proposed project, with implementation of **Special Condition 7**, is consistent with the commercial and recreational fishing provisions of the Coastal Act, including Section 30234.5.

G. AIR QUALITY

Coastal Act Section 30253 states (in relevant part):

New development shall do all of the following:

[...]

(c) Be consistent with requirements imposed by an air pollution control district or the State Air Resources Board as to each particular development.

[...]

The proposed project has the potential to produce air pollution emissions through launch activities (including fairing recovery and roll-on roll-off) and static fire tests.

In the CD the DAF states that the exhaust from Falcon 9 launches is fuel-rich and contains high concentrations of carbon monoxide (CO), and that subsequent entrainment of ambient air results in complete conversion of CO into carbon dioxide (CO₂) and oxidation of the soot from the exhaust. The Falcon 9 rocket would use liquid fuels consisting of rocket grade kerosene (RP-1) and liquid Oxygen and the rocket would use oxidizer-rich staged combustion engines that produce a diminutive amount of soot. Also, a small amount of nitrogen monoxide (NO) is formed. Since the project does not include any construction, any emissions would be from launches, including landings and recovery of the fairing and first stage (if necessary), and from ground operations, support and transport of the launch vehicle components.

The federal Clean Air Act (CAA) requires states to develop plans, known as State Implementation Plans (SIPs), stating how they will attain or maintain National Ambient Air Quality Standards (NAAQS). A SIP is developed in order to improve or maintain air quality in designated nonattainment and maintenance areas. Through this plan, states propose their strategy for reducing criteria air pollutant emissions.⁴⁵ General Conformity is a key component of the CAA strategy intended to ensure federal actions conform with SIPs in achieving and maintaining the NAAQS. Section 176 of the federal CAA

⁴⁵ <https://www.epa.gov/general-conformity/frequent-questions-about-general-conformity#4>, accessed August 12, 2021.

Amendments of 1990, contains requirements that apply specifically to federal agency actions, including actions receiving federal funding. This section of the CAA requires federal agencies to ensure that their actions are consistent with the CAA. General conformity applicability pertaining to the Proposed Action is codified in 40 CFR §93.153(b).

A federal action is exempt from general conformity analysis requirements if the total emissions resulting from the action are equal to or less than the de minimis thresholds specified in 40 CFR § 93.153(b)(1)⁴⁶. Thus, the action's calculated emissions are compared against established de minimis emission levels based on the nonattainment status for each applicable criteria pollutant in the area of concern to determine the relevant compliance requirements.

Table 2 provides the expected annual emissions of air pollutions per year in comparison to the PSD thresholds.

Table 2: Estimated Annual Air Pollutant Emissions from Launches, Static Fire Tests and Project Operations

	Estimated Emissions (Tons)						
	CO	NO _x	VOC*	SO _x	PM _{2.5}	PM ₁₀	Pb
	8.3	16.4	9.4	0.2	0.4	0.1	0.0
Prevention of Significant Threshold	250	250	250	250	250	250	25
Below Threshold for all years?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

As illustrated in Table 2 the proposed project is below the PSD threshold for all criteria pollutants and therefore, no significant impacts on air quality as a result of criteria pollutant emissions from the project would occur.

The United States Environmental Protection Agency (USEPA) is the agency responsible for writing and implementing federal regulation for the protection of the environment, including implementation of measures to address climate change and the USEPA pursues a number of efforts, including regulatory initiatives such as the GHG Reporting Program.

The Greenhouse Gas (GHG) Reporting Program, codified in 40 CFR, Part 98, requires mandatory reporting of GHG emissions for certain industrial operations, most of which are large emitters of GHGs (e.g., electricity generation facilities, oil refineries, and manufacturing operations). Mandatory reporting is also required for facilities capable of

⁴⁶ <https://www.epa.gov/general-conformity/de-minimis-tables>, accessed August 12, 2021.

emitting more than 25,000 metric tons of CO₂-equivalents (MTCO_{2e}) per year from all combined stationary fuel combustion sources (e.g., boilers and stationary engines). Since the project would emit 23,565 MTCO_{2e} per year, the project is below the significance threshold for mandatory reporting of GHG emissions.

Overall, the proposed project is not expected to exceed the annual CO_{2e} threshold or the annual threshold for criteria pollutants under the National Environmental Policy Act.

Coastal Act Section 30253(c) requires that the proposed project be consistent with the requirements imposed by the Santa Barbara County Air Pollution Control District (APCD). The APCD has jurisdiction over stationary emission sources, including federal activities, in its air basin; VSFB is within its jurisdictional air basin. The SBCAPCD has locally adopted air emission thresholds that are used to evaluate a project's impacts and applicable regulatory requirements under the District's rules and regulations. In the context of launch projects and operations, stationary source emissions include roll-on roll-off, fuel transfer on space launch complexes and also includes air emissions from ancillary sources such as diesel generators, special equipment, and solvents to clean equipment. The APCD does not have jurisdiction over emissions from rocket liftoff, as liftoff is considered a mobile emissions source. The SBCAPCD issued Authorities to Construct (ATC) 15999 and 16000 for the projects' proposed increases in launch-related operations on June 6, 2023. The issuance of these required SBCAPCD permits ensures the project is designed, constructed, and operated to meet local, state, and federal air quality requirements.

As such, the project is consistent with the requirements imposed by an air pollution control district and thus the project would be consistent with CCMP Section 30253(c).

H. CULTURAL RESOURCES

Section 30244 of the Coastal Act states:

Where development would adversely impact archaeological or paleontological resources as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required.

As discussed in the CD prepared for the project, the project would use an existing launch facility (SLC-4) and no construction or ground disturbance would be required as part of the project. Pursuant to the National Historic Preservation Act and Section 106, DAF carried out government-to-government consultation with the Santa Ynez Band of Chumash Indians tribal chairman, but did not receive an official response from the Santa Ynez Band of Chumash Indians within the 30-day review period of CFR 800.3(c)4.

As part of its review process for the April 2024 meeting, Commission staff reached out to the Santa Ynez Band of Chumash Indians and several other Tribes with potential cultural connection to the project area, as indicated by the list provided to Commission staff by the Native American Heritage Commission. Consultation invitations were mailed

to the Barbareño/Ventureño Band of Mission Indians, the Chumash Council of Bakersfield, the Coastal Band of the Chumash Nation, the Northern Chumash Tribal Council, the San Luis Obispo County Chumash Council, and the Santa Ynez Band of Chumash Indians. The Santa Ynez Band of Chumash Indians did not request additional coordination or consultation with Commission staff beyond what had already been carried out by DAF.

Commission staff, however, did receive a request for consultation from the Coastal Band of the Chumash Nation. Commission staff scheduled a consultation with the Coastal Band of the Chumash Nation on Wednesday, March 27, 2024. During the consultation the Coastal Band of the Chumash Nation shared concerns that the force of overpressures from sonic booms could adversely impact sensitive cultural resources or exfoliate new, undiscovered cultural resources that were previously buried. The Tribe also expressed concerns about possible anchoring for the offshore dronships and whether anchoring could adversely impact submerged cultural resources.

Regarding overpressures and sensitive cultural resources, the EA prepared for the project discussed previous research which determined that noise levels of 120 dB and sonic booms exceeding 2.0 psf were the threshold at which archaeological resources could potentially be affected by noise. The project is not expected to result in overpressures greater than 5.0 psf. However, a portion of the base would be subject to overpressures between 2.0 and 5.0 psf.

DAF archaeologists reviewed available literature and did a search of the California Historical Resources Information System (CHRIS) to determine which types of resources would be located within the area of potential affect (APE). DAF archaeologists also reviewed previous studies that specifically analyzed the potential effects to archaeological resources from rocket engine noise and sonic boom vibrations. Those studies included placement of a model slope sand cone and midden chunk located approximately 3,000 feet southwest of SLC-4W to determine if noise vibration resulting from SpaceX launches and boost back landings resulted in changes to the materials. No visual impacts were observed in either the midden chunk or sand cone, with the exception of a few fine grains of sand shifting down the cone which was determined to likely be from wind. DAF has also monitored a sheer cliff-face midden deposit in the southern portion of VSFB and a rock art site for adverse impacts from noise vibrations and found that no visible effect from noise vibrations has been observed at the sites. The DAF concluded that there is no potential for rocket launches and boost back to adversely impact archaeological resources.

The dronships that would be used for landing of the first stage of the Falcon 9 would be located offshore in deep international waters. Due to the depth of water it is unlikely that the dronships would be able to anchor. Additionally, since the dronships would be located 500 to 1,100 miles off the coast of Baja California it is not likely that sensitive cultural resources of California Native American Tribes would be adversely impacted by dronship operations in this area.

After the project was continued and rescheduled for the June 12, 2024 Commission meeting, Commission staff completed outreach to a refined list of the Tribes in May of 2024, including the Barbareño/Ventureño Band of Mission Indians, the Coastal Band of the Chumash Nation, the Northern Chumash Tribal Council, and the Santa Ynez Band of Chumash Indians. As of the date of this staff report Commission staff have not received any requests for additional consultation from the Tribes.

As such, the Commission therefore finds that the proposed project consistent with the cultural and archaeological resources policy of the CCMP (Section 30244 of the Coastal Act).

APPENDIX A – SUBSTANTIVE FILE DOCUMENTS

1. Air Force Consistency Determination, SpaceX Operations at Space Launch Complex 4, Vandenberg Space Force Base, March, 2024.
2. Air Force Final Supplemental Environmental Assessment Falcon 9 Cadence Increase at Vandenberg Space Force Base, California and Offshore Landing Locations, May 18, 2024.
3. Air Force Consistency Determinations for launches from Vandenberg AFB: CD-0010-22 (Construct SLC-5 and Carry out 48 Rocket Launches and 48 Static Fire Engine Tests Per Year), CD-059-03 (Ground Based Missile Defense), CD-006-99 (Theater Ballistic Missile (TBM) Targets Program), CD-064-91 (Modification to Delta II launch vehicle and complex), CD-028-90 (Conversion of SLC-6 for Titan IV/Centaur launch vehicles), CD-003-88 (Space launch vehicle modification), and CD-018-82 and CD-021-82 (Space Shuttle (SLC-6) improvements).
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APPENDIX B – SUPPLEMENTARY INFORMATION

Cumulative VSFB Launch Activities and Engine Noise

Commission staff is aware of several other pending launch programs (see Table B-1, below), a proposed increase in SpaceX launches to 50 per year (submitted as a separate consistency determination in early July) as well as another consistency determination expected in 2025 for a further increase of SpaceX launches to 100 launches per year and the addition of larger rockets, and the potential construction of new launch facilities at VSFB to support further expansion of launch activities. All of these have the potential to increase the total launch activity on the base. The cumulative effects of engine noise from space launch activities are influenced by the geographic distance between launch sites, the timing of launches, the size and engine noise intensity created by different launch vehicles, and the actual number of launches that take place (as noted above, the number of actual launches has traditionally been ten percent or less of the authorized number).

Launch activities are spread out across the geography of VSFB. The geographic distance between launch facilities reduces the frequency of intense impacts on any one population of wildlife near a particular launch facility, but also spreads less intense impacts across a larger geographic space. With operation of the proposed project and the expected further expansion of SpaceX operations in 2025, the highest number of contracted launches would be launched from the areas of SLC-4, the site of the currently proposed SpaceX project, and SLC-6, the anticipated site of proposed launches for the larger SpaceX rocket, the Falcon 9 Heavy. Both of these sites are located in the southern portion of VSFB. The habitats considered here would be affected by engine noise from several launch facilities. The USFWS Biological Opinion states:

The Service understands that the proposed project would contribute to the frequency of an existing launch disturbance baseline. Over the past five years, VSFB has supported an average of 6.2 rocket launches per year with a maximum of 17 in 2022. However, other proponents have recently initiated several adjacent launch programs within the vicinity of SLC-4. Of these, those that will have noise impacts on Honda Creek, Bear Creek, and/or the Santa Ynez River of at least 100 dB SPLmax include Phantom Daytona-E (SLC-8) and Minotaur (SLC-8), Phantom Daytona-E/Laguna-E (SLC-8), ULA Vulcan (SLC-3), Blue Origin New Glenn (SLC-9), and Relativity Terran 1 (SLC-11). If all these programs achieve full launch tempo by 2028, the total number of launch disturbance events over 100 dB SPLmax would be up to 169 within the action area. With the addition of the proposed project, this permitted total would raise to 217 launch disturbance events.

Not all space launch vehicles create the same amount of engine noise, however. Table B-1 below provides a summary of the engine noise produced at the launch pad by different space launch programs at VSFB.⁴⁷

Table B-1: Maximum Engine Noise produced at the Launch pad from space launch vehicles at VSFB

Space Launch Vehicle	Maximum Engine Noise at the Launch Pad During Launch (dB) ¹	Space Vehicle Height
Minotaur	unknown	63 feet
Firefly Alpha	120 dB ²	95 feet
ABL RS1	120 dB ²	88 feet
New Glenn (proposed)	120 dB ³	360 feet
Vulcan Centaur	120 dB ⁴	200 feet
Falcon 9	150 dB	178 feet
Laguna-E (proposed)	144 dB	78.7 feet
Daytona-E (proposed)	130 dB	54.4 feet
Delta IV (discontinued)	133 dB ⁵	236 feet

¹ Decibels (dB) and A-weighted decibels (dBA) reported here are for launch noise in the immediate vicinity of the launch pad unless otherwise stated

² Within 0.5 miles of launch pad

³ Within 5.6 miles of launch pad

⁴ Within 4.4 miles of launch pad

⁵ Highest recorded dB from monitored launches. Data is from NROL-49 Delta IV Heavy launch in January 2011; data recorded approximately 1.8 miles away from launch pad

In total, VSFB has currently contracted for up to six launches of heavy space launch vehicles, 53 launches of medium space launch vehicles, and 81 launches of small space launch vehicles annually. Additionally, up to 23 missiles are launched from the north portion of VSFB annually. These missiles are smaller, and do not produce the same level of engine noise as space launch vehicles.

However, as discussed in the Commission's findings for CD-0010-22, the significant discrepancy between contracted launches and actual launches at VSFB influences the cumulative effects of VSFB's launch programs. From 2017-2021, an average of 4.7 percent of the total number of contracted launches were carried out at VSFB. This means that although NEPA review and DAF agreements allow a high number of launches, the actual number of launches and their resulting sound effects are significantly lower. DAF has stated that the discrepancy between permitted launches and actual launches is due to the availability and need for each specific rocket. Rockets often require updates or become unavailable for extended periods of time. Authorization

⁴⁷ This information was provided to Commission staff by DAF in a previous consistency determination submittal (CD-0010-22)

for launches beyond what is required allows for DAF to shift government contracts and payloads to another rocket or provider, when necessary. Additionally, DAF states:

There is variability in need for payloads to be delivered into orbit - the higher number of launches available at each site increases the flexibility of our national defense program. We also need to be primed and ready should there be an attack on our satellites/resources in orbit. We need to ensure there are enough resources available to get additional satellites into orbit to support our warfighters and defend our nation should the need arise.

Given the current situation, DAF believes that the discrepancy between allowable launches and actual launches will continue. Ultimately, DAF has determined that the Western Range can support a maximum number of 110 space launches, and a maximum number of 15 missile launches annually. These limitations are due to personnel and range safety considerations, and the maximum number of launches remains below the potential total contracted number of launches, should all proposed space launch projects move forward.

Background Information on Sonic Booms

A literature synthesis of effects of aircraft noise and sonic booms on domestic animals and wildlife (Manci et al. 1998)⁴⁸ by the U.S. Fish and Wildlife Service National Ecology Research Center provides useful background information and figures describing how sonic booms are generated by flights that exceed the speed of sound and how they propagate through the atmosphere⁴⁹:

During supersonic flight, the shock waves generated from forward-facing portions of an aircraft are usually regions of positive overpressure. The waves originating from rear surfaces of the aircraft are typically regions of negative overpressure, or underpressure. The pressure signature is the variation in overpressure generated by the forward- and rearward-facing surfaces of an aircraft flying at supersonic speed, creating the sonic boom... As an aircraft reaches supersonic flight, the pressure signature is propagated along a path commonly referred to as the sonic boom ray (ray AC, [in Figure B-1, below]); the pressure signature is generated at the point on the flight line from which the sonic boom ray emanates (point P, [in Figure B-1, below]).

The sonic boom rays emanating from an aircraft operating at supersonic speed initially form a cone [in Figure B-1, below]. However, due to atmospheric variations (e.g., wind and temperature gradients) the rays conform to the laws of atmospheric refraction and become horn-shaped, forming a boom conoid [in Figure B-2, below]. Because all relevant refraction properties of the atmosphere

⁴⁸ Manci, K.M., D.N. Gladwin, R. Villella, and M.G. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: a literature synthesis. U.S. Fish and Wildl. Serv. National Ecology Research Center, Ft. Collins, CO. NERC-88/29. 88 pp.

⁴⁹ Figures B-1, B-2, and B-3, and captions in this report reproduced from Figures 4-6 of Manci (et al. 1998)

are usually not known, developing an accurate boom conoid for a given supersonic flight event is difficult.

Figure B-1: Vertical section of sonic boom cone (Peterson and Gross 1972)⁵⁰

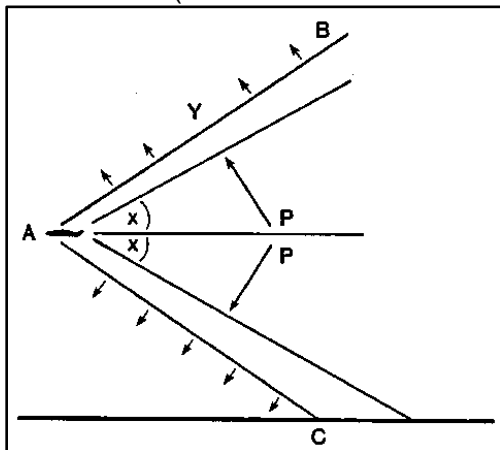
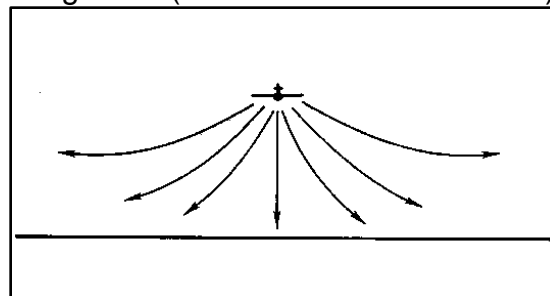
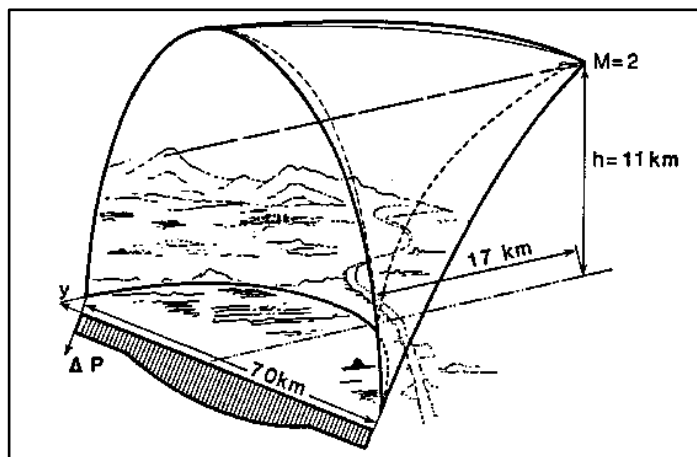


Figure B-2: Refraction of boom rays as they pass down from an aircraft to the ground (Peterson and Gross 1972)



In the absence of winds, the increase in the speed of a sonic boom along a descending ray creates a decrease in the ray angle (Peterson and Gross 1972). For this reason, a boom ray tends to be refracted upward, away from the ground. Due to this phenomenon, angles from the vertical of two boom rays from each point on a supersonic flight path are sufficiently great that the boom rays only graze, or do not reach, the ground. The sonic boom "carpet" (the area on the ground that experiences the sonic boom) is defined by the locus of points of the boom rays that just graze the ground [(in Figure B-3 below)]. Surface areas outside these points experience no sonic boom.

Figure B-3: Sonic boom carpet from supersonic flight (Peterson and Gross 1972)



⁵⁰ Peterson, A.P., and E.E. Gross, eds. 1972. Handbook of noise measurement. General Radio Company, Concord, MA

A tail wind behind an aircraft enhances the effect of the increase in sound speed. A head wind creates the opposite effect and tends to refract the boom rays toward the ground. Also, the paths of propagation of the atmospheric pressure disturbances depend on the manner the aircraft is flown, as well as on the prevailing atmospheric conditions.

Under certain aircraft operating conditions (e.g., acceleration, dives, turns, and climbs), the sonic boom conoids generated by the aircraft may intersect one another. This effect is known as sonic boom focusing. Such focusing may also result from refraction effects caused by variations in atmospheric sound and wind speed. Focused sonic booms may be of much greater intensity than unfocused booms and are typically generated by fighter aircraft in "dogfight" maneuvers.

Regarding noise propagation, Mancini et al. (1998) also explains the following:

The propagation of aircraft noise and sonic boom from source to receiver is a function of several factors, including relative distance; atmospheric attenuation due to wind, humidity, and temperature; and intervening noise barriers (e.g., large stands of trees and buildings). The distance relationship is relatively straightforward; as acoustic energy spreads out over an increasingly larger area, the amount of sound energy per unit volume of atmosphere steadily decreases. For subsonic noise, this decrease is inversely proportional to the square of the distance between the aircraft and the receiver (i.e., a decrease in acoustic intensity of approximately 6 dB for each doubling in relative distance).

Atmospheric conditions affect noise propagation. Water vapor in the atmosphere is relatively effective at absorbing noise. Also, the higher noise frequencies are more readily absorbed. For this reason, high-frequency noise typically decreases with distance more rapidly than does either midrange or low-frequency noise. For aircraft in flight, air absorption has the greatest influence on noise propagation.

Atmospheric temperature gradients also affect aircraft noise propagation. During periods of normal temperature gradients, where air temperature steadily decreases with increasing altitude, aircraft noise is, for the most part, deflected upward, thereby producing areas of little or no noise on the ground at certain distances from the aircraft. During periods of atmospheric temperature inversion, the reverse situation is true and aircraft noise tends to be deflected downward, thus increasing ground noise level (Gladwin 1978)⁵¹.

As described above, the propagation of sonic booms depends on several factors, including atmospheric conditions. As discussed in more detail below for sonic booms affecting off-base areas during rocket launches, these factors contribute to the complicated nature of modeling where sonic booms are expected to be experienced during a given launch.

⁵¹ Gladwin, D.N. 1978. A*E*I*S: an airport environmental information system for Virginia. M.S. Thesis, Virginia Polytechnical Institute and State University, Blacksburg. 333 pp.